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UNITED STATES DEPARTMENT OF THE INTERIOR

HAROLD L. ICKES, Secretary

BUREAU OF MINES

R. R. SAYERS, Director

MINERALS YEARBOOK

1942

Prepared under the direction of

E. W. PEHRSON, Chief

Economics and Statistics Service

C. E. NEEDHAM, Editor

UNITED STATES

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FOREWORD

Minerals Yearbook, 1942, presents the achievements of the mineral industries of the United States during their first full year of World War II. It is a record of outstanding accomplishment to which the Nation can point with pride and satisfaction. It also provides convincing testimony on the vital importance of our great mineral wealth to the national security, for without our abundant mineral resources our unparalleled industrial strength would be impossible, and without our magnificent industrial machine the unprecedented production of munitions during 1942 could not have been attained. Thus in large measure our success in war on land or sea or in the air reflects our ability to provide those materials indispensable to modern warfare—metals and fuels and the other nonmetallic minerals.

Statistically the production of minerals in 1942 soared to new peaks in both quantity and value. For the first time in history, the aggregate value of mineral output exceeded $7,000,000,000. Certain branches of mining reported declines from the rates established in 1941, but production of many commodities reached new records, some of which probably will stand for many years or may never be equaled. Nevertheless, demand exceeded supplies, and the pressure for even greater output intensified as the year progressed. At the close of 1942, it was evident that production of many minerals would be limited by manpower shortages, while exhaustion of the reserves of a few commodities caused anxiety as to our ability to maintain current rates of production.

The Bureau of Mines played an increasingly vital role in the war program during 1942. Extensive exploration of mineral deposits was continued; new and improved methods of mineral beneficiation and recovery were developed; surveys of the production, distribution, consumption, and stocks of essential minerals were extended in scope and frequency; health and safety measures were furthered to reduce valuable time lost in the mines and mills from illness and injuries; provisions were made to protect the production, supply, storage, and transportation of indispensable minerals and mineral products from the mines, quarries, mills, and smelters; and closer contact was effected with Federal war agencies and private war industries in prosecuting the war. Most of these activities are only briefly mentioned in this volume, which is concerned principally with the accomplishments of the Bureau in economics and statistics. More complete data regarding the Bureau's work in technology, health, and safety can be found in the annual reports of the Secretary of the Interior and in other publications of the Bureau of Mines, although censorship precludes publication at this time of many of the results of investigations of strategic and critical minerals.

Distribution of the 1942 edition of Minerals Yearbook, as with the 1941 volume, will be restricted to Government offices engaged in war work. Many of the chapters of the 1941 volume dealing with nonstrategic commodities, minus complete data on foreign trade, were released for public distribution, but because of the refusal of the

censorship authorities to permit publication of foreign trade statistics most of these chapters for 1942 will be withheld. Only a few chapters, from which foreign trade statistics have been eliminated, because they have little significance, will be available for general distribution. To partly offset this disadvantage, the Bureau of Mines has expanded its usual published Mineral Industry Survey reports to include many of the statistical details on production, consumption, and stocks of the nonstrategic minerals that are customarily distributed to industry and the public in the preprint chapters of Minerals Yearbook. Minerals Yearbook will, of course, be available to the public after the war or whenever censorship restrictions are relaxed.

The mineral industries are to be commended for their cooperation in responding to Bureau of Mines surveys in spite of the numerous handicaps and urgent production schedules under which they operated in 1942. Thanks are gratefully extended to the thousands of mine, mill, and smelter operators, distributors, consumers, public officials and agencies, and trade journals who made generous contributions of data and advice, without which this volume could not be compiled. In this connection, especial mention should be made of the cooperation of State officials who have assisted in collecting mineral statistics within their respective jurisdictions, thus eliminating duplication and improving coverage and accuracy of data. State agents cooperating in the 1942 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, director, department of geology, mines, and water resources, board of natural resources, Baltimore, Md.; R. A. Smith, State geologist, Lansing, Mich.; H. A. Buehler, State geologist, Rolla, Mo.; Meredith E. Johnson, State geologist, Trenton, N. J.; C. A. Hartnagel, State geologist, New York State Museum, Albany, N. Y.; 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, B. D. Stewart, department of mines, Juneau, Alaska, and Walter W. Bradley, State mineralogist, San Francisco, Calif., assisted in the compilation of statistics for Alaska and California, respectively.

R. R. SAYERS, *Director.*

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INTRODUCTION

Considering the many difficulties of operation under wartime conditions, the mineral industries in 1942 established a remarkable record in supplying the essential needs of the United States for its military operations and civilian economy. This issue of Minerals Yearbook which records and analyzes the progress of the mineral industries during the year is therefore in essence a tribute to their achievements. The present expanded volume differs from its predecessors in a number of respects: It gives special attention to the significance of each of the many mineral commodities in the war program. It discusses the effects of the many emergency regulations of the Government upon the normal relationships of supply and demand. It provides more comprehensive data on ore reserves. It devotes additional space, in separate chapters, to titanium and nitrogen compounds. It accents the international aspects of mineral exploration, development, reserves, output, procurement, and use.

Because Minerals Yearbook, 1942, contains information on strategic and critical minerals, including full foreign trade data which censorship authorities have directed be withheld from the enemy, the volume has been classified as confidential. A few chapters dealing with nonstrategic commodities in which foreign trade is comparatively insignificant are being distributed to the public in preprint form without 1942 data on imports and exports. In the 1941 volume only 14 chapters were withheld from publication—those covering the highly strategic and critical items. The extension of censorship in the 1942 volume results largely from the ban on foreign trade figures. Statistical data for 1942 other than imports and exports for the nonstrategic minerals have been released through the Bureau's Mineral Industry Survey service.

Acknowledgments.—Thanks are gratefully extended to the Bituminous Coal Division, United States Department of the Interior, for its valuable contribution to the Yearbook in preparing the chapter covering the bituminous-coal industry. This division has supplied the chapter each year since the division was established in 1937.

The data on imports and exports in Minerals Yearbook were obtained through the cooperation of the United States Department of Commerce.

The Bureau of Mines was enabled to obtain the vast amount of statistical data included in Minerals Yearbook through the good will and cooperation of those interested in the mineral industries. The Bureau appreciates more than ever the contributions of data from the operators, distributors, consumers, public officials, trade associations, and others who have so kindly given of their time and effort to return questionnaires or supply information in other form.

Credit for the value and usefulness of the volume is also given to the many members of the Bureau's staff who assisted in the preparation, editing, and arrangement of the Yearbook material. Especial thanks are due the following members of the staff, who have been

most active and helpful in maintaining the high standards set for the Yearbook: Martha B. Clark, of the Economics and Statistics Service, for preparing the statistical summary of mineral production, and for ascertaining the accuracy, continuity, and uniformity of statistical data; Mabel E. Winslow, of the Office of Minerals Reports, for her excellent editorial work and advice; Louis F. Perry, of the Office of Minerals Reports, for his aid in preparing the charts; Max Abel, of the Economics and Statistics Service, for supervising the preparation of charts and assisting in the administrative details of the Yearbook program; and to the unnamed members of the Economics and Statistics Service who helped the authors in the preparation of their manuscripts.

C. E. NEEDHAM.

PART I. GENERAL SUMMARY

REVIEW OF THE MINERAL INDUSTRIES IN 1942

By E. W. Pehrson

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INTRODUCTION

In the first year of World War II the mineral industry contributed metals, fuels, and other minerals—all indispensable for war—in quantities never before equaled. The physical volume of production was 3 percent more than in the previous record year 1941 and 21 percent higher than the predepression record of 1929; it exceeded the output in the war year 1918 by 54 percent. Owing to a moderate increase in mineral prices the value of production compared with 1941 was proportionately greater, having increased 10 percent to a new peak of $7,569,500,000, or 8 percent above the former record value of $6,981,340,000 established in 1920, when prices were abnormally high.

The outstanding performance for 1942 was achieved despite several factors that retarded production in some lines. Transportation bottlenecks forced severe curtailment of consumption of gasoline and fuel oil in the eastern region; as a result, the output of crude petroleum—in terms of value the largest item in the list of mineral products—declined slightly. Gold and silver production experienced the usual adverse effects of an ascending general price level and was also held back by scarcity of materials and manpower as well as the Government shut-down order effective late in the year. Price trends in 1942 did not favor the mineral industry, as mineral prices advanced only 7.5 percent over 1941, whereas the general price level rose 13 percent. Manpower shortages were felt in many branches besides precious metal mining. Preliminary figures indicate that the total number of men employed in producing minerals in 1942 was 3 percent lower than in 1941. Because of the scarcity of critical materials and manpower, several new projects that would have increased production could not be initiated.

Consumption of minerals also reached new heights in 1942 that surpassed the available supply from domestic sources. Despite the submarine menace, large quantities of foreign minerals were imported

but could not bridge the gap between domestic supply and potential demand. Consequently drastic conservation, substitution, and restrictive measures were adopted. Essential civilian requirements were cut deeply, and even allocations to war needs were subjected to rigid surveillance and limitation. The net result of the program was a gain in mineral inventories for the year. Thus at the end of 1942 the Nation's mineral-production facilities were operating at record rates, and a substantial reserve stock provided assurance that the essential war needs would not be severely impaired in 1943 for lack of raw materials.

PRODUCTION

Value of mineral output.—For the third consecutive year the quantity of minerals produced established a new all-time record, but the value of production exceeded the previous 1920 peak for the first time. Likewise, 1942 was the first year in which the value of domestic production, $7,569,500,000, reached the 7-billion mark. The former record year, 1920, $6,981,340,000, reflected the high prices of many minerals but chiefly the extraordinary prices for coal as exports soared because of the United Kingdom's inability (partly because of strikes) to meet heavy world demands. The value of the 1942 output was 10 percent greater than in 1941 and 29 percent over the predepression level of 1929.

Although dollar value is the only common denominator for measuring collectively the production of minerals of such diverse unit values as platinum and sand and gravel, it does not present a true picture of actual trends in the physical volume of production because of the influence of fluctuating prices. This fact is strikingly illustrated by comparing 1920 with 1942. The value of production in the latter year was only 8 percent above that of 1920, yet the physical volume of production, as measured by index numbers (in the computation of which the effects of price changes are largely eliminated), was 55 percent greater. Thus the growth of the mineral industry during this 22-year period and the industry's war contribution are not adequately revealed by a mere statement of value of output.

Of the total value of mineral production in 1942, fuels contributed $4,084,600,000 (54 percent), metals $2,361,800,000 (31 percent), and nonmetals other than fuels $1,123,100,000 (15 percent). Figure 1 shows the growth in value of various branches of mineral production from 1880 to 1942.

All major branches of mineral production—fuels, metals, and nonmetals—showed increased values in 1942. The value of the output of metals advanced 11 percent over 1941 and that of nonmetals other than fuels 8 percent; the value of fuels rose 10 percent. Oil and gas wells contributed a large proportion of the mineral output, with products valued at $2,452,700,000 in 1942—32 percent of the total and an increase of 5 percent over 1941. Hard- and soft-coal production was valued at $1,631,900,000, or 22 percent of the value of all mineral products and 19 percent more than the value of the 1941 coal output.

Trends in physical volume of production.—Figure 2 compares the physical volume of mineral production during the last 43 years with industrial and agricultural production and with population growth, each

expressed in terms of an index based on yearly averages for 1935–39.[1] The long-time trends of production during this 43-year period have been steadily upward, although year to year and cyclical fluctuations have been prominent. Production of minerals—the essential raw materials for industry—has been closely correlated with the trend of industrial production, experiencing the same ups and downs, whereas agricultural production has exhibited more moderate fluctuations and a growth line approximating the trend of population increase.

Because production of coal for domestic use and petroleum for automobile fuel, which has a pronounced effect on the trend of mineral output, does not respond proportionately to increases in the rate of

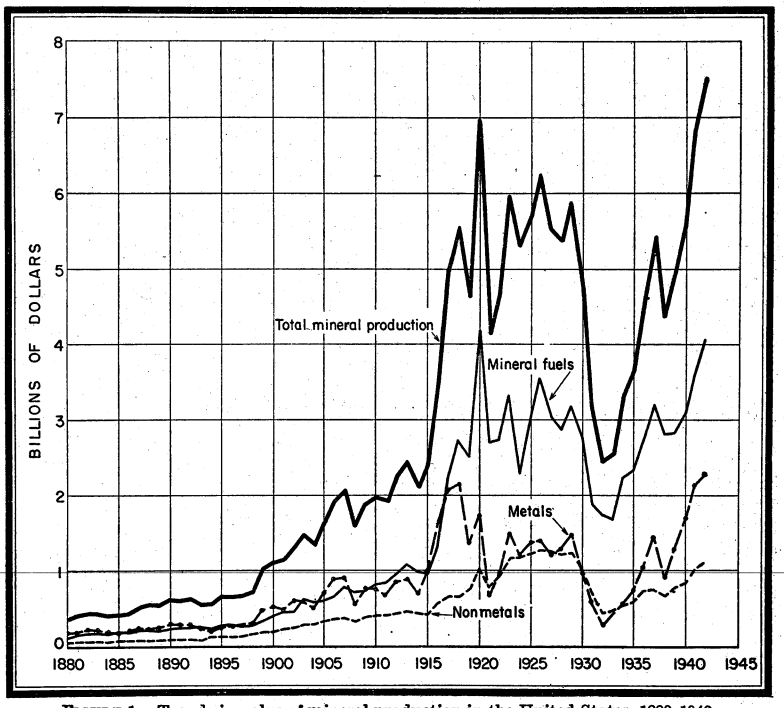

FIGURE 1.—Trends in value of mineral production in the United States, 1880–1942.

manufacturing activity and is more stable, the index of industrial production tends to exceed that of mineral production in periods of prosperity and to fall below during depressions. This characteristic explains in part the wide gaps between the two indexes in 1941 and 1942. Another factor is the extensive use of imported mineral raw materials in these years, which is reflected in the industrial index but not in the mineral index. It should also be noted that the Federal Reserve Board index of mineral production does not include certain mineral products, such as aluminum and magnesium, of which war use has increased greatly.

The production of many mineral commodities achieved new peaks in 1942. The light metals made outstanding advances; magne-

[1] The following indexes have been used—volume of farm production, U. S. Department of Agriculture; mineral production, 1900–1918, from Warren Persons' Forecasting Business Cycles; mineral production of 1919–42 and industrial production, Federal Reserve Board; total population of the United States, Bureau of the Census.

sium output increased threefold, bauxite more than doubled, and aluminum rose nearly 70 percent. Copper production broke the record established in 1916, and lead and zinc mine production also increased but failed to reach previous records. Iron ore, tungsten, molybdenum, and vanadium surpassed the high production rates of 1941, and chromite exceeded its 1918 peak. Manganese-ore production was considerably higher in 1942 than in 1941 but was below that during the last war. Except for petroleum (which declined from 1941) and anthracite, the output of fuels reached new highs in 1941, and bituminous coal broke a record that had stood since 1918.

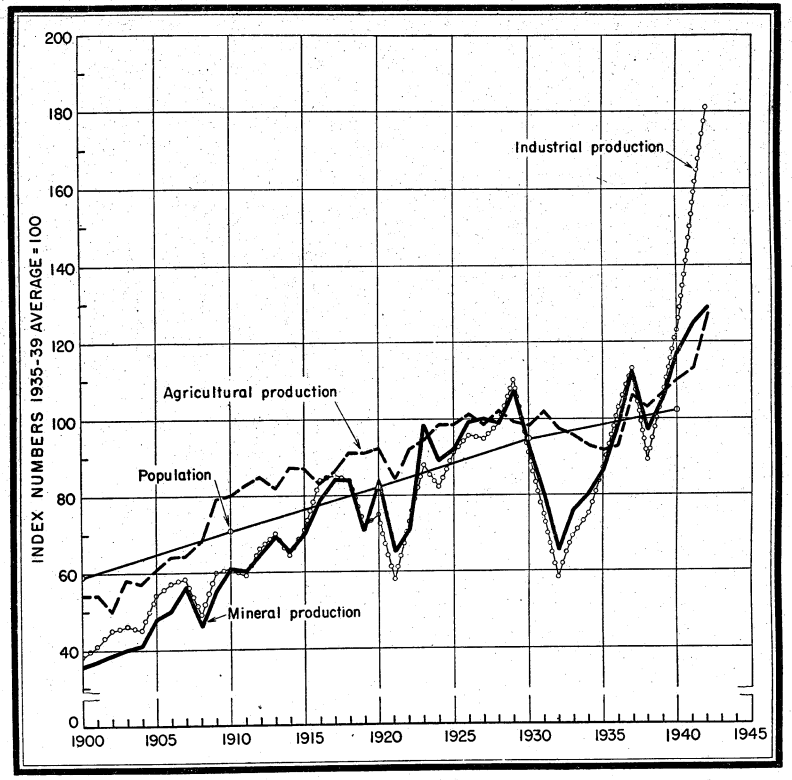

FIGURE 2.—Comparison of growth of physical volume of mineral production with that of agricultural and industrial production and population, 1900–1942.

Most of the building materials also set new high marks, reflecting the heavy war construction in 1942. Production of fluorspar, lime, potash, pyrites, sulfur, and salt advanced to new heights. Contrary to this pronounced upward trend were the decreases noted in the output of gold, silver, petroleum, asphalt, feldspar, gypsum, and phosphate rock.

STOCKS

Inventory-control schemes were in effect, directly or indirectly, for virtually all metals and important nonmetals during 1942. Idle, excessive, and enemy-owned inventories were also called upon to help effectuate the maximum output of war equipment and bolster

a shrinking volume of essential civilian supplies. Conservation, substitution and reclamation, fluctuating imports, and rapidly changing Lend-Lease needs affected relative requirements and resulted in shifts of position in critical mineral lists. As a result, there was a wide range in stock trends for individual minerals during the year, but on the whole there was a general, and in some items, a substantial, increase in stocks.

The primary acquisition of many minerals, and other commodities as well, by government agencies was greatly extended during the year. These purchases can no longer be considered as stock-pile accretions but only as inflow to a reservoir from which the discharge is channeled to the most desirable destination. In some commodities industry stocks were drawn upon for current needs while Government holdings were expanded; manganese ore, chromite, muscovite mica blocks and films, tin, molybdenum, and cadmium were typical examples. There was a net increase in the Nation's total inventory of the first three items; but stocks of tin, cadmium, and molybdenum declined, the last substantially. Industry and Government stocks of copper, lead, zinc, tungsten ore, vanadium, mica splittings, mercury, antimony, platinum, and bauxite were larger at the end of 1942 than at the beginning. There were also increases in industry stocks of nickel, acid-grade fluorspar, iron ore, and magnesium, whereas stocks of metallurgical-grade fluorspar and cement were lower. Consumers' stocks of pig iron declined moderately, but there were fairly heavy increases in consumers' and suppliers' stocks of scrap iron and steel. There was little change in stocks of anthracite, bituminous coal again showed an increase, and stocks of petroleum showed an over-all decrease.

CONSUMPTION

Mineral consumption again broke all records in 1942 and was still on a rising trend at the year end. For virtually all metals and some nonmetals, unrestricted demand would have exceeded supply but was held in check only by widespread curtailment of civilian uses. Even the amounts of materials for use in war essentials were subject to rigid scrutiny and limitation, and the substitution of less critical for more critical materials was actively pushed.

As the seriousness of the supply situation became apparent there was evolved a Production Requirements Plan (P. R. P.) in which the end use of the basic material was the governing factor in making allocations. It failed, however, to achieve the anticipated balance between supply and demand. Later in the year it was announced that the P. R. P. would be succeeded in 1943 by the Controlled Materials Plan (C. M. P.), which would be applied initially to aluminum, copper, and carbon and alloy steels. The new plan shifts control to the raw-materials source, thus requiring knowledge of material requirements throughout the manufacturing cycle down to the end product. By controlling allocations at the source, the balancing of allocations with available supply is facilitated. Responsibility for assembling estimates of raw-material requirements was placed with prime contractors, who are required to plan not only for their own needs but for those of their subcontractors and suppliers as well. Bills of materials so determined are then submitted to a

prime contractor's "claimant agency" of which seven were designated in the original order—Army, Navy, Maritime Commission, Board of Economic Warfare, etc. Each claimant agency assembles its bills of materials and submits them to the War Production Board, where they are balanced with available supply by a Requirements Committee and the respective controlled materials divisions of the War Production Board.

The year 1942 was characterized by a continuation of the war plant construction program, the near-conclusion of existing plant conversion and expansion, and a rapidly accelerated growth in war production. The thereby-expanded mineral needs are reflected by business indexes. The value of construction contracts awarded east of the Rocky Mountains (of which more than 80 percent were for public ownership) rose 37 percent from 1941 or to 8¼ billion dollars in 1942. Of the year's total, only 22 percent was for residential building, including a part applied to war housing. Of the remainder, 35 percent was for factory construction and 40 percent for public works and utilities. The Federal Reserve Board index for total construction (1923–25 equals 100) fluctuated monthly between 118 and 206 and averaged 166 for the year. For other than residential building the index increased from 149 in 1941 to 235, another new record. The adjusted index of total industrial production (1935–39 equals 100) continued the rise that began in the latter half of 1940, increased uninterruptedly from 171 in January 1942 to 197 in December, and averaged 181 for the year (unadjusted) compared with 156 in 1941 and 123 in 1940.

Consumption of minerals established many new highs in 1942. Among the metals, aluminum, chromite, copper, iron, magnesium, manganese ore, and other ferro-alloy elements reached new levels, but the use of tin, zinc, and lead declined under rigid control measures. Of the nonmetals, cement, lime, clay, fluorspar, sulfur, sand and gravel, phosphate rock, and potash exceeded previous records. In the fuel group, the demand for petroleum was held slightly under the 1941 peak by transportation difficulties; use of anthracite rose appreciably but still lagged behind the record, but bituminous-coal, natural-gas, and natural-gasoline consumption attained new peaks.

PRICES

A weighted average price for 24 major mineral commodities in 1942, which comprised over 98 percent of the total value of mineral production in that year, indicates an increase of 7.5 percent in producers' unit sales realizations compared with 1941. The average increase for the 9 metals in the group was 12.6 percent, that for the 5 fuels was 5.4 percent, and that for 10 other nonmetallic minerals was 5.3 percent. The relatively greater price rise for metals reflected premium prices paid by the Government for copper, lead, and zinc and the general pressure for increased metal production.

According to the Bureau of Labor Statistics, the wholesale price index (1926 equals 100) of metals and metal products rose from 99.4 in 1941 to 103.8 in 1942. The price index for nonferrous metals, which includes some fabricated products and excludes premium prices paid for copper, lead, and zinc, advanced from 84.4 to 85.7. Quoted prices for lead, zinc, antimony, cadmium, platinum, and mercury averaged higher in 1942 than in 1941; those of copper and

nickel were unchanged; and those of aluminum, magnesium, and tin declined, the last only slightly. The index for iron and steel products advanced less than 1 percent—from 96.4 to 97.2. Prices of ferrous raw materials, however, were virtually unchanged. Those for pig iron and most grades of scrap iron and steel were fixed throughout the year at ceiling prices; average pig iron and iron-ore prices for 1942 remained at 1941 levels, whereas the major scrap items were lower. Compared with 1941, fuel prices rose moderately. The price index for anthracite advanced from 82.7 to 85.5; bituminous coal from 104.3 to 109.7; and petroleum and its products from 57.0 to 59.8. Except for crushed stone and clay, which declined, building-material prices (brick and tile, cement, lime, and sand and gravel) increased, as did prices for phosphate rock and potash. The index price for all commodities rose 13 percent or from 87.3 in 1941 to 98.8 in 1942.

Mineral prices again lagged appreciably behind those for all commodities in 1942; the former increased only 7.5 percent over 1941, whereas the general price level rose 13 percent. Compared with 1929, the general price index in 1942 had increased 3.7 percent, whereas the index for fuels and lighting materials declined 5.4 percent (the index for petroleum and products dropped 16.1 percent), nonferrous metals 19.2 percent, and fertilizer materials 17.7 percent; the iron and steel price index rose 2.4 percent. Prices for nonmetallic minerals other than those included above averaged lower in 1942 than in 1929. In comparison with prices that prevailed in the First World War, when needs were far below those of the present, the price index for all commodities in 1942 was about a quarter below, whereas the indexes for important mineral groups, iron and steel, nonferrous metals, and petroleum and its products, were one-third to one-half under those of 1918.

EMPLOYMENT

In contrast to the serious unemployment in the mineral industries a decade ago, major segments experienced a severe shortage of labor in 1942, particularly as regards workers in nonferrous and ferro-alloy fields. The exceptional demand for most of those metals required an increase of the labor force to permit maximum use of existing capacity. Voluntary enlistments and the draft continued to make inroads among employees, but more serious was the migration to construction projects and war-production plants, which offered higher wages and less arduous work under conditions more favorable than in the mines. Turn-over increased extraordinarily, and despite widespread hiring the net number of employees continued to decline. This condition was aggravated by the enforced replacement of skilled workers with inexperienced and less competent men.[2]

In the mining of copper, which has been designated the most critical of all the war required minerals, a shortage of labor seriously threatened the attainment of production goals that in themselves scarcely met essential war needs. By that time, labor shortages had also developed in the Tri-State and western mixed-metal mines, which were attempting to increase their output of zinc, the demand for which exceeded domestic production capacity; likewise in the ferro-alloys industry the lack of manpower was causing grave apprehension, with

[2] In recognition of the pressing need for education in safety and the rapid development of efficiency in various phases of underground work, the Anaconda Copper Mining Co. initiated a training-in-work program at its Butte (Mont.) mines late in 1942. This program, the first of its kind, was described in the June 1943 issue of the Mining Congress Journal, pp. 20–27.

the situation at the world's greatest molybdenum mine especially serious. The light-metal production facilities in the West, then well on their way to completion and making an additional large drain on the labor reservoir, also experienced difficulty in obtaining an adequate labor force.

Some alleviation of the labor stringency was effected by Federal agencies. The War Manpower Commission (W. M. C.) issued a stabilization of employment order, effective September 7, 1942, in the 12 Rocky Mountain and Pacific Coast States. This order was designed to retard the outward flow of nonferrous mine workers (and those employed in the lumber industry as well) and to reduce turnover, but it did not provide for new labor supplies. Workers in these "critical" occupations were required to obtain certificates of separation from the United States Employment Service (U. S. E. S.) before seeking a job, and no employer was permitted to hire such a worker unless he furnished a certificate of separation. A liberal policy was pursued in granting these certificates, and it has been reported that only 30 percent were denied. The effectiveness of the stabilization order is said to have been sharply limited by nonobservance on the part of both workers and employers and by the lack of adequate enforcement procedure.

On September 10 National Selective Service headquarters instructed State directors to extend occupational deferment to any registrant from employment in nonferrous metal production, regardless of skill, and if any registrant left such employment to reclassify him and withdraw his designation as a "necessary man." Under these instructions Selective Service drafts declined sharply. In October, as an aid to W. M. C.'s recruitment program, authorization was given to pay transportation of western qualified workers, their families, and household goods to nonferrous mining districts, the beneficiary being required to accept employment for not less than 90 days. Incomplete returns indicate that about 4,400 men, mostly soldiers, were thus moved. In November, as a result of efforts made by W. M. C., the construction of 2,600 housing units was authorized, and actual work started within a week after the needs of each locality were determined.

Of major importance was the action of the War Department, which furloughed approximately 4,300 soldiers. Distribution to establishments that had been approved by the U. S. E. S. was made in October and November, as follows: 2,900 to copper mines, 800 to lead and zinc mines, 250 to molybdenum mines, 90 to tungsten mines, and the remainder to miscellaneous mines. The Office of Services of Supply (now the Army Service Forces) also authorized its officers to release workers employed at arsenals or other projects for mine work.

The Gold Mine Closing Order, L–208, issued by W. P. B. on October 8, 1942, displaced about 2,700 workers by the end of the year. Of these 2,100 registered with the U. S. E. S.; about 60 percent were referred to nonferrous mines and about 30 percent to other essential activities. Further incentive to employment was the War Labor Board award of October 16, increasing wages of copper, zinc, and lead workers in Utah and Idaho. The increases of 50 cents or $1 a day were conditioned upon continuity at work and upon certain productive standards. They were made retroactive to May 15 in Idaho and July 1 in Utah.

The result of these measures and those of the mine, mill, and smelter operators was a gain of roughly 5 percent in the number of employees

in the Nation's copper mines for 1941, and of 2 percent in the Mississippi Valley lead and zinc mines. In these sections of the mineral industry, some mines already had gone to a 7-day work week in 1941. The practice was considerably extended in 1942, and despite the higher rate of absenteeism that persisted throughout the year the average number of hours of employment per man for the year in the areas mentioned above rose 7 and 13 percent, respectively.

Labor shortages in the coal industry were met in part by increasing the number of operating days at the mines. A 6-day week was initiated in the soft-coal mines late in 1942 and in the anthracite mines early in 1943. Bituminous-coal mines made a 12-percent gain in production in 1942 over 1941, with a 2-percent decline in the number of workers. Pennsylvania anthracite mines increased their output by 7 percent, with a personnel 6 percent under that of 1941. An 8-percent increase in the production of coke (beehive and byproduct) was accomplished by a 5-percent increase in the number of employees at the ovens.

For the industry as a whole, an all-time record of mineral production was accomplished with 3 percent fewer employees, but the average number of hours per man rose 11 percent, and the output per man-hour—measured in value—remained close to the 1941 level.

SAFETY

Accidents to persons employed in the mineral industries were more numerous in 1942 than in 1941, and there was a slight increase in both fatality and injury rates. However, in the light of the substantial rise in accident rates experienced by industry as a whole in 1942 the safety record of the mining industry may be considered favorable. According to present reports, 1,878 deaths and 97,232 nonfatal lost-time injuries were caused by accidents in 1942, compared with 1,622 deaths and 90,334 injuries in 1941. This increase in the absolute number of accidents in 1942 was not materially out of alinement with the increased man-hours of exposure to risk. The amount of exposure to occupational hazards is measured by the number of man-days or man-hours during which the employees are at work. The weighted average of the operating time of the mineral industries during 1942, according to information available at present, was 259 days, a gain of 25 days per employee or 11 percent more than the average for 1941. Measured in man-hours, the amount of exposure to risk in 1942 was 1,550,000,000 hours, an increase of 7.6 percent. Considering the number of man-hours worked and the number of accidents, the record for 1942 shows a fatality rate of 1.20 and an injury rate of 62.72 per million man-hours of employment compared with 1.13 and 62.69, respectively, for 1941. Thus, the production record of 1942, though showing an increase in the number of accidents, was achieved without materially disturbing the number of accidents in relation to the number of man-hours worked in 1941.

Although higher accident-frequency rates were reported by some branches of the mineral industries—such as lead-zinc mines in the Mississippi Valley States, gold and silver mines, slate quarries, and smelters—lower, more favorable rates were reported for some other groups, such as copper mines, miscellaneous metal mines (a group that includes mines producing metals declared "strategic" in the conduct of the war), marble quarries, trap-rock quarries, and beehive-coke ovens.

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A special study of accidents to men engaged in the production of petroleum was conducted for the second consecutive year, 1942, and it revealed an accident-frequency rate of 17.97 per million man-hours of employment. This rate compares favorably with that revealed by a similar study covering 1941, which was 20.21 per million man-hours.

GOVERNMENT ORGANIZATION FOR WAR

In previous editions of Minerals Yearbook, Government organization for war insofar as it related to the mineral industries has been summarized under the heading National Defense Activity. This review carries the record forward to July 1, 1943.

The initial step toward industrial mobilization was taken on August 9, 1939, when the short-lived War Resources Board was created. In May 1940, a second step was taken with the creation of the Advisory Commission to the Council of National Defense to supervise and expedite the Nation's defense program. Eventually this commission disintegrated, and out of it emerged the Office of Production Management in January 1941 and the Office of Priec Administration and Civilian Supply in April. In August 1941 the latter became the Office of Price Administration, and its civilian-supply functions were transferred to the Office of Production Management. In addition to these agencies and the permanent Government bureaus, the following temporary organizations were in existence at the beginning of 1942 (all of them had some responsibility with regard to the production, procurement, and distribution of mineral raw materials): Office for Emergency Management, Board of Economic Warfare, Office of Scientific Research and Development, Office of Petroleum Coordinator for National Defense, Office of Solid Fuels Coordinator for War, National War Labor Board, and several subsidiaries of the Reconstruction Finance Corporation. Other agencies with functions more indirectly related to the mineral industries included: Office of Lend-Lease Administration; Office of the Coordinator of Inter-American Affairs; Supply, Priorities, and Allocations Board; Office of Defense Transportation; Office of Censorship; and others of minor significance to the mineral industries.

Reorganization and expansion of Government war administration for industry continued in 1942. In January, the War Production Board replaced the Office of Production Management and the Supply, Priorities, and Allocations Board, with Donald M. Nelson as Director replacing the dual directorship of William S. Knudsen and Sidney Hillman. In the same month a Combined Raw Materials Board was set up by the United States and Great Britain, with broad responsibility for effecting the most efficient use of the raw material resources of the two nations and for collaboration with the other United Nations along similar lines. The Reconstruction Finance Corporation, with its war subsidiaries, was transferred from the Federal Loan Agency to the direction and supervision of the Secretary of Commerce in February. April witnessed the creation of a War Manpower Commission, with Paul V. McNutt as Chairman, to establish policies and plan for the most effective use of manpower, and the delegation of broad powers to the Board of Economic Warfare in formulating policy and in directing the procurement of foreign materials for war purposes; under this authority the Board took over full responsibility for foreign purchases (except financing and warehousing) from the Reconstruc-

tion Finance Corporation in January 1943. In June 1942 the Office of War Information was set up to coordinate and determine policy for Government controls on information, and Congress passed a law creating a Smaller War Plants Corporation within the War Production Board, to insure that small business concerns will be used most efficiently and effectively in the war program.

By late summer it had become evident that more rigid control measures were required to achieve stability on the economic front. An act of October 2, 1942, passed by Congress, amended the Emergency Price Control Act of January 1942. The new act reaffirmed the existing authority of the Office of Price Administration and also authorized the President to stabilize prices, wages, and salaries affecting the cost of living. On October 3 the President delegated his powers under this statute to a Director of Economic Stabilization working through an Office of Economic Stabilization. Another outstanding development during the latter half of 1942 was the delegation of much broader powers to the Petroleum Coordinator for War and his designation as Petroleum Administrator for War.

During the first half of 1943 few changes occurred in the Government's war administration for industry. In April the Office of Solid Fuels Coordinator for War was succeeded by the Solid Fuels Administration for War. Of major significance was the establishment of an Office of War Mobilization to coordinate the Nation's war program on the industrial front, announced by the President late in May. The new agency was given full authority to determine policy and issue orders to accomplish the maximum use of the Nation's natural and industrial resources, effective use of manpower not in the armed forces, stabilization of the civilian economy, and adjustment of such economy to war needs and conditions.

Further information regarding the status and internal changes of the more important of the afore-mentioned agencies follows, and details of the action taken during 1942 are given in the commodity chapters of this volume.

Office for Emergency Management.—This is essentially an administrative agency of the Executive Office designed to maintain liaison between the President and the national war agencies and to facilitate coordination of the activities of the latter. Although many war functions have been established within the Office for Emergency Management it is essentially a clearing agency and is only remotely related to war activities in the mineral industries.

Office of War Mobilization.—The Office of War Mobilization was established within the Office for Emergency Management by Executive Order 9347 of May 27, 1943, to provide for more effective coordination of the Nation's mobilization for war. The same order also created an advisory committee composed of the Director of War Mobilization, James F. Byrnes, Chairman; the Secretaries of War and Navy; the Chairman of the Munitions Assignments Board; the Chairman of the War Production Board; and the Director of Economic Stabilization. Fred Searls is Adviser on Production to the Office of War Mobilization. The mineral industries will have little direct contact with the Office of War Mobilization but to the extent that this agency determines policies and develops programs for the maximum use of the Nation's natural and industrial resources and coordinates the activities of the action agencies, its decisions will affect mining considerably.

Office of Economic Stabilization.—This agency was created by Executive Order 9250 on October 3, 1942, to control the inflationary tendencies that had become quite acute at that time. James F. Byrnes was appointed Director of Economic Stabilization and was succeeded by Fred M. Vinson late in May 1943, when Byrnes became Director of War Mobilization. The Director of Economic Stabilization was authorized to formulate and to develop a comprehensive national economic policy relating to the control of civilian purchasing power, prices, rents, wages, salaries, profits, rationing, subsidies, and related matters for the purpose of effecting greater stability on the economic and industrial fronts. To advise the Director of Economic Stabilization, an Economic Stabilization Board was established consisting of the Director of Economic Stabilization as Chairman; the Secretaries of Treasury, Agriculture, Commerce, and Labor; the Chairman, Board of Governors, Federal Reserve System; the Director, Bureau of the Budget; the Administrator, Office of Price Administration; the Chairman, National War Labor Board; and two representatives each for labor, agriculture, and management.

War Production Board.—The War Production Board, established in January 1942 as a successor to the Office of Production Management, is the chief government agency concerned with industrial production for war, including war administration of metals and the nonmetallic minerals other than fuels. The organization of the Board, as of May 1942, was briefly described in Minerals Yearbook, 1941, but since that time many changes have been made. A major reorganization was announced by Chairman Donald M. Nelson on July 8, 1942, for the purpose of tying economic and military strategies more closely together and making more effective the Board's determination of policies and programs governing the flow of materials. William L. Batt was named Vice Chairman to serve as general assistant and deputy to Nelson. All program-development work was brought together under James S. Knowlson, who was designated a Vice Chairman for Program Determination. Other major operating units of the reorganized board included a Deputy Chairman for Program Progress (Ernest H. Kanzler) and a Director General for Operations (Amory Houghton). All industry and commodity divisions were transferred to the Director General for Operations with A. I. Henderson, formerly chief of the old Materials Division, in immediate charge as a Deputy Director General. On September 15, Kanzler succeeded Houghton, resigned, as Director General for Operations.

In September 1942 two new vice chairmen were appointed. Charles E. Wilson was designated Chairman of a new Production Executive Committee as well as Vice Chairman of the War Production Board and was assigned responsibility for seeing that programs and schedules for the war program were met. He thus became top production authority in the War Production Board. Ferdinand Eberstadt replaced Knowlson as Vice Chairman on Program Determination, was given control of the Director General for Operations, and at the same time took over the chairmanship of the War Production Board Requirements Committee. This gave him full responsibility for developing proper programs and schedules and for making materials available to meet them. Knowlson was transferred to other duties, while a new War Production Board Program Coordination Division was established under Eberstadt, with Donald D. Davis as Director. A. I.

Henderson resigned as Deputy Director General for Operations on October 31, and Knowlson resigned in January 1943.

The adoption of the Controlled Materials Plan early in November 1942 resulted in further reorganization of the War Production Board. The offices of Program Determination and Operations were consolidated under Eberstadt, with Kanzler continuing as Director General for Operations. A Program Bureau with Davis as Director and a Facilities Bureau, Fred Searls, Director, were established directly under Eberstadt. Under Kanzler four Deputy Directors General—for staff, industry divisions, field operations, and distribution—were appointed. On November 18 J. A. Krug, Deputy Director General for Distribution, announced the establishment of a Controlled Materials Plan Division, with Harold Boeschenstein as Director; he also was named Chairman of a Controlled Materials Board. At this time the industry and commodity branches, all of which had been reporting to a Deputy Director General for Industry Operations, were regrouped. The Iron and Steel, Tungsten and Molybdenum, Manganese and Chromite, and Nickel Branches were consolidated in a new Steel Division, which, together with the Copper and Aluminum-Magnesium Divisions—the three divisions coming under the Controlled Materials Plan—were placed directly under the Director General for Operations although working closely with the Controlled Materials Plan Division. The Mining, Mica-Graphite, Tin-Lead, Zinc, and Miscellaneous Minerals Branches were grouped in a Minerals Bureau under Joseph M. Scribner, Director. The Chemicals, and Cork and Asbestos Branches were merged with other industry branches in a Commodities Bureau, and the Building Materials Branch was placed in a Construction and Utilities Bureau.

The next major reorganization of the War Production Board took place early in March 1943, following the resignation of Eberstadt and the designation of Wilson as Executive Vice Chairman, with authority over all phases of War Production Board programs and activities. Meanwhile several minor changes had occurred. On November 23 an Office of Production Research and Development was established, with Harvey N. Davis as Director and C. K. Leith as Chief of its Metals and Minerals Branch. The announcement early in February of plans to coordinate and correlate the mineral programs of the various Government agencies working in this field was of particular interest to the mining industry. At that time a Mineral Resources Coordinating Division was established, which was to be aided by a Mineral Resources Operating Committee and a Minerals and Metals Advisory Committee. Howard I. Young was named Director of the new division and Chairman of the two committees. He also succeeded Scribner as Director of the Mineral Bureau.

The March 1943 reorganization was announced as a "major War Production Board shake-up." Ralph J. Cordiner, formerly Director General for War Production Scheduling, was named a Vice Chairman and special assistant to Executive Vice Chairman Wilson. Krug became Vice Chairman in charge of Materials Distribution and Chairman of the Requirements Committee, Donald D. Davis was appointed Vice Chairman for Operations, and Curtis Calder, who had succeeded Kanzler as Director General for Operations in January, was named executive assistant to Wilson.

In June 1943 two labor Vice Chairmen were named—one to handle

liaison with the War Manpower Commission and the other to have authority over labor production.

As of July 1, 1943, the members of the War Production Board and the organization units and staff dealing with policy or administration affecting the mineral industries were briefly as follows:

Members	
Chairman	Donald M. Nelson
Secretary of War	Henry L. Stimson
Secretary of the Navy	Frank Knox
Secretary of Commerce	Jesse H. Jones
Secretary of Agriculture	Claude R. Wickard
Lieutenant General in Charge of War Department Production	William S. Knudsen
Administrator, Office of Price Administration	Prentiss M. Brown
Chairman, Board of Economic Warfare	Henry A. Wallace
Special Assistant to the President	Harry L. Hopkins
Chairman, War Manpower Commission	Paul V. McNutt
Director, Office of Defense Transportation	Joseph B. Eastman
Petroleum Administrator for War	Harold L. Ickes
Staff	
Executive Office of the Chairman:	
Office of War Utilities, Director	J. A. Krug
Power Division, Director	B. J. Sickler
Manufactured Gas Division, Director	Alexander Macomber
Natural Gas Division, Director	Vacancy
Executive Vice Chairman	C. E. Wilson
Controller of Shipbuilding	William Francis Gibbs
Steel Division, Director	John T. Whiting
Deputy Director	Norman W. Foy
Asst. Director for Raw Materials and Facilities	Carl W. Meyers
Plant Facilities Branch, Chief	Julius A. Claus
Metallurgy and Conservation Branch, Chief	H. J. French
Raw Materials Branch, Chief	W. C. Kerber
Asst. Director for Production	J. V. Honeycutt
Asst. Director for Program and Distribution	J. L. Block
Asst. Director and Chairman Production Directive Committee	C. H. Longfield
Asst. Director for Manpower	H. J. Ruttenberg
Copper Division, Director	Harry O. King
Aluminum and Magnesium Division, Director	A. H. Bunker
Asst. Director for Ferro-Alloys	Miles K. Smith
Ferro-Alloys Branch, Chief	Andrew Leith
Program Vice Chairman	J. A. Krug
Program Bureau, Director	John F. Fennelly
Stock-Piling and Transportation Division, Director	W. Y. Elliott
Production Controls Bureau, Director	Harold Boeschenstein
Operations Vice Chairman	Donald D. Davis
Deputy Vice Chairman for Industry Operations	John J. Hall
Deputy Vice Chairman for Field Operations	Wade T. Childress
Conservation Division, Director	Howard Coonley
Salvage Division, Director	Paul C. Cabot
Redistribution Division, Director	Col. C. P. Baxter
Mineral Resources Coordinating Division, Director	Howard I. Young
Mineral Resources Operating Committee, Chairman	Howard I. Young
Representing Board of Economic Warfare	Alan Bateman
Representing Reconstruction Finance Corporation	H. DeWitt Smith
Representing Bureau of Mines	Reginald S. Dean
Representing War Production Board	Harvey N. Davis

Minerals and Metals Advisory Committee, Chairman	Howard I. Young
Lt. Col. Joseph Woodlock, War Dept.	
Lt. Com. E. H. Augustus, Navy Dept.	
Alan Bateman, Board of Economic Warfare	
Reginald S. Dean, Bureau of Mines	
H. DeWitt Smith, Reconstruction Finance Corporation.	
Donnel F. Hewett, United States Geological Survey	
Walter Janssen, Bureau of Foreign and Domestic Commerce	
Stanley B. Adams, Office of Civilian Requirements, War Production Board	
C. K. Leith, Office of Production Research and Development, War Production Board	
Ellsworth R. Bennett, Facilities Bureau, War Production Board	
Clinton Golden, Labor Production Division, War Production Board	
W. Y. Elliott, Stockpiling and Transportation Branch, War Production Board	
Minerals Bureau, Director	Howard I. Young
Mica and Graphite Division, Deputy Director	M. H. Billings
Mining Division, Director	Arthur S. Knoizen
Miscellaneous Minerals Division, Director	R. J. Lund
Tin and Lead Division, Director	Erwin Vogelsang
Zinc Division, Director	James Douglas
Commodities Bureau, Director	H. D. Hughes
Chemicals Division, Director	D. P. Morgan
Cork, Asbestos, and Fibrous Glass Division, Director	Fred W. Gardner
Consumers Goods Bureau, Director	Lewis S. Greenleaf, Jr.
Construction and Utilities Bureau, Director	James Auten
Building Materials Division, Director	John L. Haynes
Equipment Bureau, Director	Harry A. Rapelye
Vice Chairman	
Procurement Policy Division, Acting Director	Tudor Bowen
Statistics Division, Director	Stacy May
Office of Production Research and Development, Director	Harvey N. Davis
Office of Progress Reports, Director	Stacy May
Office of Special Projects, Executive Officer	A. C. C. Hill, Jr.
Facilities Bureau, Director	Charles E. Volkhardt
Facilities Division, Director	William B. Murphy
Vice Chairman for Civilian Requirements	Arthur D. Whiteside
Metals and Minerals Division, Director	S. B. Adams
Vice Chairman on Smaller War Plants	Brig. Gen. Robert W. Johnson
Vice Chairman (International Supply)	William L. Batt

Office of Price Administration.—The Emergency Price Control Act of 1942, approved by the President on January 30, 1942, created the Office of Price Administration as an independent agency with statutory authority to enforce price-control measures. Before the passage of the act it had functioned only under general executive orders. The act was amended on October 2, 1942, to extend its period of effectiveness to June 30, 1944, and to convey broader powers to the President. As previously stated, these powers were delegated to the Office of

Economic Stabilization, which thus became the agency for determining broad economic policy.

The general policy of paying subsidies for submarginal mineral production rather than stimulating output by general price increases has been continued. A General Maximum Price Regulation was issued on April 30, 1942, effective May 11, 1942, establishing maximum prices for all minerals for which ceilings previously had not been set (except "domestic ores and ore concentrates)" based on the highest price charged by seller during March 1942. The exemption of ores and concentrates had little significance because most of them were under contract to smelters under terms tied to metal prices, which were fixed, or were under contract to the Government at stipulated prices. Several revisions of the General Maximum Price Regulation were issued subsequently; details are given in the commodity chapters.

Prentiss M. Brown replaced Leon Henderson as Price Administrator in January 1943, and J. K. Galbraith resigned as Deputy Administrator of the Price Department in June 1943. As of July 1, 1943, the following units and executives of the Price Department were administering prices for minerals:

Industrial Materials Price Division:	
Director	Clair Wilcox
Office of Metal Mining Analysis, Director	Jesse L. Maury
Building Materials Branch, Price Executive	Neil Staebler
Nonferrous Metals Branch, Price Executive	John D. Sumner
Iron and Steel Branch, Price Executive	Donald D. Kennedy
Industrial Manufacturing Price Division, Director	Ben Lewis, Acting for Donald H. Wallace
Chemicals and Drugs Branch, Price Executive	Joseph D. Coppock
Fuel Price Division, Director	Sumner Pike
Petroleum Branch, Price Executive	Orville Judd
Solid Fuels Branch, Price Executive	G. G. Johnson

Board of Economic Warfare.—The most significant development in this agency in recent months, from the viewpoint of the mineral industries, was the transfer of authority and responsibility with respect to the procurement and production of imported commodities from the Reconstruction Finance Corporation to the Board of Economic Warfare. Under this arrangement, the Reconstruction Finance Corporation retained only accounting, financing, and warehousing functions in connection with purchases of foreign minerals. Further details of this transfer, as well as the Board's activities during the past year, are presented in the chapter International Aspects of War Mineral Procurement.

The foreign mineral procurement activities are largely centered in the Board's Office of Imports, under Morris Rosenthal. The technical staff of its Metals and Minerals Branch was as follows on July 1, 1943:

Acting Chief	Paul H. Nitze
Associate Chief	Alan M. Bateman
Chief Technical Consultant	Chas. W. Wright
Nonferrous Metals Division, Chief	Spencer S. Shannon
Major Base Metals Section, Chief	Raymond Brooks
Minor Base Metals Section, Chief	Neil O'Donnell
Ferro-Alloy Metals Division, Chief	Vacancy
Major Ferro-Alloys Section, Chief	Robert H. Ridgway
Minor Ferro-Alloys Section, Chief	Hugh E. McKinstry
Scrap Metals Section, Chief	Benjamin Schwartz
Industrial Minerals Division, Acting Chief	Kurt Lowenstein
Minor and Rare Metals Section, Chief	James S. Baker
Nonmetallic Minerals Section, Chief	Vacancy

Technical Services Division, Chief	Vacancy
Analysis and Reports Section, Chief	Robert K. Warner
Economics Section, Chief	John W. Evans
Mine Service and Equipment Section, Chief	C. J. Pateneaux
Foreign Plant Staff, Chief	N. S. Maddock

Petroleum Administration for War.—On May 28, 1941, the President designated the Secretary of the Interior as Petroleum Coordinator for National Defense. The designation was changed on April 20, 1942, to the Office of Petroleum Coordinator for War, and by Executive Order 9276 of December 2, 1942, this agency became the Petroleum Administration for War with the Secretary of the Interior as Administrator ex officio, directly responsible to the President. The same order greatly extended the responsibilities and powers of the Administrator to establish basic policies and formulate plans and programs to assure for the prosecution of the war the conservation and most effective development and utilization of petroleum resources in the United States and to issue necessary policy and operating orders. Formerly the Coordinator was instructed only to "make specific recommendations to appropriate departments." The Petroleum Administration for War has also been designated as Claimant Agency for the petroleum industry under the Controlled Materials Plan.

As of July 1, 1943, the organization of the Petroleum Administration for War was as follows:

Administrator—Harold L. Ickes
Deputy Administrator—Ralph H. K Davies
Assistant Deputy Administrator—R. E. Allen
Assistant Deputy Administrator—B. K. Brown
Assistant Deputy Administrator—E. L. DeGolyer
Chief Counsel—J. Howard Marshall
Executive Officer—E. L. Kohler
Director of Organizational Planning—L. S. Fish
Labor Counselor—F. H. Harbison
Production Division—Don R. Knowlton, Director
Refining Division—E. D. Cumming, Director
Transportation Division—J. R. Parten, Director
Marketing Division—Walter Hochuli
Natural Gas and Natural Gasoline Division—E. Holley Poe, Director
Foreign Division—James Terry Duce, Director
Petroleum Reserves Division—W. B. Heroy, Director
Petroleum Supply Division—Vacancy
Materials Division—Frank A. Watts, Director
Facility Security Division—A. A. Jergins, Director
Research Division—Edward B. Swanson, Director
Public Relations Division—Gordon M. Sessions, Director
Program Division—Stewart P. Coleman

Cooperation and counsel from the industry are obtained through the Petroleum Industry War Council, headed by W. R. Boyd, Jr., District Industry Committees in each of five districts into which the country has been divided, and a Foreign Operations Committee. A National Conference of State Regulatory Authorities has been organized to coordinate the activities of the State regulatory bodies governing the production of crude petroleum and natural gas, with the programs of P. A. W.; and interdepartmental committees and boards provide for clearance of matters pertaining to the activities of the various agencies of the Federal Government concerned with petroleum. Field representation of the Petroleum Administration is accomplished through five district offices, with headquarters at New York, N. Y.; Chicago, Ill.; Houston, Tex.; Denver, Colo.; and Los

Angeles, Calif. The Petroleum Administration for War also has a representative in London and through the State Department maintains petroleum attachés in various other foreign countries.

Solid Fuels Administration for War.—This agency was established within the Department of the Interior by Executive Order 9332 on April 19, 1943, to centralize the Government's policies and to broaden its activities relating to solid fuels. It succeeded the Office of Solid Fuels Coordinator for War (so designated on May 25, 1942) which had been set up as the Office of Solid Fuels Coordination for National Defense at the request of the President to the Secretary of the Interior on November 5, 1941. The Secretary of the Interior, serving ex officio as Solid Fuels Administrator, is authorized to establish policies and formulate plans and programs to assure the most effective wartime conservation, development and utilization of solid fuels, to issue necessary policy and operating orders, and to appoint any necessary industry committees or councils. He is directed to compile data and make continuing surveys of the effect of prices on solid fuels and to recommend to the O. P. A. any needed maximum price adjustments; subject to the direction of the Chairman of the War Production Board, to provide adequate supplies of solid fuels for indirect military and essential industrial and civilian requirements and to effect proper distribution of critical materials allotted to the solid-fuels industries by the War Production Board; to determine the areas and times for the rationing of solid fuels; to recommend to the Office of Defense Transportation and to the War Shipping Administration action to provide adequate transportation of solid fuels; to request action by the War Manpower Commission on manpower requirements; and to obtain from private or Government sources information, statistics, and data required to effectuate his functions.

By Executive Order 9340, issued May 1, 1943, the Secretary of the Interior took possession and control of the Nation's larger coal mines in which stoppages or strikes had occurred or were threatened. Operation of these mines was handled by the Solid Fuels Administration through an organization set up for that purpose until the establishment of a coal-mines operating organization, to which that function was transferred.

As of July 1, 1943, the organization of the Solid Fuels Administration was as follows:

Administrator—Harold L. Ickes
Deputy Administrator—Howard A. Gray
Associate Deputy Administrator—Thomas J. Thomas
Associate Deputy Administrator for Transportation—Fred A. Dawson
Assistant Deputy Administrator—Charles J. Potter
Assistant Deputy Administrator—Harlen M. Chapman
Assistant Deputy Administrator for New England—Oscar F. Ostby
Assistant Deputy Administrator at Seattle, Wash.—Vacant
Principal Assistant to the Associate Deputy Administrator—B. B. Brown
Technical Advisor—William F. Hahman
Head Conversion Engineer—Allen W. Thorson
Director, Information Division—L. W. Mosby

A Solid Fuels Advisory War Council, composed of representatives of mine producers, mine labor, coal transportation and distribution agencies, and the general public, provides cooperation and counsel. It is headed by Dr. Walter Dill Scott of Evanston, Ill., president emeritus of Northwestern University, a public representative.

Bureau of Mines.—Because of the importance of minerals in the

war program the Bureau's normal functions were quickly placed on a 100-percent war basis by a slight change in emphasis, accompanied by a substantial expansion in activity. While the Bureau had for years been conducting research on various phases of the strategic mineral problem, its present comprehensive war program was initiated following the passage of the Strategic Materials Act of 1939. At first investigations were largely restricted to the more critical materials—manganese ore, chromite, tungsten, antimony, mercury, nickel, and tin. As the defense program gained momentum this work was expanded. Simultaneously industry's demands for raw materials began reaching unprecedented proportions, causing shortages in minerals of which the Nation had enjoyed self-sufficiency for decades. Submarine warfare and shipping shortages seriously threatened imports from certain Western Hemisphere sources which had previously been considered reasonably safe, even in war. As a result of these developments, the Bureau was obliged to extend its investigation of resources to include a great variety of raw materials; many of these required technical research to develop feasible methods of beneficiation.

Early in 1943 the Director of the Bureau of Mines reported that exploratory crews were at work in 48 States and Alaska and that since the start of the work in 1939 over 92,000,000 tons of war minerals (ore) had been charted, including 35,000,000 tons of the strategic minerals previously mentioned, 46,000,000 tons of iron ore, about 5,000,000 tons of bauxite in Arkansas, 3,000,000 tons of bauxite of various grades in other areas, 2,000,000 tons of alunite, and 1,500,000 tons of magnesium ores.

In addition to its extensive program of exploration, laboratory research, and pilot-plant testing, the Bureau's work in other fields was likewise oriented to war. Economic and statistical services were expanded to meet the demands of the war agencies for more and more data on production, consumption, stocks, and sources of minerals. Helium production was rapidly increased for use in blimps, balloons, and other military and civilian uses. The Bureau's petroleum experts were busily engaged in studying the numerous problems in petroleum supply and in seeking raw materials for aviation gasoline, synthetic rubber, and high explosives. Bureau engineers were called upon to help solve coal- and coke-supply problems that threatened to slow war production, and research on production of liquid fuels from coal was speeded in preparation for possible petroleum shortages. Promotion of health and safety continued unabated, not only for the protection of the workers in the mineral industry but to keep absenteeism through accidents at a minimum at a time when manpower was scarce. Other war jobs performed by the Bureau included administration of the Explosives Control Act and inspection of mines and plants with a view to recommending precautions against sabotage and other threats to production.

The operating structure of the Bureau was decentralized into three regional units during 1942 to facilitate field operations on war projects involving exploration and metallurgical testing, which were placed under the direction of three regional engineers and a corps of 23 district engineers. The Foreign Mineral Service established in 1935 was transferred to the Department of State and converted into a Mineral Attaché Service to advise on foreign mineral problems. The Bureau

of Mines will cooperate with the new service in a consulting and supervisory capacity.

Geological Survey.—The Geological Survey staff was greatly enlarged during 1942, and its activities were almost completely diverted to war work. Its Geologic and Alaskan Branches, with the exception of the Military Geology Unit, which supplied vital information for the armed forces, were searching for war minerals in the United States, Alaska, and Latin America. Its Conservation Branch continued to administer mineral and fuel production from public lands and its expanded mapping and map-making facilities were hard-pressed to keep abreast of the enormous direct military demand for maps. The Water Resources Branch supplies data regarding water supplies for military and war-industry establishments, and several of its geologists were commissioned by the Army and assigned to solution of ground-water problems in foreign territory.

In the minerals field, stress was laid on examinations of deposits and mining properties made at the specific request of various war agencies, and more than 700 reports were transmitted to them. Geologic studies of promising regions or districts with a view toward expediting company development or production directly or toward formulating recommendations for further exploration by the Bureau of Mines or the agents of the Metals Reserve Co. were carried forward as in the previous year. To provide closer cooperation with the Bureau of Mines after its decentralization, four regional offices were established in Spokane, Salt Lake City, Rolla, and College Park. These were staffed with geologists who could be assigned to Bureau of Mines projects so as to provide geologic guidance during actual exploration and to join in the estimation of reserves. Establishment of these regional offices made no change in the Survey's basic internal organization on a commodity basis wherein groups of geologists specialize on specific mineral commodities or geologically related groups of commodities.

Investigation in Latin America in 1942 was carried on by field parties in Mexico, Cuba, Panama, Venezuela, Brazil, and Argentina.

Reconstruction Finance Corporation.—Virtually all projects for increasing the supply of minerals for war are financed through this agency or its subsidiaries. In general, the Corporation acts on the requests of the War Production Board for domestic projects and the Board of Economic Warfare for foreign projects, but it maintains close scrutiny over all proposals. The activities of the Corporation and its subsidiaries are described in the chapter on International Aspects of War Mineral Procurement.

GOVERNMENT STOCK PILES

Government purchases of minerals for stock-piling, price control, stimulation of production, preclusive buying, and other purposes continued at an accelerated rate in 1942. The wide variety of minerals and mineral products now being acquired by the Government and the extent to which the program has been expanded are indicated by the following list, which shows the items being purchased at various times:

As of end of 1941	*Added in 1942*	*Added in January–June 1943*
Aluminum (refined)	Alumina	Amblygonite
Antimony	Alumina (hydrate)	Apatite (calcium phosphates)
Asbestos	Aluminum (reclaimed)	Arsenical speiss
Bauxite	Antimony ore	Bismuth ore
Beryllium ore	Arsenic (crude)	Coal
Cadmium	Arsenic (trioxide)	Coke (petroleum)
Chromium ore	Aviation gasoline	Diamond bort
Cobalt	Baddeleyite	Emery ore (Turkish)
Copper (refined)	Beryllium oxide	Iron (pig)
Corundum ore	Bismuth	Manganese (electrolytic)
Diamonds, industrial	Carbons (Brazilian)	Mica (amber phlogopite splittings)
Graphite	Cobalt-nickel compound	Mica (amber phlogopite block)
Iridium	Cobalt oxide	Mica films
Iron ore	Columbite	Monazite sand
Kyanite	Copper (matte)	Nickel (matte content)
Lead (refined)	Copper ore	Nitrate (synthetic)
Lead ore	Corundum grain	Osmiridium
Lead vanadate concentrates	Cryolite ore	Platinum ore
Manganese ore	Ferrochromium	Tin (reclaimed)
Mercury	Ferromanganese	Tin slags
Mica	Ferrovanadium	Topaz
Nickel (refined)	Fluorspar	
Nitrate of soda	Gold ore	
Platinum	Iodine (crude)	
Quartz crystals	Iron (carbonyl)	
Rutile	Lead (bullion)	
Scrap iron	Magnesite (deadburned)	
Tin ore	Magnesium	
Tin	Manganese-iron ore	
Tungsten ore	Molybdenite	
Zinc (refined)	Nickel (copper-refinery residues)	
Zinc concentrates	Nickel (matte content)	
Zirconium ores	Osmium	
	Palladium	
	Potash (muriate)	
	Rhodium	
	Ruthenium	
	Sapphire (natural Montana)	
	Silver (foreign)	
	Slags (tantalum-columbium)	
	Spodumene	
	Strontium ores (celestite)	
	Talc (steatite)	
	Tantalite	
	Tin (cast metal)	
	Vanadium	

Many of the commodities shown are not obtained for stock-piling purposes but are purchased by the Government to centralize buying, particularly of foreign materials, to coordinate shipping, and to facilitate distribution of materials to the most essential uses. To effect the distribution of materials the War Production Board promulgated Imports Order M–63 late in December 1941; this prohibits any person, except Government agencies or their authorized representatives, from making arrangements for importing into the United States materials listed in the order, except under contracts existing at the effective date of the order or by special authorization from the War Production Board. The lists were revised several times during 1942 and at the end of the year included most of the mineral commodities being acquired by the Government.

The chief procurement agent for mineral raw materials is the Metals Reserve Co., although Defense Supplies Corporation also is an important participant in the program. Final responsibility for foreign purchases has been vested in the Board of Economic Warfare since April 1942. Details of the public purchases and stock-piling activity during 1942 are given in subsequent chapters of this volume.

STIMULATION OF DOMESTIC PRODUCTION

Several measures were adopted in 1942 to stimulate domestic production of critical minerals, all with a view to avoiding the extraordinarily high prices that prevailed during World War I, or to restrict payment of high prices to submarginal producers. A premium-price

plan for copper, lead, and zinc was announced jointly by the Office of Price Administration and the Office of Production Management (now War Production Board) in January 1942. Under the plan substantial premiums were paid over established ceiling prices for production in excess of quotas determined by a joint committee of the Office of Price Administration and the War Production Board and approved by the Metals Reserve Co. Some of the original premiums announced in January were raised in December 1942 and again in February 1943, and many quotas were revised to offset rising costs of production and to bring in additional output where possible. During 1942 premiums paid by the Government in excess of ceiling prices totaled approximately $22,500,000.

As early as 1940 the Metals Reserve Co. began contracting for large quantities of domestic ores, particularly manganese ores, guaranteeing a market for fixed tonnages at stipulated prices. This program was designed to get submarginal deposits of strategic minerals into production. However, it developed that some more flexible procedure was required to encourage small producers, so in March 1942 the company set up several buying depots where small tonnages of critical minerals would be purchased under price schedules issued from time to time. The original program has been expanded, and as of July 1943 about 30 purchase depots were operating in Arizona, Arkansas, California, Colorado, Montana, Nevada, New Hampshire, New Mexico, New York, North Carolina, Oregon, Utah, and South Dakota. Commodities purchased at these depots included chromite, manganese ores, mercury, tungsten ores, tin ores, antimony ores, vanadium ores, oxidized lead-zinc ores, beryl, molybdenum ores, mica, and columbite-tantalite ores. No one depot purchases all of these minerals, and some purchase only one or two.

Government-owned expansion of plant capacity for war mineral production is handled chiefly through the Defense Plant Corporation, which operates largely on recommendations from other war agencies charged with responsibility for administering the war program. The plants and equipment are owned by Defense Plant Corporation and operated by private industry under lease, management contract, or other arrangement. The Corporation receives rentals from the plants and in some instances has contracts for reimbursement by the war agency sponsoring the project. In the mineral field, the chief domestic commitments of this agency have been in petroleum pipe lines and in production facilities for aluminum, magnesium, steel, aviation gasoline, tin, copper, chromite, manganese ore, and zinc.

In addition to the extensive activities of its subsidiaries—Metals Reserve Co. and Defense Plant Corporation—the Reconstruction Finance Corporation has stimulated mineral production by direct loans to industry. Mining loans were liberalized considerably during 1942. In March the Corporation announced that development loans on properties that give reasonable promise of success could be obtained without mortgaging the property and could be repaid out of proceeds from production. Public Law 603, approved June 11, 1943, authorized the Corporation to make loans up to $5,000 to any one borrower for the purpose of financing the renovating, retimbering, or other preliminary development of mine workings, when such loans are deemed by the R. F. C. to be advantageous to the war program.

Prospecting and exploration assistance was given throughout the year by the Bureau of Mines and Geological Survey of the United

States Department of the Interior. Both agencies have expanded their staffs to increase war mineral production and to the extent permitted by available appropriations undertake geological investigations and exploration of ore deposits that might contribute to the war supply of minerals. In addition, the Bureau of Mines assists in determining improved methods for treating ores and in recommending to the War Production Board projects for increasing production.

Federal Aids for War Mineral Production, a pamphlet describing the various Government services for stimulating output, was issued by the War Production Board on December 15, 1942 (second edition).

INTERNATIONAL ASPECTS OF WAR MINERAL PROCUREMENT

By J. S. McGrath

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INTRODUCTION

Entry into the war in December 1941 soon terminated the period of uncertainty as to the extent of this country's actual dependence on foreign sources for certain minerals. For a number of years there had been some agitation in official circles for the accumulation of mineral stock piles, but the Government took no precautionary action to anticipate inevitable shortages of many raw materials normally imported. This period ended with the enactment by Congress of the Strategic Materials Act, Public 117, 76th Congress, 1st Session, approved June 7, 1939. The purchase from abroad or from domestic sources (if available) of strategic and critical materials, as defined by the Army-Navy Munitions Board, was authorized, and $100,000,000 was to represent the total expenditure for stock piles under this act. The Procurement Division, Treasury Department, was designated as the Federal agency to purchase and stock pile the commodities specified by the Army-Navy Munitions Board. Limitations and definite restrictions in the original act retarded actual acquisition of the stock piles during the first year of operation under Public 117. The program received needed impetus in 1940 by enactment of Public 664, 76th Congress, 3d Session, approved June 25, 1940, which amended section 5 (d) of the Reconstruction Finance Corporation Act. Public 664 overshadowed Public 117 in importance. It authorized the Reconstruction Finance Corporation to organize and finance corporations "to produce, acquire, and carry strategic and critical materials as described by the President." These broad

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powers of Public 664 were extended by an amendment (Public 108, 77th Cong., 1st Sess.) approved June 10, 1941. Public 108 authorized the Reconstruction Finance Corporation "to take such other action as the President and the Federal Loan Administrator may deem necessary to expedite the National Defense Program." Thus the Reconstruction Finance Corporation was provided with effective legal authority for the Government purchasing program that was in operation throughout 1942.

Under authority of Public 664, approved June 25, 1940, the Reconstruction Finance Corporation created the Metals Reserve Co., the U. S. Commercial Co., the Defense Supplies Corporation, and the Defense Plant Corporation. All of these agencies are owned, managed, and operated under supervision of the Reconstruction Finance Corporation and all have played vital roles in the acquisition of strategic and critical materials required in the conduct of the war by this country and the other United Nations.

FEDERAL AGENCIES ENGAGED IN FOREIGN MINERAL INVESTIGATIONS

METALS RESERVE COMPANY

This agency was created June 28, 1940, by the Reconstruction Finance Corporation and commenced operations with the object of building stock piles of strategic and critical metals and minerals. The program was expanded soon thereafter to include the sale of such materials when necessary in the defense program. At first, the company contracted for the purchase of materials upon a delivered basis, buying all such materials as would comply with requirements necessary to produce the required finished product. Later this program was expanded by the execution of agreements with the governments of foreign countries, particularly in South America, whereby all the exportable surplus[1] of such countries was to be sold to the Metals Reserve Co.

Between the date of its creation on June 28, 1940, and October 31, 1942, Metals Reserve Co. made commitments aggregating $3,224,348,323, of which $1,812,087,030 was for domestic activities and $1,412,261,293 for foreign transactions. Of the total commitments, $143,181,997 has been canceled, and some of the balance probably will not be used.

Antimony.—The company has contracted to purchase antimony produced in China, Mexico, Central America, and South America (chiefly Bolivia) at an approximate cost of $12,698,000. Disbursements for deliveries totaled $3,415,000 at the date of the latest company report.[2]

Chromite.—In purchasing chromite, principally for use by the steel industry in alloys, the company has contracted for production from seven countries outside the Western Hemisphere. Contracts for such production total approximately $37,665,970. In addition, contracts have been made for chromite produced in Brazil, Cuba, Alaska, and

[1] See U. S. Tariff Commission, Latin America as a Source of Strategic and Other Essential Materials, Report 144.

[2] For a complete report of this agency and other subsidiaries of the Reconstruction Finance Corporation see Report of the Reconstruction Finance Corporation, and Its Subsidiaries in Connection With the War, as of October 31, 1942.

the United States at an approximate cost of $26,774,295. Disbursements for delivery total $11,980,000.

Copper.—The company has contracted to purchase copper and copper ore, both domestic and foreign. Most of the copper and copper ore comes from other countries of the Western Hemisphere. Of the total cost of these purchases—$328,428,926—$226,203,716 has been disbursed in payment against deliveries. The copper is sold almost as rapidly as received. Defense Plant Corporation is also financing the expansion of two plants in the United States, in addition to those in Chile.

Cryolite.—The company has contracted for the purchase and importation of cryolite ore at an approximate cost of $5,308,000.

Industrial diamonds.—The company has purchased industrial diamonds from Brazil at a cost of $5,765,000. Of this amount, $4,250,000 has been disbursed for deliveries. The company has also contracted for crushing bort from other foreign countries at a cost of $2,275,000.

Graphite.—Contracts have been made for graphite from foreign countries at a cost of $5,480,000 (of which $683,000 has been disbursed), as well as for the purchase of graphite of domestic origin.

Iron ore.—The company has contracted for the purchase of domestic and Brazilian iron ore at an approximate cost of $21,896,000.

Lead.—Contracts have been made for importing refined lead from four foreign countries and ore and concentrates from seven countries at a cost of $107,497,000. Of this amount, $47,511,000 has been disbursed for deliveries.

Manganese.—Contracts have been made for imports of manganese ore from 10 foreign countries as well as for domestic ore. The amount of all contracts will aggregate approximately $149,453,000, of which $33,058,000 has been disbursed for deliveries.

Mercury.—Mercury is being purchased from Mexico, Canada, and South American countries, as well as from domestic sources. Commitments total $12,872,000, of which $7,521,000 has been disbursed.

Mica.—Mica is being purchased from four foreign countries. Purchases aggregate $9,673,000, of which $1,861,000 has been disbursed against deliveries.

Nickel.—In addition to the nickel to be produced by the facilities in Cuba financed by Defense Plant Corporation, Metals Reserve Co. has contracted for nickel and nickel-cobalt speiss for import at a cost of $8,317,000. Of this amount, $4,124,000 has been disbursed against deliveries.

Platinum.—The company has made commitments to purchase imported crude platinum at a total cost of $1,707,000. Crude platinum contains platinum, iridium, osmium, ruthenium, palladium, and gold. The company has also purchased, at a cost of $128,000, iridium produced in Russia and requisitioned by the War Department when delivered in New York.

Quartz crystals.—The company has contracted to import quartz crystals from Brazil at a cost of $7,640,000. A total of $6,929,000 has been disbursed for deliveries. Quartz crystals are necessary in radio manufacture.

Silver.—At the request of the War Production Board, and with the consent of the Secretary of the Treasury, it has been agreed to buy 10,000,000 ounces of foreign silver at 45 cents an ounce and make it available to industry under allocation by the War Production Board.

Tin.—Agreements with the International Tin Committee, starting June 28, 1940, provided for the purchase of 112,500 tons of refined tin produced in the Far East before December 31, 1941, for stock-pile purposes. In addition, the company agreed to purchase a minimum of 37,500 tons during the first 6 months of 1942, provided the International Scheme for the Regulation of Production and Export was renewed for a further term beyond December 31, 1941; the scheme, however, was not renewed. 41,596 tons of fine tin were received under this agreement, and 12,728 tons of fine tin were received in the form of tin ore for smelting in the Texas tin smelter—a total of 54,324 tons before the supply was cut off through enemy action. 11,700 tons of fine tin have been received from China and Belgian Congo. Tin ores have been received from Bolivia sufficient to manufacture 35,000 tons of fine tin, making a total already received of slightly more than 100,000 tons. A small amount has been sold.

Defense Plant Corporation constructed the Texas tin smelter at an approximate cost of $6,300,000. This smelter will produce tin both from Bolivian ores and from Far Eastern alluvial ores. When the tin smelter started operations April 5, 1942, there were in stock pile Bolivian tin ores and Netherlands East Indies ores totaling approximately a year's capacity for the smelter, which is operated for account of Metals Reserve Co.

Tungsten.—The company has contracted to purchase tungsten-containing ores from eight foreign countries and from domestic producers. Commitments for the domestic and imported ores aggregate $166,112,000, of which $19,220,000 has been disbursed.

Vanadium.—As practically all available vanadium from foreign and domestic sources is being purchased by American industry, the company has agreed to finance experimental test work for extracting vanadium from coal, crude oils, and iron ores in countries of the Western Hemisphere.

Zinc.—The company has contracted to purchase zinc and zinc ore produced in the United States and imported from eight foreign countries, at a cost of $57,748,000. Of this amount, $12,723,000 has been disbursed for deliveries.

Canadian agreement.—On June 29, 1942, the company executed an agreement with War Supplies, Ltd., a Canadian company; under its terms the company will advance (from time to time) funds not exceeding $10,000,000 to be used by the Canadian company for developing new sources of supply of copper, zinc, lead, and other strategic and critical materials and minerals required for the war effort. Under the terms of this agreement, all minerals produced from new projects developed by means of the funds advanced and also any increased production from existing projects resulting from expenditures made from such funds will be purchased by Metals Reserve Co. at cost of production and delivery. When such purchases are made, the advances for development will be amortized in the cost of the materials.

UNITED STATES COMMERCIAL COMPANY

This agency was created March 27, 1942. Its principal purpose is to compete in neutral countries, such as Spain, Turkey, and Argentina, with enemy powers for the purchase of any material that might be of use to the Axis Nations.

The company has established a working agreement with its British counterpart, the United Kingdom Commercial Corporation. The

effect of this arrangement is to enable the U. S. Commercial Co. to utilize the facilities of the British company wherever they exist. The U. S. Commercial Co. also has representatives in a number of foreign countries.

This company will sustain proportionately heavy losses.

DEFENSE SUPPLIES CORPORATION

All procurement activities involving minerals that the war requires to be financed by the Reconstruction Finance Corporation, other than those handled by Metals Reserve Co., Defense Plant Corporation, and U. S. Commercial Co., are handled by Defense Supplies Corporation. Effective July 2, 1942, the Government assumed control over virtually all imported materials by amendment to War Production Board General Preference Order M–63.

Since its creation August 29, 1940, the corporation has made commitments aggregating $3,650,725,563, of which $2,511,303,120 is for domestic and $1,139,422,443 for foreign activities. Of the total, $334,347,105 has been canceled, and much more probably will not be used. Many of these activities will involve very substantial losses. These amounts involve mineral and all other commodities and activities.

Commitments by Defense Supplies Corporation include $1,499,906,141 for the purchase of aviation gasoline and component parts and aviation-gasoline-plant expansion, essentially a domestic expenditure, and $100,000,000 to Russia for metals and other materials.

Russia.—Before lend-lease aid was extended to Russia, Defense Supplies Corporation contracted with Amtorg Trading Corporation, a United States corporation owned by Russia, to purchase needed materials from the Soviet Union to the extent of $100,000,000 and made an advance payment of $49,668,248, in the form of a loan, against delivery, subject to the condition that such advance payment be used to purchase in this country supplies needed by the Soviet Union. Materials already shipped by the Soviet Union, through Amtorg Trading Corporation, including cargoes delivered or that have been sunk, include the following mineral commodities: Asbestos, chrome ore, dead-burned magnesite, potash, and platinum.

DEFENSE PLANT CORPORATION

This agency has financed and contracted to finance the construction, equipment, partial equipment, or expansion of 1,337 plants for building or fabricating ships, bombing, fighting, transport, and cargo planes, tanks, heavy guns, ordnance, magnesium, aluminum, steel, tin, copper and other metals, synthetic rubber, high-octane aviation gasoline, machine tools, flying schools, pipe lines, etc., at an aggregate estimated cost of $8,333,839,503; by November 1942 $2,407,294,064 had been disbursed and $798,239,768 canceled. Most of this construction activity has been within the United States, but the Defense Plant Corporation is financing facilities for producing additional copper in Chile at an estimated cost of $4,999,850 and has agreed to finance another plant at an estimated cost of $15,000,000. It is also establishing facilities, at an estimated cost of $19,300,000, for producing nickel in Cuba and has authorized $4,000,000 for constructing facilities for producing vanadium in Peru.

TRANSFER OF AUTHORITY AND RESPONSIBILITY FROM RECONSTRUCTION FINANCE CORPORATION TO BOARD OF ECONOMIC WARFARE

Effective February 25, 1943, by order [3] of the Chairman, Board of Economic Warfare, the authority and functions of the four subsidiary companies of the Reconstruction Finance Corporation herein described as they pertained to imported materials, with the exception of their responsibilities relating to "the corporate execution of imported materials contracts, the disbursement of funds thereunder, the necessary accounting with respect to such disbursements, and the acceptance of delivery of commodities and materials," were transferred to the Office of Imports, Board of Economic Warfare.

BOARD OF ECONOMIC WARFARE

The genesis of the Board as it now functions may be traced to Executive Order 8839 of July 30, 1941, which established the Economic Defense Board "for the purpose of developing and coordinating policies, plans, and programs designed to protect and strengthen the international economic relations of the United States in the interest of international defense." In order to define further the functions and duties of the Economic Defense Board with respect to the unlimited national emergency as declared by the President on May 27, 1941, the following Executive orders were promulgated:

No. 8900 of September 15, 1941, transferred the duties of the Administrator of Export Control and thus amended and extended the powers of the original Executive order creating the Board.

No. 8926 of October 28, 1941, established the Lend-Lease Administration.

No. 8942 of November 19, 1941, provided for administration of the requisitioning of property required for national defense.

No. 8982 of December 17, 1941, changed the name of the Board as originally created in July 1941.

No. 9128 of April 13, 1942, defined additional duties and functions of the Economic Defense Board.

Amendment to Executive Order 9128, issued by the President on May 20, 1942, clarified and interpreted Executive Order 9128 in respect to certain functions of the United States Department of State and to relations with the Board of Economic Warfare.

Order 5, effective February 25, 1943, issued by the Vice President of the United States in his capacity of Chairman, Board of Economic Warfare, provided for additional delegations of authority to the Board and prescribed procedures and methods with respect to the procurement and production of imported commodities financed through the subsidiary companies of the Reconstruction Finance Corporation.

Attention is directed to the full texts [4] of Executive Orders 8839 of July 30, 1941; 9128 of April 13, 1942; the statement issued by the President on May 29, 1942, clarifying the relationship between the Department of State and the Board of Economic Warfare; and Order 5, effective February 25, 1943, issued by the Chairman, Board of Economic Warfare.

[3] Board of Economic Warfare, Order 5: Federal Register, vol. 8, No. 13, January 20, 1943, pp. 908–909.

[4] The text of all Presidential proclamations and Executive orders, and of rules and regulations issued by Federal agencies that have general applicability and legal effect appear in the Federal Register, published daily by the Division of the Federal Register, The National Archives, Washington, D. C.

As a war agency the Board of Economic Warfare has been vested with broad powers and responsibilities incident to the export from this country of all commodities to foreign neutrals and allied belligerents as well as to the importation of essential raw materials from such sources. One of the principal subdivisions of the Board has as its main objectives the control and direction of commodity export movements in such a manner that the power to supply essential materials can be used as a positive economic weapon in successful prosecution of the war.

Office of Exports.—In addition to other responsibilities and with special reference to mining and related activities, the Office of Exports directs the Board's action in such a way as: To expedite the flow of raw materials required by friendly countries for the war effort either in military or civilian operations; to prevent the export of raw materials consigned to unfriendly nations or individuals; to prevent excessive depletion of stocks of essential materials in this country; and to aid in supplying machinery and other necessary equipment for development and industrial projects in friendly foreign countries where such materials are required to further the war program.

In a more positive way, the Office of Imports directs the Board's activities with respect to the mineral-procurement program.

Office of Imports.—The record of achievement in the foreign mineral program established by the Reconstruction Finance Corporation subsidiaries terminated, as already outlined, on February 25, 1943. Thereafter—except for banking and warehousing responsibilities retained by the Reconstruction Finance Corporation—the Office of Imports, Board of Economic Warfare, assumed responsibility for the negotiation, preparation, supervision, and administration, both in the United States and abroad, of all existing or future imported-materials contracts financed by the Reconstruction Finance Corporation, including development, preclusive operations, and related activities. However, all negotiations abroad are conducted in complete accordance with the provisions set forth in the statement of the President dated May 20, 1942, relating to established prerogatives of the United States Department of State.

UNITED STATES DEPARTMENT OF STATE

As the principal responsibility of the Department is to determine policies of this Government in its relation to international problems, it participates actively in the war program with respect to the procurement of essential materials from foreign countries and assumes its obvious prerogatives in connection with the longer-range postwar economic planning program.

The Executive orders heretofore mentioned, which created the several subsidiary companies of the Reconstruction Finance Corporation and the Board of Economic Warfare, provided for foreign representation of these agencies by technically trained mining experts (engineers, geologists, and ore buyers), whose duties have been confined more or less to their specialized fields. In most foreign countries where the United States has negotiated for the purchase of essential minerals (this is especially true in Latin America), preliminary transactions and final contracts with producers have been facilitated and concluded through the intermediary of some Government agency of the country involved. Thus the State Department of necessity par-

ticipated in the negotiations by procurement agencies of the United States Government whose direct responsibility has been acquisition of strategic materials. Although the Metals Reserve Co. did negotiate a 5-year contract with Bolivian tin producers in November 1940 and about the same time concluded arrangements for substantially the entire copper production of Latin America, this Government in 1941 began active negotiations with the principal American republics for over-all agreements whereby the exportable surplus of all their strategic materials would be made available to the United States. Rigid export-control systems by producing countries obviously were essential and constituted one of the principal obstacles finally surmounted in the successful negotiations of four over-all Government-to-Government agreements concluded during 1941, three of which were in operation during 1942 with Brazil, Mexico, and Chile; a Peruvian agreement expired in September 1942, and, although negotiations for a new agreement were begun later in the year, no conclusive arrangement was reached by the beginning of 1943. Separate agreements were also in effect throughout 1942 between United States Government buying agencies and individual producers of certain minerals in Argentina and Colombia.

Throughout all these negotiations, the United States Department of State maintained close contact with all agencies involved and retained its over-all responsibility for coordinating activities and efforts of the representatives of other agencies of this Government engaged in commercial or economic work within any particular country. The Bureau of Mines, by a cooperative arrangement with the State Department, provided technical assistance throughout 1942; details are covered later in this summary.

To assist the Petroleum Coordinator for War and other war agencies in collecting current information relating to the petroleum situation in key producing countries of Latin America, the State Department employed specialists and assigned them to certain American embassies.

UNITED STATES DEPARTMENT OF THE INTERIOR

Geological Survey.—The foreign work of the Survey has been confined to Latin America, where it has participated since 1940 in the cultural relations program sponsored and financed through the United States Department of State. The plans and modes of handling the projects and problems involved have been approved by that Department and the foreign governments concerned before the assignment of geologists, usually specialists in certain strategic minerals. During the fiscal year 1942 Survey geologists made detailed studies in Cuba, Mexico, and Brazil, and reconnaissance studies in Honduras and Costa Rica. During the fiscal year 1943 investigations were conducted in Cuba, Mexico, Brazil, and Central America, and additional projects were developed in Panama and Argentina. Both the War Production Board and the Board of Economic Warfare have benefited by the work of the Survey.

Bureau of Mines.—Because information regarding the mineral resources of Latin America was inadequate and urgent need for such data was anticipated, the Bureau in 1939 assigned one mining engineer to the area to collect such material. During the next 2 years comprehensive reports were compiled relating to the mineral production and trade of Bolivia, Peru, Chile, Argentina, Brazil, Uruguay, and Paraguay. During this period, officials of American embassies in the

several countries of Latin America were confronted with an ever-increasing number of problems and projects relating to mining, precipitated by the national defense program of this Government. The need for reliable technical aid to enable the several embassies to function more efficiently was evident, and the Bureau of Mines assumed responsibility for assigning mining engineers to serve as technical advisers to American embassies in Argentina, Brazil, Chile, Bolivia, Peru, and Mexico; this arrangement was in effect until July 1, 1942. The impetus of our entry into the war, with particular reference to this country's need for increased mineral supplies, resulted in the almost immediate assignment of mining engineers, geologists, and buyers throughout Latin America in particular, as well as in South Africa, Belgian Congo, and Australia, by the two agencies of this Government directly responsible for the mineral-procurement program, namely, Metals Reserve Co. and the Board of Economic Warfare. Early in 1942 the United States Department of State, empowered by special authorization to employ technical experts, created a mineral attaché service as a segment of its Auxiliary Foreign Service and on July 1, 1942, assumed administrative responsibility for the Bureau's foreign mineral specialists, who were already serving as technical advisers to our several American embassies afore-mentioned. A cooperative arrangement between the Bureau of Mines and the State Department has placed responsibility on the former for the technical supervision and direction of these mineral attachés. Coincidental with this arrangement, the Bureau has proposed for early adoption a plan whereby it will assume responsibility for more active participation in the economic studies conducted by this Government which may serve as basic data essential in the planning of international economic policy for the postwar period.

OTHER FEDERAL AGENCIES

Other than joint economic committees and raw materials boards composed of representatives of the United States and other United Nations (of which several were created during 1942 to develop maximum utilization of their combined resources in the production of war requirements), a few Federal agencies of importance in the war program were in operation during the year whose functions and responsibilities have had a direct influence on the foreign mineral investigations of those establishments afore-mentioned, although they did not participate actively in field activities.

War Production Board.—Established within the Office for Emergency Management by Executive Order 9024 of January 16, 1942, this Board has exercised direction over the entire war production and procurement program. Its recommendations have served as operating instructions covering the mineral commodities and tonnages of each to be purchased abroad and imported by the United States to insure maximum production of munitions.

Office of the Coordinator of Inter-American Affairs.—Soon after its establishment on July 30, 1941, by Executive Order 8840, this agency developed a program for assisting other American republics by providing technical aid to mining agencies of such Governments. Groups of mining engineers had been assigned to Brazil and Peru early in 1942, when the Board of Economic Warfare assumed over-all responsibility for similar activities; in consequence, these particular functions and

the personnel involved were transferred to the Board of Economic Warfare in May 1942.

Miscellaneous.—Other agencies, such as the Office of Strategic Services (a unit of the combined Chiefs of Staff, United States and Great Britain, established on February 6, 1942), the Office of Censorship, established by Executive Order 8985 of December 19, 1941, the Army-Navy Munitions Board, and the Intelligence Services of War and Navy Departments established commodity research units to analyze foreign mineral data. Major economic research and statistical agencies, such as the United States Tariff Commission and the Bureau of Foreign and Domestic Commerce, by special arrangements with the Board of Economic Warfare directed most of their activities toward meeting the requirements of the Board.

OBJECTIVES OF RESEARCH

The vast increase in the volume and character of foreign technical, economic, and statistical research relating to one phase or another of mining developed during 1942 by the Federal Government had as its preliminary objective attainment, as quickly as possible, of maximum production and procurement of the raw materials essential to the United States and other United Nations in conducting the global war against the Axis Powers. Of secondary but not minor significance is the definite need for these accumulated data in postwar economic planning programs, some ideas of which were manifest during 1942 but which early in 1943 received considerable impetus probably as a result of the military successes of the Allies in the North African and Mediterranean areas. In this connection, many plans and suggestions have been advanced that contemplate international action of one kind or another with reference to mineral production and distribution, as well as the equitable commercial and political control of mineral resources among the nations of the world. Most of the plans suggested thus far appear to stem from a desire to make effective article 4 of the Atlantic Charter, which reads—

> They will endeavor with due responsibility for their existing obligations, to further the enjoyment by all States, great or small, victor or vanquished, of access on equal terms to the trade and to the raw materials of the world which are needed for their economic prosperity.

Some ideas of the trend of thought in this direction may be gleaned from the following references:

FEIS, HERBERT (adviser on international economic affairs, U. S. Department of State). Raw Materials, War and Post-war. Dept. of State Bull., vol. 8, No. 200, April 24, 1943, pp. 339–347.

DIVISION FOR THE SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE. Mineral Resources and the Atlantic Charter. Trans. of conference held July 24–25, 1942; pub. by British Association for the Advancement of Science, Burlington House, London, W. 1, in Advancement of Science, vol. 2, No. 7, October 1942, pp. 187–253.

LEITH, C. K., FURNESS, J. W., AND LEWIS, CLEONA. World Minerals and World Peace. Brookings Inst., Washington, January 1943, 253 pp.

CORBETT, PERCY E. Post-war Worlds. Inst. Pacific Relations, New York, 1942, 211 pp.

STATISTICAL SUMMARY OF MINERAL PRODUCTION

(GENERAL UNITED STATES SUMMARY AND DETAILED PRODUCTION BY STATES)

By MARTHA B. CLARK AND MARIAN E. MEYER

SUMMARY OUTLINE

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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 the value of domestic clay in its first marketable form results from the inclusion of the value of clay sold by producers and of clay products other than pottery and refractories, the United States and State

totals include such values for the clay industries. This change in practice should be borne in mind when comparing the values beginning 1936 with those for earlier years.

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

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

GENERAL TABLES

Mineral products of the United States, 1940–42 [1]

Product	1940		1941		1942	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC						
Aluminum, short tons (2,000 pounds)	206,280	$75,292,000	[2 3]	[2 3]	[2 3]	[2 3]
Antimonial lead, do	[4] 29,762	[4]	[4] 40,237	[4]	[4] 51,762	[4]
Antimony:						
Metal, do	[5]	[5]	[2 5]	[2 5]	[2 5]	[2 5]
Ore and concentrates, do	1,124	72,900	[2 3]	[2 3]	[2 3]	[2 3]
Bauxite, do	487,186	2,578,968	[2 3]	[2 3]	[2 3]	[2 3]
Beryllium concentrates, do	121	3,721	158	$7,300	[2 3]	[2 3]
Cadmium:						
Metal, pounds	6,467,260	4,527,082	7,044,417	5,498,404	[2 3]	[2 3]
In compounds, do	205,900	144,130	265,700	207,246	[2 3]	[2 3]
Chromite, short tons	2,982	28,784	[2 3]	[2 3]	[2 3]	[2 3]
Copper,[6] sales value, do	909,084	205,453,000	966,072	227,993,000	1,087,991	[7] $256,766,000
Ferro-alloys, do	1,292,660	128,127,810	[2 3]	[2 3]	[2 3]	[2 3]
Gold [8], troy ounces	6,003,105	210,108,700	5,976,419	209,174,600	3,741,806	130,963,210
Iron:						
Ore [9], short tons	84,221,854	[9] 189,086,799	104,220,473	[9] 249,705,903	118,707,133	[9] 279,178,751
Pig, do	46,958,929	840,442,032	55,223,641	1,111,811,316	59,100,601	1,227,389,689
Lead (refined),[6] sales value, do	433,065	43,307,000	470,517	53,639,000	467,367	[7] 58,888,000
Magnesium (new ingot), pounds	12,823,633	[10] 3,462,380	[2 3]	[2 3]	[2 3]	[2 3]
Manganese ore (35 percent or more Mn), short tons	44,936	1,169,024	[2 3]	[2 3]	[2 3]	[2 3]
Manganiferous ore (5 to 35 percent Mn), do	1,272,932	3,348,042	[2 3]	[2 3]	[2 3]	[2 3]
Mercury:						
Metal, flasks (76 pounds net)	37,777	6,681,618	[2 3]	[2 3]	[2 3]	[2 3]
Ore, short tons	[11]	[12]	[11]	[12]	[11]	[12]
Molybdenum, pounds	25,329,000	17,189,000	[2 3]	[2 3]	[2 3]	[2 3]
Nickel, short tons	554	[13]	[2 3]	[2 3]	[2 3]	[2 3]
Ores (crude), old tailings, etc.:						
Copper, do	69,278,000	[12]	78,453,000	[12]	92,664,000	[12]
Dry and siliceous (gold and silver), do	18,700,000	[12]	17,639,000	[12]	11,649,000	[12]
Lead, do	6,144,000	[12]	6,151,000	[12]	7,612,000	[12]
Lead-copper, do	10,000	[12]	6,000	[12]	1,000	[12]
Zinc, do	9,521,000	[12]	10,492,000	[12]	9,155,000	[12]
Zinc-copper, do	79,000	[12]	81,000	[12]	7,000	[12]
Zinc-lead, do	12,866,000	[12]	16,211,000	[12]	18,827,000	[12]
Zinc-lead-copper, do	4,000	[12]	1,000	[12]	2,000	[12]
Platinum metals (refined) (value at New York City), troy ounces	47,339	1,986,000	[2 3]	[2 3]	[2 3]	[2 3]

See footnotes at end of table.

Mineral products of the United States, 1940–42—Continued

Product	1940		1941		1942	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC—continued						
Selenium ..... pounds	368,709	[13]	681,650	[13]	316,613	[13]
Silver [14] ..... troy ounces	69,585,734	$49,483,189	72,336,029	$51,438,954	56,090,855	$39,886,830
Tantalite-columbite ..... pounds			250	219	[2 3]	[2 3]
Tellurium ..... do	88,996	[13]	239,983	[13]	98,798	[13]
Tin (metallic equivalent) ..... short tons	55	54,900	[2 3]	[2 3]	[2 3]	[2 3]
Titanium concentrates:						
Ilmenite ..... do	20,702	183,686	21,526	196,522	[13]	[13]
Rutile ..... do	2,657	393,243	3,431	493,782	2,649	410,956
Tungsten ore (60-percent concentrates) ..... do	5,319	6,576,318	[2 3]	[2 3]	[2 3]	[2 3]
Vanadium ..... pounds	2,162,916	1,044,100	[2 3]	[2 3]	[2 3]	[2 3]
Zinc,[6] sales value ..... short tons	589,988	74,338,000	652,599	97,890,000	629,957	[7] 109,613,000
Other metallic [15]		1,192,471		2,031,953		3,641,913
Total value of metallic products (approximate)		1,678,600,000		2,132,000,000		2,361,800,000
NONMETALLIC						
Arsenious oxide ..... short tons	23,339	561,300	34,784	1,119,320	[2 16]	[2 16]
Asbestos ..... do	20,060	674,508	[2 16]	[2 16]	[2 16]	[2 16]
Asphalt:						
Native ..... do	500,281	2,766,240	691,168	3,169,193	975,373	4,279,442
Oil (including road oil) [9] ..... do	5,262,959	[9] 41,398,735	[2 9]	[2 9]	[2 9]	[2 9]
Barite (crude) ..... do	409,353	2,596,743	503,156	3,134,234	429,484	2,673,002
Boron minerals ..... do	243,355	5,643,390	301,282	6,785,662	226,723	5,733,648
Bromine ..... pounds	59,266,275	11,772,515	68,317,019	11,506,213	65,880,935	13,729,383
Calcium-magnesium chloride (75 percent $CaCl_2$) ..... short tons	99,536	998,241	165,932	1,333,370	224,527	1,733,169
Cement ..... barrels (376 pounds net)	132,864,383	193,464,869	170,365,440	250,589,481	187,809,208	286,905,197
Clay:						
Products (other than pottery and refractories)		[17] 114,000,000		[17] 135,000,000		[17] 115,000,000
Raw (sold by producers) ..... short tons	4,700,951	18,162,485	7,018,056	24,925,717	7,342,843	24,523,227
Coal:						
Bituminous [18] ..... do	[19] 460,771,500	[19] 879,327,227	[19] 514,149,245	[19] 1,125,362,836	[19] 580,000,000	[19] 1,360,219,000
Pennsylvania anthracite ..... do	51,484,640	205,490,000	56,368,267	240,275,000	60,327,729	271,673,000
Coke [9] ..... do	57,072,134	[9] 273,832,410	65,186,578	[9] 352,967,237	70,568,944	[9] 425,613,744
Diatomite ..... do	[20]	[20]	[20]	[20]	[20]	[20]
Emery ..... do	1,046	9,349	4,876	42,484	5,277	49,413
Feldspar (crude) ..... long tons (2,240 pounds)	290,763	1,271,995	338,860	1,519,456	307,823	1,516,791
Fluorspar ..... short tons	233,600	4,744,808	320,669	6,724,782	360,316	8,897,749
Fuller's earth ..... do	146,568	1,471,083	207,446	2,111,674	204,244	2,139,670
Garnet for abrasive purposes ..... do	4,716	259,345	5,501	371,752	4,357	299,904
Gems and precious stones		[21]		[21]		[21]

Graphite:						
Amorphous	short tons	[20]	[20]	[2 16]	[2 16]	[2 16]
Crystalline	pounds			[2 16]	[2 16]	[2 16]
Grindstones and pulpstones	short tons	13,323	496,448	15,536	545,556	14,681	539,739
Gypsum (crude)	do	3,699,015	5,227,910	4,788,534	6,794,223	4,697,568	6,811,180
Helium	cubic feet	[22] 9,450,855	[22] 85,061	[20]	[20]	[20]	[20]
Iodine	pounds	[20]	[20]	[20]	[20]	[20]	[20]
Kyanite	short tons	4,241	93,716	8,335	175,581	8,708	190,750
Lime	do	4,886,929	33,956,385	6,079,416	42,941,162	6,103,791	44,367,441
Lithium minerals	do	2,011	80,679	3,832	115,718	5,405	243,516
Magnesite (crude)	do	333,166	2,487,969	374,799	2,655,547	497,368	3,874,334
Magnesium compounds (natural) (including brucite)	pounds	216,532,000	2,452,814	274,714,000	3,587,784	738,514,000	10,727,560
Marl:							
Calcareous	short tons	25,516	42,481	183,009	175,393	194,878	135,046
Greensand	do	6,697	389,888	11,120	619,664	10,110	448,440
Mica:							
Scrap	do	22,386	314,565	[2 16]	[2 16]	[2 16]	[2 16]
Sheet	pounds	1,625,437	291,685	[2 16]	[2 16]	[2 16]	[2 16]
Millstones			6,558		15,579		10,391
Mineral pigments:							
Natural pigments and manufactured iron oxide pigments	short tons	[23]	[23]	[23]	[23]	97,327	7,764,232
Zinc and lead pigments [24]	do	164,775	19,334,347	228,123	27,994,694	156,215	21,255,125
Mineral waters	gallons sold	[21]	[21]	[21]	[21]	[21]	[21]
Natural gas	M cubic feet	2,660,222,000	577,939,000	2,812,658,000	621,333,000	3,055,000,000	711,738,000
Natural gasoline and allied products:							
Natural gasoline and cycle products	gallons	2,339,400,000	68,261,000	2,688,714,000	105,815,000	2,708,034,000	102,000,000
Liquefied petroleum gases	do	[11]	[11]	707,196,000	13,305,000	801,780,000	19,000,000
Oilstones, etc	short tons	[20]	[20]	[20]	[20]	[20]	[20]
Olivine	do	2,500	15,000	4,828	24,401	5,739	45,201
Peat	do	70,097	516,865	86,503	657,556	71,500	516,887
Petroleum	barrels (42 gallons)	1,353,214,000	1,385,440,000	1,402,228,000	1,602,000,000	1,385,479,000	1,620,000,000
Phosphate rock	long tons	4,002,700	12,334,662	4,689,652	15,596,273	4,644,240	16,597,492
Potassium salts	short tons	[25] 393,058	12,562,050	[25] 531,346	17,368,237	[25] 680,831	22,962,518
Pumice	do	82,407	449,914	117,310	669,514	126,522	706,199
Pyrites	long tons	626,640	1,920,000	645,257	2,009,000	720,363	2,464,000
Salt (sodium chloride)	short tons	10,359,960	26,474,619	12,720,629	33,620,376	13,693,284	38,144,234
Sand and gravel:							
Glass sand	do	2,759,544	4,881,508	3,475,111	6,113,529	3,622,487	6,784,427
Sand (molding, building, etc.) and gravel	do	235,548,000	105,806,000	285,240,000	141,093,000	300,724,000	181,716,000
Sand-lime brick	thousands of brick	[26] 104,519	[26] 1,174,044	[26]	[26]	[26]	[26]
Silica (quartz)	short tons	31,865	176,390	41,685	228,587	65,878	331,494
Slate	do	473,450	5,738,269	618,660	7,515,634	590,770	6,360,223
Sodium salts (carbonates and sulfates) (natural)	do	317,267	3,157,916	304,201	3,266,123	325,652	3,815,272
Stone [27]	do	153,733,040	160,044,115	183,107,960	195,337,426	195,884,490	205,002,019
Sulfur	long tons	2,558,742	40,900,000	3,401,410	54,400,000	3,128,559	50,100,000
Sulfuric acid (60° Baumé) (byproduct) [28]	short tons	840,937	6,797,421	915,989	7,201,161	960,764	8,253,104
Talc, pyrophyllite, and ground soapstone [27]	do	281,375	3,008,320	416,369	4,701,892	387,963	4,754,076
Tripoli	do	30,212	366,569	29,301	421,746	17,536	272,428

See footnotes at end of table.

Mineral products of the United States, 1940–42—Continued

Product	1940		1941		1942	
	Quantity	Value	Quantity	Value	Quantity	Value
NONMETALLIC—continued						
Vermiculite.....short tons	22,299	$137,698	23,438	$125,444	57,848	$319,931
Other nonmetallic [29]		2,806,861		4,457,215		4,257,086
Total value of nonmetallic products (approximate)		3,935,300,000		4,746,000,000		5,207,700,000
SUMMARY						
Total value:						
Metallic		1,678,600,000		2,132,000,000		2,361,800,000
Nonmetallic:						
Fuels		3,116,500,000		3,708,100,000		4,084,600,000
Other		818,800,000		1,037,900,000		1,123,100,000
Grand total approximate value of mineral products		5,613,900,000		6,878,000,000		7,569,500,000

[1] In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1942 are subject to revision. For details see following chapters of this volume.

[2] Figures withheld from publication at request of Committee for War Information.

[3] Value included in total value of metallic products.

[4] 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.

[5] Largely from foreign ore; value not included in total value.

[6] Product from domestic ores only.

[7] Value does not include premiums paid to miners by the Government. Total premiums for copper, lead, and zinc amounted to approximately $22,500,000.

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

[9] Value not included in total value.

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

[11] Figures not available.

[12] Figures showing values not available.

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

[14] According to Bureau of the Mint.

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

1940: Bismuth, cobalt, iron ore sold for paint (9,981 short tons, $45,578), and thallium.

1941: Bismuth, cobalt, indium, iron ore sold for paint (23,287 short tons, $101,710), radium, thallium, uranium compounds, and zircon (174 short tons, $5,153).

1942: Bismuth, cobalt, germanium, indium, radium, thallium, and zircon.

[16] Value included in total value of nonmetallic products.

[17] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941–42: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.

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

[19] According to Bituminous Coal Division; value for bituminous includes selling expenses. Figures for 1942 are preliminary.

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

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

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

[23] Canvass discontinued after 1915. Figures for iron ore sold for paint given in footnote 15.

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

[25] Equivalent as K_2O.

[26] 1940: Figures obtained through cooperation with Bureau of the Census; 1941–42: No canvass by Bureau of the Census and no estimate made.

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

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

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

1940: Andalusite, crude aplite, natural sulfonated bitumen, chats (3,786,906 short tons, $572,739), dumortierite, flint lining for tube mills, pebbles for grinding, silica sand and sandstone (ground) (342,218 short tons, $2,088,314), strontium minerals (2,343 short tons, $41,442), and sulfur ore (280 long tons, $3,203).

1941: Andalusite, crude aplite, natural sulfonated bitumen, chats (5,291,491 short tons, $897,940), dumortierite, flint lining for tube mills (3,411 short tons, $54,216), pebbles for grinding (13,561 short tons, $221,826), silica sand and sandstone (ground) (487,665 short tons, $3,073,730), strontium minerals (4,724 short tons, $69,054), and sulfur ore (409 long tons, $2,553).

1942: Andalusite, crude aplite, natural sulfonated bitumen, dumortierite, flint lining for tube mills (2,576 short tons, $49,967), pebbles for grinding (15,487 short tons, $245,794), silica sand and sandstone (ground) (527,886 short tons, $3,646,643), strontium minerals (4,041 short tons, $55,529), and sulfur ore.

Value of mineral products of the United States, 1880–1942 [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	1,291,700,000	2,834,300,000	788,200,000	3,622,500,000	4,914,200,000
1940	1,678,600,000	3,116,500,000	818,800,000	3,935,300,000	5,613,900,000
1941	2,132,000,000	3,708,100,000	1,037,900,000	4,746,000,000	6,878,000,000
1942 [3]	2,361,800,000	4,084,600,000	1,123,100,000	5,207,700,000	7,569,500,000
Grand total	50,904,927,000	91,698,152,000	30,850,110,000	122,548,262,000	173,453,189,000

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

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

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

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

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

Value of mineral products of the United States, 1937–41, and total, 1911–41, by States [1]

State	1937	1938	1939	1940	1941	1911–41 [1]		
						Total value	Rank	Percent of total for United States
Alabama	$53, 518, 993	$46, 296, 293	$52, 158, 173	$64, 998, 018	$82, 730, 210	$1, 680, 206, 000	20	1. 54
Alaska	27, 927, 958	28, 796, 753	25, 673, 566	28, 724, 221	26, 809, 380	680, 502, 000	30	. 62
Arizona	94, 564, 494	60, 756, 253	75, 087, 930	85, 291, 347	100, 472, 791	2, 771, 051, 000	12	2. 54
Arkansas	25, 578, 393	29, 395, 086	29, 572, 632	37, 479, 135	47, 081, 326	876, 454, 000	29	. 80
California	476, 880, 603	490, 108, 428	467, 612, 196	455, 672, 038	506, 795, 395	10, 229, 545, 000	3	9. 36
Colorado	67, 338, 548	60, 369, 440	64, 144, 557	63, 188, 421	73, 960, 602	1, 789, 394, 000	19	1. 64
Connecticut	3, 689, 554	3, 059, 688	4, 306, 351	3, 914, 177	5, 284, 955	142, 946, 000	41	. 13
Delaware	397, 362	320, 621	401, 333	457, 326	492, 631	12, 377, 000	50	. 01
District of Columbia	522, 687	568, 717	591, 837	640, 480	700,000	18, 915, 000	49	. 02
Florida	13, 811, 958	12, 866, 981	13, 060, 453	14, 854, 206	19, 268, 779	384, 296, 000	34	. 35
Georgia	12, 584, 060	11, 598, 421	14, 633, 655	16, 932, 335	21, 049, 261	348, 434, 000	36	. 32
Idaho	40, 633, 119	31, 738, 606	33, 138, 452	40, 799, 920	45, 673, 740	878, 414, 000	28	. 80
Illinois	133, 437, 554	130, 155, 083	210, 798, 331	277, 943, 011	320, 509, 559	5, 648, 790, 000	6	5. 17
Indiana	54, 886, 756	47, 892, 364	53, 884, 995	58, 975, 110	80, 572, 397	2, 288, 780, 000	14	2. 09
Iowa	26, 941, 350	24, 794, 058	25, 170, 181	26, 006, 904	28, 872, 177	953, 953, 000	26	. 87
Kansas	154, 376, 403	129, 675, 438	122, 959, 513	130, 859, 896	171, 991, 685	3, 128, 410, 000	10	2. 86
Kentucky	127, 423, 680	106, 654, 903	112, 840, 566	131, 974, 410	169, 009, 195	3, 148, 031, 000	9	2. 88
Louisiana	182, 118, 905	172, 306, 761	168, 903, 151	189, 153, 312	228, 440, 044	2, 471, 958, 000	13	2. 26
Maine	4, 129, 391	3, 548, 638	3, 769, 791	4, 374, 976	4, 692, 448	139, 861, 000	42	. 13
Maryland	10, 634, 854	9, 407, 723	11, 781, 531	12, 605, 171	17, 291, 523	463, 086, 000	33	. 42
Massachusetts	7, 813, 345	6, 666, 281	8, 242, 956	7, 573, 122	9, 293, 169	305, 903, 000	37	. 28
Michigan	119, 167, 573	81, 380, 602	116, 088, 154	124, 774, 581	142, 433, 673	3, 274, 370, 000	8	3. 00
Minnesota	152, 107, 070	51, 425, 289	106, 455, 607	128, 571, 690	178, 790, 274	3, 118, 542, 000	11	2. 85
Mississippi	4, 821, 950	5, 209, 547	5, 192, 156	7, 239, 647	17, 750, 726	90, 765, 000	44	. 08
Missouri	52, 446, 272	39, 560, 739	45, 633, 707	50, 324, 566	61, 545, 052	1, 941, 986, 000	18	1. 78
Montana	82, 086, 815	48, 602, 547	63, 343, 802	79, 487, 873	86, 583, 460	2, 166, 995, 000	17	1. 98
Nebraska	4, 837, 809	4, 028, 712	4, 390, 291	4, 692, 146	6. 499, 070	116, 531, 000	43	. 11
Nevada	38, 871, 816	27, 031, 281	34, 670, 879	42, 570, 529	46, 341, 010	938, 200, 000	27	. 86
New Hampshire	1, 219, 869	1, 146, 606	1, 187, 339	1, 065, 337	1, 382, 506	68, 017, 000	47	. 06
New Jersey	31, 467, 931	24, 408, 545	30, 441, 758	33, 653, 732	39, 074, 518	1, 482, 903, 000	21	1. 36
New Mexico	72, 855, 745	63, 568, 953	69, 987, 797	80, 969, 723	97, 849, 086	1, 080, 600, 000	23	. 99
New York	77, 665, 874	73, 217, 430	78, 409, 560	76, 119, 505	91, 582, 704	2, 190, 528, 000	16	2. 00
North Carolina	11, 160, 444	14, 959, 228	18, 533, 720	21, 112, 732	18, 915, 461	257, 841, 000	39	. 24
North Dakota	2, 873, 011	2, 653, 473	2, 689, 627	2, 987, 351	3, 327, 627	75, 925, 000	46	. 07
Ohio	131, 025, 104	104, 812, 531	120, 681, 969	130, 655, 129	164, 826, 884	5, 388, 654, 000	7	4. 93

[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 1942 not yet available. Comparable totals for years before 1911 not available.

Value of mineral products of the United States, 1937–41, and total, 1911–41, by States—Continued

State	1937	1938	1939	1940	1941	1911–41		
						Total value	Rank	Percent of total for United States
Oklahoma	$367,444,222	$272,860,078	$236,194,064	$235,535,062	$263,763,923	$9,018,834,000	4	8.25
Oregon	6,609,710	7,536,408	8,637,047	11,229,670	12,830,176	179,224,000	40	.16
Pennsylvania	599,817,364	472,773,327	531,007,890	618,347,805	737,143,530	12,362,465,000	1	11.31
Rhode Island	862,710	911,599	980,916	994,997	1,133,400	28,125,000	48	.03
South Carolina	4,022,325	4,364,034	5,422,979	5,305,597	7,236,503	88,485,000	45	.08
South Dakota	23,472,873	23,583,359	24,813,621	23,528,825	24,501,696	380,789,000	35	.35
Tennessee	34,893,847	32,428,512	39,818,234	42,683,407	56,301,592	1,013,272,000	25	.93
Texas	813,290,605	740,147,465	701,972,035	725,005,009	868,082,690	10,977,481,000	2	10.04
Utah	105,652,422	59,236,355	80,127,521	104,392,989	122,386,473	2,249,087,000	15	2.06
Vermont	7,042,547	6,439,552	6,972,234	6,979,772	8,131,670	302,595,000	38	.28
Virginia	46,019,085	42,370,169	43,902,881	50,003,672	71,340,934	1,077,759,000	24	.99
Washington	26,658,257	21,167,004	31,595,704	28,090,188	28,507,282	606,594,000	31	.55
West Virginia	306,590,947	254,995,309	276,084,118	329,891,960	425,626,303	8,674,276,000	5	7.94
Wisconsin	15,239,524	10,636,741	12,704,942	13,553,683	17,020,722	489,892,000	32	.45
Wyoming	41,087,908	37,364,363	39,413,001	43,073,533	52,751,354	1,294,270,000	22	1.18

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
15	Aluminum	Tennessee, New York, Washington, North Carolina	Rank same as for quantity.
101	Andalusite	California	Do.
(2)	Antimonial lead	Not separable by States	Not separable by States.
82	Antimony ore	Idaho, Nevada, Alaska, Oregon	Idaho, Alaska, Nevada, Montana.
83	Aplite (crude)	Virginia	Rank same as for quantity.
56	Arsenious oxide	Montana, Utah	Do.
61	Asbestos	Vermont, Arizona, North Carolina, Georgia	Do.
	Asphalt:		
43	Native	Texas, Oklahoma, Kentucky, Alabama	Utah, Kentucky, Oklahoma, Texas.
17	Oil	Not separable by States	Not separable by States.
44	Barite (crude)	Missouri, Tennessee, Georgia, California	Missouri, Tennessee, Georgia, Arkansas.
38	Bauxite	Arkansas, Alabama, Virginia, Georgia	Rank same as for quantity.
97	Beryllium concentrates	South Dakota, New Hampshire, Wyoming, Maine	South Dakota, Wyoming, New Hampshire, Maine.
55	Bismuth	Not separable by States	Not separable by States.
99	Bitumen (natural sulfonated)	Utah	Rank same as for quantity.
35	Boron minerals	California	Do.
28	Bromine	North Carolina, Texas, Michigan, California	Michigan, North Carolina, Texas, California.
37	Cadmium	Not separable by States	Not separable by States.
52	Calcium-magnesium chloride	Michigan, West Virginia, California, Ohio	Rank same as for quantity.
6	Cement	Pennsylvania, California, New York, Texas	Do.
59	Chats	Oklahoma, Missouri, Kansas	Missouri, Oklahoma, Kansas.
74	Chromite	California, Oregon	Rank same as for quantity.
	Clay:		
13	Products (other than pottery and refractories)		Ohio, Pennsylvania, California, New York.
25	Raw (sold by producers)	Pennsylvania, Georgia, Missouri, Ohio	Georgia, Pennsylvania, Kentucky, Missouri.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Illinois, Kentucky	West Virginia, Pennsylvania, Kentucky, Illinois.
	Pennsylvania anthracite	Pennsylvania	Rank same as for quantity.
71	Cobalt	Pennsylvania, Vermont, Nevada	Do.
5	Coke	Pennsylvania, Ohio, Indiana, New York	Do.
8	Copper	Arizona, Utah, Montana, Nevada	Do.
46	Diatomite	California, Oregon, Nevada, Washington	Do.
102	Dumortierite	Nevada	Do.
93	Emery	New York	Do.
51	Feldspar (crude)	North Carolina, South Dakota, New Hampshire, Colorado	North Carolina, New Hampshire, South Dakota, Colorado.
10	Ferro-alloys	Pennsylvania, New York, West Virginia, Ohio	Rank same as for quantity.
92	Flint lining for tube mills	North Carolina, Minnesota, Texas, Tennessee	Minnesota, North Carolina, Texas, Tennessee.
36	Fluorspar	Kentucky, Illinois, New Mexico, Colorado	Illinois, Kentucky, New Mexico, Colorado.
49	Fuller's earth	Texas, Georgia, Florida, Illinois	Rank same as for quantity.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
Separate figures for antimonial lead from primary sources not available.

Mineral products of the United States and principal producing States in 1941—Continued

Rank in value	Product	Principal producing States	
		In order of quantity	In order of value
72	Garnet (abrasive)	New York, North Carolina, Vermont, Idaho	New York, North Carolina, Idaho, Vermont.
(3)	Gems and precious stones	No canvass for 1941	No canvass for 1941.
9	Gold	California, Alaska, South Dakota, Colorado	Rank same as for quantity.
77	Graphite:		
	Amorphous	Nevada	Do.
	Crystalline	New York, Alabama, Georgia, Washington	Do.
66	Grindstones and pulpstones	Ohio, West Virginia, Washington	Do.
34	Gypsum (crude)	New York, Michigan, Iowa, Texas	New York, Michigan, Nevada, Iowa.
87	Helium	Texas	Rank same as for quantity.
88	Indium	Not separable by States	Not separable by States.
68	Iodine (natural)	California	Rank same as for quantity.
	Iron:		
7	Ore	Minnesota, Michigan, Alabama, Pennsylvania	Minnesota, Michigan, Alabama, New York.
3	Pig	Pennsylvania, Ohio, Indiana, Illinois	Rank same as for quantity.
53	Sinter	Tennessee	Do.
80	Kyanite	Virginia, California, North Carolina, Georgia	Virginia, North Carolina, Georgia, California.
19	Lead	Missouri, Idaho, Utah, Oklahoma	Rank same as for quantity.
21	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
86	Lithium minerals	South Dakota, California, North Carolina	Do.
48	Magnesite (crude)	Washington, California, Nevada, Texas	Do.
32	Magnesium	Michigan, Texas, California	Do.
41	Magnesium compounds (natural)	Michigan, Nevada, California, Texas	Michigan, California, Nevada, Texas.
47	Manganese ore	Montana, Virginia, Arkansas, Georgia	Rank same as for quantity.
40	Manganiferous ore	Minnesota, New Mexico, Nevada, Georgia	Minnesota, New Mexico, Montana, Nevada.
65	Manganiferous zinc residuum	New Jersey	Rank same as for quantity.
	Marl:		
81	Calcareous	Michigan, Indiana, Virginia, Minnesota	Michigan, North Carolina, Wisconsin, Virginia.
64	Greensand	New Jersey	Rank same as for quantity.
30	Mercury	California, Oregon, Nevada, Arkansas	Do.
58	Mica	North Carolina, Georgia, Colorado, Virginia	North Carolina, Connecticut, New Hampshire, South Dakota.
	Scrap	do	North Carolina, Georgia, Virginia, South Dakota.
	Sheet	North Carolina, New Hampshire, South Dakota, Connecticut	North Carolina, Connecticut, New Hampshire, South Dakota.
96	Millstones		North Carolina, West Virginia, New York, Virginia.
23	Mineral paints (zinc and lead pigments)	Pennsylvania, Illinois, Kansas, Ohio	Pennsylvania, Illinois, Kansas, Indiana.
(3)	Mineral waters	No canvass for 1941	No canvass for 1941.
24	Molybdenum	Colorado, Utah, New Mexico, Arizona	Rank same as for quantity.
4	Natural gas	Texas, Louisiana, California, Oklahoma	Texas, California, West Virginia, Louisiana.
14	Natural gasoline and allied products:		
	Natural gasoline and cycle products	Texas, California, Oklahoma, Louisiana	Rank same as for quantity.
	Liquefied petroleum gases	Texas, Oklahoma, California, Illinois	Texas, California, Oklahoma, West Virginia.
69	Nickel	Not separable by States	Not separable by States.
85	Oilstones, etc	Arkansas, Ohio, New Hampshire, Indiana	Rank same as for quantity.
95	Olivine	North Carolina	Do.

(4)	Ores (crude), etc.:		
	Copper	Utah, Arizona, New Mexico, Nevada	Value not available.
	Dry and siliceous (gold and silver)	Alaska, California, Nevada, South Dakota	Do.
	Lead	Missouri, Idaho, Utah, Montana	Do.
	Lead-copper	Utah, Arizona, Idaho, and Colorado and Montana	Do.
	Zinc	Oklahoma, Kansas, Tennessee, New Jersey	Do.
	Zinc-copper	Arizona	Do.
	Zinc-lead	Oklahoma, Kansas, Idaho, Missouri	Do.
	Zinc-lead-copper	Utah	Do.
63	Peat	New York, Illinois, New Jersey, Michigan	Maine, New York, Iowa, Michigan.
76	Pebbles for grinding	North Carolina, Minnesota, Texas, Wisconsin	North Carolina, Minnesota, Wisconsin, Texas.
1	Petroleum	Texas, California, Oklahoma, Illinois	Rank same as for quantity.
27	Phosphate rock	Florida, Tennessee, Montana, Idaho	Florida, Tennessee, Idaho, Montana.
60	Platinum metals	Alaska, California, Oregon, Montana	Rank same as for quantity.
26	Potassium salts	New Mexico, California, Utah, Maryland	Do.
62	Pumice	California, Kansas, Nebraska, New Mexico	California, New Mexico, Kansas, Nebraska.
50	Pyrites	Tennessee, California, Virginia, New York	Rank same as for quantity.
89	Radium	Not separable by States	Not separable by States.
22	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Ohio, Kansas.
12	Sand and gravel	California, New York, Michigan, Illinois	California, New York, Pennsylvania, Ohio.
57	Selenium	Not separable by States	Not separable by States.
75	Silica (quartz)	Wisconsin, North Carolina, California, Tennessee	North Carolina, Wisconsin, California, Tennessee.
45	Silica sand and sandstone (ground)	Illinois, New Jersey, Ohio, Pennsylvania	Illinois, New Jersey, Ohio, West Virginia.
20	Silver	Idaho, Montana, Utah, Arizona	Rank same as for quantity.
31	Slate		Pennsylvania, Vermont, New York, Virginia.
42	Sodium salts (carbonates and sulfates) (natural).	California, Texas, Wyoming, Utah	Rank same as for quantity.
11	Stone	Pennsylvania, Michigan, Ohio, Illinois	Pennsylvania, Ohio, New York, Illinois.
90	Strontium minerals	California, Texas, Washington	Rank same as for quantity.
18	Sulfur	Texas, Louisiana, California	Do.
33	Sulfuric acid from copper and zinc smelters and roasters and from roasting of high-sulfide gold and silver concentrates.	Pennsylvania, Illinois, Arizona, Tennessee	Pennsylvania, Illinois, Arizona, Oklahoma.
100	Sulfur ore	Texas, Nevada, Colorado	Texas, Colorado, Nevada.
39	Talc, pyrophyllite, and ground soapstone [5]	New York, North Carolina, California, Vermont	New York, California, Vermont, North Carolina.
103	Tantalite-columbite	Wyoming	Rank same as for quantity.
73	Tellurium	Not separable by States	Not separable by States.
94	Thallium	do	Do.
91	Tin	Alaska, New Mexico, Alabama, South Dakota	Rank same as for quantity.
	Titanium concentrates:		
78	Ilmenite	Virginia, Florida	Do.
67	Rutile	Virginia, Arkansas, Florida	Do.
70	Tripoli	Illinois, Missouri, Arkansas, Oklahoma	Do.
29	Tungsten ore	California, Nevada, Idaho, Colorado	California, Nevada, Colorado, Idaho.
79	Uranium compounds	Not separable by States	Not separable by States.
54	Vanadium	Colorado, Idaho, Utah, Arizona	Colorado, Utah, Idaho, Arizona.
84	Vermiculite	Montana, Wyoming, North Carolina	Rank same as for quantity.
16	Zinc	Oklahoma, New Jersey, Idaho, Kansas	Do.
98	Zircon	Florida, California	Do.

[3] No canvass for 1941. [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 1941 [1]

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama	18	1.47	Coal, iron ore, cement, stone.
Alaska	31	.48	Gold, platinum metals, coal, silver.
Arizona	14	1.79	Copper, gold, silver, zinc.
Arkansas	25	.84	Petroleum, coal, bauxite, natural gas.
California	3	9.03	Petroleum, natural gas, gold, cement.
Colorado	20	1.32	Coal, molybdenum, gold, silver.
Connecticut	44	.09	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	34	.34	Phosphate rock, stone, cement, sand and gravel.
Georgia	33	.37	Raw clay, stone, cement, clay products.
Idaho	27	.81	Lead, zinc, silver, gold.
Illinois	5	5.71	Petroleum, coal, stone, cement.
Indiana	19	1.43	Coal, cement, petroleum, stone.
Iowa	29	.51	Cement, coal, stone, clay products.
Kansas	9	3.06	Petroleum, natural gas, zinc, coal.
Kentucky	10	3.01	Coal, natural gas, petroleum, stone.
Louisiana	7	4.07	Petroleum, natural gas, sulfur, natural gasoline.
Maine	45	.08	Stone, cement, sand and gravel, slate.
Maryland	37	.31	Sand and gravel, coal, cement, stone.
Massachusetts	40	.17	Stone, sand and gravel, clay products, lime.
Michigan	12	2.54	Iron ore, petroleum, cement, salt.
Minnesota	8	3.18	Iron ore, manganiferous ore, sand and gravel, stone.
Mississippi	36	.32	Petroleum, sand and gravel, natural gas, clay products.
Missouri	22	1.10	Lead, cement, stone, coal.
Montana	17	1.54	Copper, zinc, silver, gold.
Nebraska	43	.12	Cement, petroleum, sand and gravel, stone.
Nevada	26	.83	Copper, gold, silver, tungsten ore.
New Hampshire	47	.02	Clay products, stone, sand and gravel, feldspar.
New Jersey	28	.70	Zinc, clay products, sand and gravel, stone.
New Mexico	15	1.74	Petroleum, copper, potassium salts, natural gas.
New York	16	1.63	Cement, petroleum, stone, sand and gravel.
North Carolina	35	.34	Clay products, stone, bromine, sand and gravel.
North Dakota	46	.06	Coal, sand and gravel, clay products, stone.
Ohio	11	2.94	Coal, clay products, natural gas, lime.
Oklahoma	6	4.70	Petroleum, natural gas, zinc, natural gasoline.
Oregon	39	.23	Gold, stone, cement, sand and gravel.
Pennsylvania	2	13.13	Coal, cement, natural gas, petroleum.
Rhode Island	48	.02	Stone, sand and gravel, clay products, lime.
South Carolina	42	.13	Stone, clay products, raw clay, sand and gravel.
South Dakota	32	.44	Gold, stone, cement, sand and gravel.
Tennessee	23	1.00	Coal, stone, cement, zinc.
Texas	1	15.46	Petroleum, natural gas, sulfur, natural gasoline.
Utah	13	2.18	Copper, gold, coal, silver.
Vermont	41	.14	Stone, slate, talc, asbestos.
Virginia	21	1.27	Coal, stone, sand and gravel, cement.
Washington	30	.51	Coal, cement, gold, sand and gravel.
West Virginia	4	7.58	Coal, natural gas, petroleum, stone.
Wisconsin	38	.30	Stone, iron ore, sand and gravel, cement.
Wyoming	24	.94	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, 1932–42 [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
1941	35.00	[8] .711+	.118	.057	.075
1942	35.00	[8] .711+	.121	.067	.093

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

[2] 1932: Legal coinage value; 1933–34: Yearly average weighted Government price; 1935–42: Price under authority of Gold Reserve Act of January 31, 1934.

[3] 1932–33: Average New York price for bar silver; 1934 and 1938–42: 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, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Aluminum short tons			[1] [2]	[1] [2]
Asphalt (native) do	[1]	[1]	[1]	[1]
Bauxite do	[1]	[1]	[1]	[1]
Cement barrels	[3] 5,249,759	[3] $7,617,405	[3] 7,610,030	[3] $11,142,649
Clay:				
Products (other than pottery and refractories)		[4] 2,394,000		[4] 2,647,000
Raw (sold by producers) short tons	144,354	143,363	179,023	186,476
Coal do	[5] 15,324,163	[5] 35,777,923	[5] 15,464,523	[5] 41,985,942
Coke do	4,727,378	[2] 13,748,837	4,855,062	[2] 18,628,534
Ferro-alloys do	45,184	[2] 3,422,111	[1] [2]	[1] [2]
Gold troy ounces	5	175	30	1,050
Graphite, crystalline pounds			[1]	[1]
Iron:				
Ore short tons	8,210,061	12,606,369	8,818,015	18,090,992
Pig do	3,476,072	[2] 49,706,851	3,712,018	[2] 64,037,109
Lime do	234,147	1,359,371	306,836	1,705,558
Manganese ore do	272	[1]	[1]	[1]
Manganiferous ore do	383	[1]		
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	900	[7]	1,020	[7]
Sand and gravel do	1,840,945	936,724	2,428,995	1,556,457
Silver troy ounces	3	2	3	2
Stone short tons	2,496,480	3,048,043	2,804,740	3,745,651
Tin (metallic equivalent) do			[1]	[1]
Miscellaneous [8]		1,114,643		8,468,526
Total value, eliminating duplications		64,998,018		82,730,210

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[4] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "[1]" and "[3]" above.

Mineral production of Alaska, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates) short tons	[1]	[1]	[1]	[1]
Arsenic do	[2]	[2]	[2]	[2]
Coal do	[3] 173,970	[3] $695,000	[4] 238,960	[4] $944,588
Copper pounds	110,000	12,430	144,000	16,992
Gold troy ounces	755,970	26,458,950	695,467	24,341,345
Lead short tons	779	77,900	662	75,468
Mercury flasks (76 pounds)	162	28,653	[1]	[1]
Ores (crude), etc.:				
Copper short tons			144	[5]
Dry and siliceous (gold and silver) do	4,885,023	[5]	4,480,364	[5]
Platinum metals (crude) troy ounces	32,300	1,093,000	[1]	[1]
Sand and gravel short tons	515,011	103,217	[6] 530,997	[6] 87,116
Silver troy ounces	191,679	136,305	191,522	136,193
Stone short tons	[1]	[1]		
Tin (metallic equivalent) do	52	52,000	[1]	[1]
Miscellaneous [7]		66,766		1,207,678
Total value, eliminating duplications		28,724,221		26,809,380

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

Mineral production of Arizona, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)—short tons	(1)	(1)	(2)	(2)
Arsenious oxide—do	(3)	(3)	(3)	(3)
Asbestos—do	1,197	$149,290	(1)	(1)
Bismuth—pounds	(3)	(3)	(3)	(3)
Clay:				
Products (other than pottery and refractories)		[4] 306,000		[4] $284,000
Raw (sold by producers)—short tons	(1)	(1)	(1)	(1)
Coal—do	[1 5]	[1 5]	[1 5]	[1 5]
Copper—pounds	562,338,000	63,544,194	652,634,000	77,010,812
Feldspar (crude)—long tons	(1)	(1)	(1)	(1)
Fluorspar—short tons	(1)	(1)	(1)	(1)
Gems and precious stones		[6]		[6]
Gold—troy ounces	294,807	10,318,245	315,392	11,038,720
Lead—short tons	13,266	1,326,600	15,638	1,782,732
Lime—do	67,882	502,998	58,146	413,095
Manganese ore—do	413	4,940	(1)	(1)
Manganiferous ore—do			(1)	(1)
Mercury—flasks (76 pounds)	740	130,884	(1)	(1)
Mica, scrap—short tons	(1)	(1)	(1)	(1)
Molybdenum—pounds	406,306	(1)	(1)	(1)
Ores (crude), etc.:				
Copper—short tons	20,284,826	(7)	24,153,483	(7)
Dry and siliceous (gold and silver)—do	928,448	(7)	975,790	(7)
Lead—do	8,813	(7)	18,432	(7)
Lead-copper—do	44	(7)	663	(7)
Zinc—do			2,143	(7)
Zinc-copper—do	79,044	(7)	80,810	(7)
Zinc-lead—do	271,000	(7)	260,473	(7)
Sand and gravel—do	245,602	114,500	702,889	335,474
Sand-lime brick—thousands of brick	[1 8]	[1 8]	[8]	[8]
Silica (quartz)—short tons	(1)	(1)	(1)	(1)
Silver—troy ounces	7,075,215	5,031,264	7,498,260	5,332,096
Stone—short tons	1,149,000	1,043,101	455,900	340,872
Sulfuric acid [9]—do	[1 10]	[1 10]	[1 10]	[1 10]
Tungsten ore (60-percent concentrates)—do	349	471,546	(1)	(1)
Vanadium—pounds	(1)	(1)	(1)	(1)
Zinc—short tons	15,456	1,947,456	16,493	2,473,950
Miscellaneous [11]		812,684		2,079,919
Total value, eliminating duplications		85,291,347		100,472,791

[1] Value included under "Miscellaneous."
[2] Less than 1 ton; value not recorded.
[3] Figures not available.
[4] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[9] From copper smelting.
[10] Value not included in total value for State.
[11] Includes minerals indicated by "1" above.

Mineral production of Arkansas, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Barite—short tons	(1)	(1)	(1)	(1)
Bauxite—do	474,077	$2,501,393	(1)	(1)
Cement—barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 792,780		[2] $1,110,000
Raw (sold by producers)—short tons	24,997	13,845	15,249	14,487
Coal—do	[3] 1,453,611	[3] 4,879,286	[3] 1,574,172	[3] 5,882,934
Gems and precious stones		[4]		[4]
Gypsum (crude)—short tons			(1)	(1)
Lead—do	55	5,500	11	1,254
Lime—do	(1)	(1)	(1)	(1)
Manganese ore—do	6,808	(1)	(1)	(1)
Manganiferous ore—do	1,204	(1)	(1)	(1)
Mercury—flasks (76 pounds)	1,159	204,992	(1)	(1)
Mineral waters—gallons sold	(4)	(4)	(4)	(4)

See footnotes at end of table.

Mineral production of Arkansas, 1940–41—Continued

Product	1940		1941	
	Quantity	Value	Quantity	Value
Natural gas M cubic feet	14,379,000	$2,622,000	19,148,000	$2,988,000
Natural gasoline and allied products:				
Natural gasoline gallons	32,096,000	818,000	28,108,000	1,173,000
Liquefied petroleum gases do	(5)	(5)	6,281,000	57,000
Oilstones and whetstones short tons	(1)	(1)	(1)	(1)
Ores (crude), etc.:				
Lead do	(5)	(6)	100	(6)
Zinc do	(5)	(6)	1,800	(6)
Zinc-lead do	(5)	(6)	1,100	(6)
Petroleum barrels	25,775,000	21,700,000	26,327,000	24,500,000
Sand and gravel short tons	2,664,178	1,068,701	3,587,906	1,798,307
Slate		(1)		(1)
Stone short tons	1,222,690	1,152,328	[7] 1,788,470	[7] 1,763,196
Titanium concentrates: Rutile do	(1)	(1)	(1)	(1)
Tripoli do	(1)	(1)	(1)	(1)
Zinc do	440	55,440	206	30,900
Miscellaneous [8]		1,664,870		7,762,248
Total value, eliminating duplications		37,479,135		47,081,326

[1] Value included under "Miscellaneous."
[2] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] No canvass.
[5] Figures not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of crushed marble, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of California, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Andalusite short tons			(1)	(1)
Antimony ore (concentrates) do	74	$3,700	(1)	(1)
Arsenious oxide do	(2)	(2)	(2)	(2)
Asbestos do			(1)	(1)
Asphalt (native) do	(1)	(1)	(1)	(1)
Barite do	(1)	(1)	(1)	(1)
Boron minerals do	243,355	5,643,390	301,282	$6,785,662
Bromine pounds	(1)	(1)	(1)	(1)
Calcium chloride short tons	(1)	(1)	(1)	(1)
Cement barrels	13,813,362	17,296,522	20,186,028	28,019,494
Chromite short tons	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[3] 8,417,000		[3] 8,649,000
Raw (sold by producers) short tons	343,526	926,633	530,140	1,422,511
Copper pounds	12,876,000	1,454,988	7,886,000	930,548
Diatomite short tons	(1)	(1)	(1)	(1)
Feldspar (crude) long tons	2,711	18,254	4,464	22,490
Fuller's earth short tons			(1)	(1)
Gems and precious stones		(4)		(4)
Gold troy ounces	1,455,671	50,948,485	1,408,793	49,307,755
Gypsum (crude) short tons	259,321	437,504	381,951	618,685
Iodine pounds	(1)	(1)	(1)	(1)
Iron ore short tons	1,200	(1)	59,955	(1)
Kyanite do	(1)	(1)	(1)	(1)
Lead do	1,772	177,200	3,464	394,896
Lime do	112,522	1,031,352	122,375	1,168,767
Lithium minerals do	(1)	(1)	(1)	(1)
Magnesite do	(1)	(1)	(1)	(1)
Magnesium pounds			(1)	(1)
Magnesium salts (natural) do	(1)	(1)	12,810,000	656,297
Manganese ore short tons	177	(1)	(1)	(1)
Manganiferous ore do	97	(1)	(1)	(1)
Mercury flasks (76 pounds)	18,629	3,294,911	(1)	(1)
Mica, scrap short tons	(1)	(1)	(1)	(1)
Mineral paints (zinc and lead pigments) do	[1 5]	[1 5]	[1 5]	[1 5]
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Molybdenum pounds	(1)	(1)	(1)	(1)
Natural gas M cubic feet	351,950,000	90,006,000	374,905,000	96,673,000

See footnotes at end of table.

Mineral production of California, 1940–41—Continued

Product		1940		1941	
		Quantity	Value	Quantity	Value
Natural gasoline and allied products:					
Natural gasoline	gallons	587,476,000	$27,901,000	577,127,000	$24,067,000
Liquefied petroleum gases	do	(2)	(2)	82,638,000	2,082,000
Ores (crude), etc.:					
Copper	short tons	446,392	(6)	292,232	(6)
Dry and siliceous (gold and silver)	do	4,214,650	(6)	3,968,283	(6)
Lead	do	8,199	(6)	18,338	(6)
Lead-copper	do	11	(6)	2	(6)
Zinc	do			1,330	(6)
Zinc-lead	do	181	(6)		
Peat	do	4,116	21,110	3,618	17,898
Pebbles for grinding	do	(1)	(1)	574	2,856
Petroleum	barrels	223,881,000	216,720,000	230,263,000	239,500,000
Platinum metals (crude)	troy ounces	1,400	(1)	(1)	(1)
Potassium salts	short tons	(1)	(1)	(1)	(1)
Pumice	do	32,123	152,885	77,951	268,734
Pyrites	long tons	(1)	(1)	(1)	(1)
Salt (sodium chloride)	short tons	469,354	2,200,640	484,632	2,290,265
Sand and gravel	do	18,913,301	8,988,894	[7] 19,617,609	[7] 10,988,766
Sand and sandstone (ground)	do	5,505	39,080	(1)	(1)
Silica (quartz)	do	(1)	(1)	2,526	36,721
Silver	troy ounces	2,359,776	1,678,063	2,154,188	1,531,867
Slate			(1)		53,765
Sodium salts (carbonates and sulfates) (natural)	short tons	233,590	2,183,110	218,903	2,224,084
Stone	do	6,340,080	5,048,242	[8] 9,139,390	[8] 7,535,017
Strontium minerals	do	287	4,282	(1)	(1)
Sulfur	long tons	(1)	(1)	8,803	139,800
Sulfuric acid [9]	short tons	(1 5)	(1 5)	(1 5)	(1 5)
Talc and ground soapstone	do	36,282	476,926	59,203	811,793
Tripoli	do	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates)	do	2,070	2,561,042	(1)	(1)
Zinc	do	79	9,954	440	66,000
Zircon	do			30	545
Miscellaneous [10]			8,155,536		20,707,659
Total value, eliminating duplications			455,672,038		506,795,395

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by 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] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[8] Exclusive of dimension unclassified stone, value for which is included under "Miscellaneous."
[9] From roasting of high-sulfide gold and silver concentrates.
[10] Includes minerals indicated by "1," "7," and "8" above.

Mineral production of Colorado, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Arsenious oxide	short tons	(1)	(1)	(1)	(1)
Barite	do	(2)	(2)	(2)	(2)
Beryllium concentrates	do	(2)	(2)		
Bismuth	pounds	(1)	(1)	(1)	(1)
Cement	barrels	(2)	(2)	(2)	(2)
Clay:					
Products (other than pottery and refractories)			[3] $1,391,000		[3] $1,864,000
Raw (sold by producers)	short tons	115,670	156,588	164,444	226,644
Coal	do	[4] 6,588,742	[4] 16,644,265	[4] 6,948,532	[4] 19,654,459
Coke	do	605,965	(2 5)	703,003	(2 5)
Copper	pounds	24,304,000	2,746,352	13,496,000	1,592,528
Feldspar (crude)	long tons	34,105	123,514	42,326	147,640
Ferro-alloys	short tons	(2 5)	(2 5)	(2 5)	(2 5)
Fluorspar	do	11,032	163,285	15,566	225,069
Fuller's earth	do	(2)	(2)		
Gems and precious stones			(6)		(6)
Gold	troy ounces	367,336	12,856,760	380,029	13,301,015
Gypsum (crude)	short tons	24,641	36,787	(2)	(2)
Iron, pig	do	(2 5)	(2 5)	(2 5)	(2 5)
Lead	do	11,476	1,147,600	12,574	1,433,436

See footnotes at end of table.

Mineral production of Colorado, 1940–41—Continued

Product	1940		1941	
	Quantity	Value	Quantity	Value
Lime—short tons	7,944	$82,486	(2)	(2)
Manganese ore—do	251	(2)	(2)	(2)
Manganiferous ore—do	3,699	(2)		
Mica:				
Scrap—do	(2)	(2)	(2)	(2)
Sheet—pounds			(2)	(2)
Mineral waters—gallons sold	(6)	(6)	(6)	(6)
Molybdenum—pounds	18,600,897	(2)	(2)	(2)
Natural gas—M cubic feet	2,533,000	573,000	3,256,000	$714,000
Natural gasoline—gallons	380,000	14,000	390,000	18,000
Nickel—short tons			(2)	(2)
Ores (crude), etc.:				
Copper—do	334,312	(7)	207,678	(7)
Dry and siliceous (gold and silver)—do	1,528,737	(7)	1,572.763	(7)
Lead—do	10,199	(7)	7,917	(7)
Lead-copper—do	1,037	(7)	4	(7)
Zinc—do	27	(7)	224	(7)
Zinc-lead—do	283,453	(7)	434,200	(7)
Peat—do	(2)	(2)	(2)	(2)
Petroleum—barrels	1,626,000	1,480,000	2,150,000	2,300,000
Pumice—short tons	(2)	(2)		
Pyrites—long tons	14,473	34,697	11,774	(2)
Salt—short tons	(2)	(2)	(2)	(2)
Sand and gravel—do	1,853,359	508,403	8 809,270	8 528,116
Silver—troy ounces	9,710,709	6,905,393	7,301,697	5.192,318
Stone—short tons	1,089,650	1,067,788	1,104,820	1,073,400
Sulfur ore—long tons	89	1,000	49	550
Tungsten ore (60-percent concentrates)—short tons	693	822,988	(2)	(2)
Vanadium—pounds	1,897,194	(2)	(2)	(2)
Vermiculite—short tons	(2)	(2)		
Zinc—do	5,060	637,560	15,722	2,358,300
Miscellaneous 9		25,105,109		36,897,076
Total value, eliminating duplications		63,188,421		73,960,602

1 Figures not available.
2 Value included under "Miscellaneous."
3 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
4 According to Bituminous Coal Division; value includes selling expenses.
5 Value not included in total value for State.
6 No canvass.
7 Not valued as ore; value of recoverable metal content included under the metals.
8 "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
9 Includes minerals indicated by "2" and "3" above.

Mineral production of Connecticut, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		1 $1,007,612		1 $1,521,000
Raw (sold by producers)—short tons	(2)	(2)	(2)	(2)
Coke—do	(2 3)	(2 3)	(2 3)	(2 3)
Feldspar (crude)—long tons	24,404	128,348	13,693	92,397
Iron ore—short tons			31	(2)
Lime—do	(2)	(2)	(2)	(2)
Mica:				
Scrap—do	300	4,900	(2)	(2)
Sheet—pounds	285,690	40,316	(2)	(2)
Mineral waters—gallons sold	(4)	(4)	(4)	(4)
Peat—short tons	(5)	(2)	(2)	(2)
Sand and gravel—do	1,646,870	736,317	2,076,977	941,902
Stone—do	1,915,990	1,918,132	5 2.244,900	6 2,435,841
Miscellaneous 6		3,342,258		3.855,978
Total value, eliminating duplications		3,914,177		5.284,955

1 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
2 Value included under "Miscellaneous."
3 Value not included in total value for State.
4 No canvass.
5 Exclusive of crushed granite, value for which is included under "Miscellaneous."
6 Includes minerals indicated by "2" and "3" above.

Mineral production of Delaware, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $200,000		[1] $225,000
Raw (sold by producers)—short tons	[2]	[2]	[2]	[2]
Sand and gravel—do	[3] 167,138	[3] 91,913	168,359	102,854
Stone—do	114,690	152,313	109,850	147,212
Miscellaneous		13,100		17,565
Total value, eliminating duplications		457,326		492,631

[1] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."

Mineral production of the District of Columbia, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		([1] [2])		([1] [2])
Stone—short tons	([1])	([1])		
Miscellaneous		$640,480		$700,000
Total value, eliminating duplications		640,480		700,000

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.

Mineral production of Florida, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement—barrels	([1])	([1])	([1])	([1])
Clay:				
Products (other than pottery and refractories)		[2] $153,000		[2] $224,000
Raw (sold by producers)—short tons	([1])	([1])	([1])	([1])
Diatomite—do	([1])	([1])	([1])	([1])
Ferro-alloys—do	([1] [3])	([1] [3])	([1] [3])	([1] [3])
Fuller's earth—do	([1])	([1])	([1])	([1])
Lime—do	25,038	227,440	23,265	216,254
Mineral waters—gallons sold	([4])	([4])	([4])	([4])
Peat—short tons	([1])	([1])	([1])	([1])
Phosphate rock—long tons	2,845,012	7,741,177	3,365,572	10,234,031
Sand and gravel—short tons	1,162,075	800,085	1,462,276	949,980
Stone—do	[5] 2,880,540	[5] 2,750,017	[5] 4,065,450	[5] 3,852,539
Titanium concentrates:				
Ilmenite—do	([1])	([1])	([1])	([1])
Rutile—do	([1])	([1])	([1])	([1])
Zircon—do			144	4,608
Miscellaneous [6]		3,190,127		3,790,719
Total value, eliminating duplications		14,854,206		19,268,779

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of dimension unclassified stone in 1940 and of unclassified stone in 1941, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "[1]" and "[3]" above.

Mineral production of Georgia, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Asbestos	short tons	[1]	[1]	[1]	[1]
Barite	do	92,302	$464,590	104,446	$553,445
Bauxite	do	[1]	[1]	[1]	[1]
Cement	barrels	[1]	[1]	[1]	[1]
Clay:					
Products (other than pottery and refractories)			[2] 2,582,000		[2] 2,689,000
Raw (sold by producers)	short tons	595,010	4,859,826	823,013	6,609,605
Coal	do	[3] 42,307	[3] 100,570	[1 3]	[1 3]
Copper	pounds	25,200	2,848		
Fuller's earth	short tons	[1]	[1]	[1]	[1]
Gems and precious stones			[4]		[4]
Gold	troy ounces	961	33,635	311	10,885
Graphite, crystalline	pounds			[1]	[1]
Iron ore—					
Shipped to furnaces, etc	short tons	112,383	182,613	290,021	598,497
Sold for paint	do	1,057	3,144	1,926	4,991
Kyanite	do	[1]	[1]	[1]	[1]
Lime	do	13,774	92,281	12,515	85,325
Manganese ore	do	4,001	68,508	[1]	[1]
Manganiferous ore	do	11,528	63,761	[1]	[1]
Mica:					
Scrap	do	[1]	[1]	[1]	[1]
Sheet	pounds	[1]	[1]	[1]	[1]
Mineral waters	gallons sold	[4]	[4]	[4]	[4]
Ore (dry and siliceous) (gold and silver)	short tons	6,963	[5]	1,641	[5]
Sand and gravel	do	490,136	231,591	615,511	283,148
Silver	troy ounces	630	448	38	27
Slate			[1]		[1]
Stone	short tons	2,507,600	5,034,288	2,808,790	5,809,755
Talc and ground soapstone	do	20,104	219,959	28,511	364,560
Miscellaneous [6]			2,992,273		4,040,023
Total value, eliminating duplications			16,932,335		21,049,261

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Includes minerals indicated by "[1]" above.

Mineral production of Idaho, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Antimony ore (concentrates)	short tons	302	$18,100	[1]	[1]
Arsenious oxide	do	[2]	[2]	[2]	[2]
Bismuth	pounds	[2]	[2]	[2]	[2]
Cement	barrels	[1]	[1]	[1]	[1]
Clay:					
Products (other than pottery and refractories)			[3] 82,000		[3] $122,000
Raw (sold by producers)	short tons	[1]	[1]	[1]	[1]
Coal	do	[1 4]	[1 4]	[1 4]	[1 4]
Copper	pounds	6,698,000	756,874	7,242,000	854,556
Diatomite	short tons	[1]	[1]	[1]	[1]
Garnet, abrasive	do	[1]	[1]	[1]	[1]
Gems and precious stones			[5]		[5]
Gold	troy ounces	146,480	5,126,800	149,816	5,243,560
Lead	short tons	104,834	10,483,400	104,914	11,960,196
Lime	do	[1]	[1]	120	2,160
Manganese ore	do			[1]	[1]
Manganiferous ore	do	351	[1]	[1]	[1]
Mercury	flasks (76 pounds)	[1]	[1]	[1]	[1]
Ores (crude), etc.:					
Copper	short tons	4,931	[6]	7,979	[6]
Dry and siliceous (gold and silver)	do	878,993	[6]	903,510	[6]
Lead	do	164,508	[6]	212,251	[6]
Lead-copper	do	232	[6]	174	[6]
Zinc	do	101	[6]	22,551	[6]
Zinc-lead	do	1,507,922	[6]	1,558,215	[6]
Phosphate rock	long tons	99,088	441,598	97,274	444,154

See footnotes at end of table.

Mineral production of Idaho, 1940–41—Continued

Product		1940		1941	
		Quantity	Value	Quantity	Value
Sand and gravel	short tons	1,943,723	$657,848	2,846,752	$882,867
Silver	troy ounces	17,552,240	12,481,593	16,672,410	11,855,936
Stone	short tons	967,900	809,797	767,750	644,006
Tungsten ore (60-percent concentrates)	do	260	(1)	(1)	(1)
Vanadium	pounds			(1)	(1)
Zinc	short tons	70,601	8,895,726	79,084	11,862,600
Miscellaneous [7]			1,046,184		1,801,705
Total value, eliminating duplications			40,799,920		45,673,740

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

Mineral production of Illinois, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Cement	barrels	[1] 4,937,127	[1] $7,209,431	[1] 5,958,376	[1] $8,660,104
Clay:					
Products (other than pottery and refractories)			[2] 7,052,000		[2] 7,977,000
Raw (sold by producers)	short tons	169,938	419,740	276,016	528,136
Coal	do	[3] 50,610,430	[3] 85,584,043	[3] 54,703,284	[3] 98,990,565
Coke	do	3,014,840	[4] 18,217,939	3,660,878	[4] 25,214,769
Ferro-alloys	do	([4 5])	([4 5])	([4 5])	([4 5])
Fluorspar	do	104,698	2,313,747	133,333	3,047,247
Fuller's earth	do	([5])	([5])	26,676	209,577
Iron, pig	do	4,093,623	[4] 73,882,065	5,461,459	[4] 113,558,606
Lead	do	1,508	150,800	2,376	270,864
Lime	do	161,358	1,150,113	246,574	1,702,129
Mineral paints (zinc and lead pigments)	do	([4 5])	([4 5])	([4 5])	([4 5])
Mineral waters	gallons sold	([6])	([6])	([6])	([6])
Natural gas	M cubic feet	8,359,000	1,557,000	10,053,000	1,668,000
Natural gasoline and allied products:					
Natural gasoline	gallons	21,499,000	805,000	54,872,000	2,693,000
Liquefied petroleum gases	do	([7])	([7])	38,293,000	1,054,000
Ores (crude), etc.:					
Lead	short tons	50	([8])		
Zinc	do	60	([8])	25	([8])
Zinc-lead	do	41,830	([8])	72,573	([8])
Peat	do			([8])	([8])
Petroleum	barrels	147,647,000	156,500,000	132,393,000	172,100,000
Pyrites	long tons	13,021	21,876	12,026	([8])
Sand and gravel	short tons	[9] 10,103,214	[9] 5,578,309	13,888,985	8,271,170
Sand and sandstone (ground)	do	106,397	628,488	131,581	808,402
Silver	troy ounces	4,766	3,389	20,340	14,464
Stone	short tons	[10] 9,209,170	[10] 7,556,497	[10] 11,856,340	[10] 10,706,996
Sulfuric acid (60° Baumé) [11]	do	188,355	[4] 1,721,565	213,749	[4] 1,814,729
Tripoli	do	11,521	155,576	13,833	200,700
Zinc	do	4,818	607,068	9,198	1,379,700
Miscellaneous [12]			3,410,794		5,986,696
Total value, eliminating duplications			277,943,011		320,509,559

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value not included in total value for State.
[5] Value included under "Miscellaneous."
[6] No canvass.
[7] Figures not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[10] Exclusive of unclassified stone in 1940 and of sandstone in 1941, value for which is included under "Miscellaneous."
[11] From zinc smelting.
[12] Includes minerals indicated by "1," "5," "9," and "10" above.

Mineral production of Indiana, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement—barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $4,265,000		[2] $5,967,000
Raw (sold by producers)—short tons	89,230	92,712	217,913	176,367
Coal—do	[3] 18,868,572	[3] 28,810,864	[3] 22,483,929	[3] 38,150,201
Coke—do	6,412,716	[4] 37,308,469	7,406,724	[4] 48,432,824
Ferro-alloys—do			(1 4)	(1 4)
Gold—troy ounces	5	175		
Iron, pig—short tons	5,333,915	[4] 97,407,801	6,393,223	[4] 135,655,190
Lime—do	84,462	457,629	106,407	588,879
Marl, calcareous—do			30,223	17,815
Mineral paints (zinc and lead pigments)—do	(1 4)	(1 4)	(1 4)	(1 4)
Mineral waters—gallons sold	(5)	(5)	(5)	(5)
Natural gas—M cubic feet	1,137,000	661,000	1,522,000	906,000
Petroleum—barrels	4,978,000	5,200,000	7,411,000	9,400,000
Pyrites—long tons	2,734	4,887	(1)	(1)
Rubbing stones and scythestones—short tons	(1)	(1)	(1)	(1)
Sand and gravel—do	6,265,163	3,306,165	8,897,976	4,560,652
Sand-lime brick—thousands of brick	(1 6)	(1 6)	(6)	(6)
Stone—short tons	[7] 4,498,490	[7] 5,822,006	5,257,530	6,742,744
Miscellaneous [8]		12,636,594		17,083,691
Total value, eliminating duplications		58,975,110		80,572,397

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value not included in total value for State.
[5] No canvass.
[6] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[7] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Iowa, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement—barrels	4,597,781	$7,641,163	5,328,398	$8,659,014
Clay:				
Products (other than pottery and refractories)		[1] 3,649,000		[1] 3,895,000
Raw (sold by producers)—short tons	10,005	51,267	10,022	50,700
Coal—do	[2] 3,231,177	[2] 8,060,587	[2] 2,938,626	[2] 8,058,700
Ferro-alloys—do	(3 4)	(3 4)	(3 4)	(3 4)
Gypsum (crude)—do	487,379	587,223	630,930	736,185
Iron, pig—do	(3 4)	(3 4)	(3 4)	(3 4)
Mineral waters—gallons sold	(5)	(5)	(5)	(5)
Peat—short tons	2,500	30,000	(3)	(3)
Sand and gravel—do	[6] 3,464,803	[6] 1,852,285	6,271,702	1,728,741
Stone—do	4,013,740	3,832,070	5,790,920	5,657,585
Miscellaneous [7]		2,880,942		4,421,573
Total value, eliminating duplications		26,006,904		28,872,177

[1] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[2] According to Bituminous Coal Division; value includes selling expenses.
[3] Value included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[7] Includes minerals indicated by "3" and "4" above.

Mineral production of Kansas, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Cement	barrels	[1] 3,441,612	[1] $5,192,160	[1] 4,734,129	[1] $7,136,933
Chats	short tons	163,180	25,747	360,951	55,447
Clay:					
Products (other than pottery and refractories)			[2] 1,035,000		[2] 1,121,000
Raw (sold by producers)	short tons	([3])	([3])	([3])	([3])
Coal	do	[4] 3,578,952	[4] 6,717,318	[4] 4,007,572	[4] 7,950,431
Gypsum (crude)	do	([3])	([3])	([3])	([3])
Lead	do	11,927	1,192,700	14,538	1,657,332
Mineral paints (zinc and lead pigments)	do	([3 5])	([3 5])	([3 5])	([3 5])
Mineral waters	gallons sold	([6])	([6])	([6])	([6])
Natural gas	M cubic feet	90,003,000	31,931,000	111,121,000	36,552,000
Natural gasoline and allied products:					
Natural gasoline	gallons	64,691,000	1,295,000	72,876,000	2,631,000
Liquefied petroleum gases	do	([7])	([7])	12,815,000	410,000
Ores (crude), etc.:					
Lead	short tons	2,000	([8])		
Zinc	do	1,137,704	([8])	1,344,123	([8])
Zinc-lead	do	2,014,096	([8])	2,352,124	([8])
Petroleum	barrels	66,139,000	68,700,000	83,242,000	95,700,000
Pumice	short tons	39,215	129,959	23,659	111,835
Pyrites	long tons			3,902	([3])
Salt	short tons	684,053	2,710,847	781,014	3,254,828
Sand and gravel	do	2,264,871	893,962	2,927,921	1,288,920
Stone	do	2,880,930	3,672,644	2,727,290	3,171,598
Zinc	do	57,032	7,186,032	71,403	10,710,450
Miscellaneous[9]			2,760,184		3,852,673
Total value, eliminating duplications			130,859,896		171,991,685

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete: 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] Value included under "Miscellaneous."
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Figures not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "[1]" and "[3]" above.

Mineral production of Kentucky, 1940–41

Product		1940		1941	
		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] $1,258,000		[2] $1,690,000
Raw (sold by producers)	short tons	345,023	1,328,644	503,427	1,978,222
Coal	do	[3] 49,140,904	[3] 91,153,768	[3] 53,710,346	[3] 116,561,332
Coke	do	([1 4])	([1 4])	([1 4])	([1 4])
Fluorspar	do	103,939	2,043,866	142,862	2,957,982
Iron, pig	do	290,610	([1 4])	329,125	([1 4])
Lead	do	360	36,000	282	32,148
Lime	do	([1])	([1])		
Mineral waters	gallons sold	([5])	([5])	([5])	([5])
Natural gas	M cubic feet	53,056,000	22,936,000	69,067,000	28,769,000
Natural gasoline and allied products:					
Natural gasoline	gallons	9,539,000	350,000	10,247,000	475,000
Liquefied petroleum gases	do	([6])	([6])	25,124,000	1,055,000
Ores (crude), etc.:					
Zinc	short tons	([6])	([7])	1,455	([7])
Zinc-lead	do	([6])	([7])	14,885	([7])
Petroleum	barrels	5,188,000	5,400,000	4,762,000	6,200,000

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Divison; value includes selling expenses.
[4] Value not included in total value for State.
[5] No canvass.
[6] Figures not available.
[7] Not valued as ore; value of recoverable metal content included under the metals.

Mineral production of Kentucky, 1940–41—Continued

Product	1940		1941	
	Quantity	Value	Quantity	Value
Sand and gravel.....short tons	1,226,325	$815,688	[8] 1,654,183	[8] $1,124,705
Stone.....do	4,620,750	4,207,875	[9] 5,779,800	[9] 5,177,170
Zinc.....do	1,278	161,028	427	64,050
Miscellaneous [10]		10,740,370		14,669,799
Total value, eliminating duplications		131,974,410		169,009,195

[8] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "[1]," "[8]," and "[9]" above.

Mineral production of Louisiana, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement.....barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $540,000		[2] $874,000
Raw (sold by producers).....short tons	10,189	96,314	12,159	100,339
Lime.....do			(1)	(1)
Mineral waters.....gallons sold	(3)	(3)	(3)	(3)
Natural gas.....M cubic feet	343,191,000	63,577,000	403,855,000	71,089,000
Natural gasoline and allied products:				
Natural gasoline and cycle products.....gallons	113,741,000	2,552,000	201,049,000	6,376,000
Liquefied petroleum gases.....do	[4]	[4]	24,675,000	388,000
Petroleum.....barrels	103,584,000	107,500,000	115,908,000	132,100,000
Salt.....short tons	1,132,594	2,804,406	1,242,242	3,251,492
Sand and gravel.....do	2,580,478	1,381,044	3,700,140	2,386,097
Stone.....do	(1)	(1)	(1)	(1)
Sulfur.....long tons	543,004	8,688,064	549,619	8,793,904
Miscellaneous [5]		2,014,484		3,081,212
Total value, eliminating duplications		189,153,312		228,440,044

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] No canvass.
[4] Figures not available.
[5] Includes minerals indicated by "[1]" above.

Mineral production of Maine, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Beryllium concentrates.....short tons	(1)	(1)	(1)	(1)
Cement.....barrels	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories)		[2] $275,000		[2] $417,000
Feldspar (crude).....long tons	18,390	84,796	22,566	116,610
Gems and precious stones		(3)		(3)
Lime.....short tons	(1)	(1)	(1)	(1)
Mica:				
Scrap.....do	(1)	(1)	(1)	(1)
Sheet.....pounds	(1)	(1)	(1)	(1)
Mineral waters.....gallons sold	(3)	(3)	(3)	(3)
Peat.....short tons	8,173	118,897	8,527	178,058
Sand and gravel.....do	3,836,131	878,820	3,891,656	935,902
Silica (quartz).....do	160	538	202	722
Slate		286,660		442,212
Stone.....short tons	[4] 245,580	[4] 1,876,198	324,060	1,295,180
Miscellaneous [5]		854,067		1,306,764
Total value, eliminating duplications		4,374,976		4,692,448

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by 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, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Asbestos short tons	[1]	[1]		
Cement barrels	[1]	[1]	[1]	[1]
Clay:				
Products (other than pottery and refractories)		[2] $1,856,000		[2] $2,042,000
Raw (sold by producers) short tons	49,036	114,531	57,489	149,744
Coal do	[3] 1,503,433	[3] 3,171,243	[3] 1,700,574	[3] 4,088,426
Coke do	1,682,701	[1 4]	1,752,538	[1 4]
Feldspar (crude) long tons	[1]	[1]	[1]	[1]
Iron, pig short tons	2,350,773	[1 4]	2,372,932	[1 4]
Lime do	63,745	355,771	65,624	431,200
Mineral waters gallons sold	[5]	[5]	[5]	[5]
Potassium salts short tons	[1]	[1]	[1]	[1]
Sand and gravel do	3,426,525	2,763,322	5,167,445	4,446,850
Silica (quartz) do	[1]	[1]	[1]	[1]
Slate		[1]		[1]
Stone short tons	1,109,960	1,395,373	1,604,430	2,218,478
Talc and ground soapstone do	[1]	[1]	15,628	105,363
Miscellaneous [6]		46,596,893		60,911,136
Total value, eliminating duplications		12,605,171		17,291,523

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by "1" above.

Mineral production of Massachusetts, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $976,895		[1] $1,022,000
Raw (sold by producers) short tons	[2]	[2]	[2]	[2]
Coke do	1,130,311	[2 3]	1,161,732	[2 3]
Feldspar (crude) long tons			[2]	[2]
Iron, pig short tons	[2 3]	[2 3]	[2 3]	[2 3]
Lime do	108,797	965,333	106,336	1,007,773
Manganiferous ore do	2,128	[2]	[2]	[2]
Mineral waters gallons sold	[4]	[4]	[4]	[4]
Peat short tons	703	3,495	[2]	[2]
Sand and gravel do	3,563,760	1,681,222	5,351,002	2,674,557
Sand and sandstone (ground) do	1,425	6,240	1,352	6,327
Sand-lime brick thousands of brick	[2 5]	[2 5]	[5]	[5]
Silica (quartz) short tons	786	4,716	850	5,525
Stone do	2,176,340	3,819,708	2,602,120	4,547,808
Miscellaneous [6]		9,436,083		15,178,812
Total value, eliminating duplications		7,573,122		9,293,169

[1] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[6] Includes minerals indicated by "2" above.

Mineral production of Michigan, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Bromine—pounds	14,173,936	$2,878,900	15,899,731	$3,906,486
Calcium chloride—short tons	84,918	900,801	148,918	1,236,783
Cement—barrels	8,519,416	11,389,191	9,819,218	13,333,850
Clay:				
Products (other than pottery and refractories)		[1] 2,377,000		[1] 2,925,000
Raw (sold by producers)—short tons	[2]	[2]	[2]	[2]
Coal—do	[3] 410,169	[3] 1,592,051	[3] 310,775	[3] 1,312,777
Coke—do	2,872,026	[4] 15,445,452	2,863,563	[4] 18,213,048
Copper—pounds	90,396,000	10,214,748	92,880,000	10,959,840
Gems and precious stones		[5]		[5]
Gypsum (crude)—short tons	746,982	1,017,126	805,861	1,090,309
Iron:				
Ore—do	15,402,206	40,474,951	17,025,813	43,765,164
Pig—do	1,340,402	[4] 18,472,588	1,360,139	[4] 21,384,383
Lime—do	41,814	308,926	55,447	388,104
Magnesium—pounds	12,823,633	3,462,380	[2]	[2]
Magnesium salts (natural):				
Carbonate—do	[2]	[2]	1,922,000	181,255
Chloride—do	[2]	[2]	[2]	[2]
Sulfate—do	[2]	[2]	[2]	[2]
Manganiferous ore—short tons	20,851	[2]		
Marl, calcareous—do	[2]	[2]	66,854	35,684
Mineral waters—gallons sold	[5]	[5]	[5]	[5]
Natural gas—M cubic feet	12,648,000	8,339,000	13,916,000	8,722,000
Natural gasoline—gallons	3,919,000	162,000	5,670,000	261,000
Ores (crude), etc.: Copper—short tons	4,438,219	[6]	4,282,448	[6]
Peat—do	5,326	32,750	11,340	75,500
Petroleum—barrels	19,753,000	20,150,000	16,359,000	21,900,000
Salt—short tons	2,863,035	7,479,905	3,620,649	10,975,872
Sand and gravel—do	13,650,528	4,978,006	15,606,215	6,190,336
Sand-lime brick—thousands of brick	[7] 14,564	[7] 170,678	[7]	[7]
Silver—troy ounces	88,657	63,045	60,796	43,233
Stone—short tons	13,527,170	6,891,433	15,161,820	8,349,607
Miscellaneous [8]		1,891,690		6,780,873
Total value, eliminating duplications		124,774,581		142,433,673

[1] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[8] Includes minerals indicated by "2" above.

Mineral production of Minnesota, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement—barrels	[1]	[1]	[1]	[1]
Clay:				
Products (other than pottery and refractories)		[2] $988,116		[2] $1,119,000
Raw (sold by producers)—short tons	[1]	[1]	[1]	[1]
Coke—do	524,360	[3] 3,662,908	685,873	[3] 5,082,787
Ferro-alloys—do			[1 3]	[1 3]
Flint lining for tube mills—do	[1]	[1]	[1]	[1]
Gems and precious stones		[4]		[4]
Iron:				
Ore—short tons	53,652,633	118,947,968	70,419,878	167,781,967
Pig—do	282,728	[1 3]	369,549	[1 3]
Lime—do	[1]	[1]	[1]	[1]
Manganiferous ore—do	1,171,939	2,894,388	[1]	[1]
Marl, calcareous—do	[1]	[1]	21,387	11,664
Mineral waters—gallons sold	[4]	[4]	[4]	[4]
Peat—short tons	1,984	19,980	[1]	[1]
Pebbles for grinding—do	[1]	[1]	[1]	[1]
Sand and gravel—do	8,729,205	1,924,716	13,517,069	2,705,534
Sand-lime brick—thousands of brick	[1 5]	[1 5]	[5]	[5]
Stone—short tons	1,119,230	1,987,822	1,002,190	1,811,805
Miscellaneous [6]		7,083,749		13,944,941
Total value, eliminating duplications		128,571,690		178,790,274

[1] Value included under "Miscellaneous."
[2] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[6] Includes minerals indicated by "1" above.

Mineral production of Mississippi, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $787,000		[1] $915,000
Raw (sold by producers)—short tons	[2]	[2]	92,479	420,322
Iron ore—do	56	38	57	101
Mineral waters—gallons sold	[3]	[3]	[3]	[3]
Natural gas—M cubic feet	6,365,000	1,637,000	4,268,000	1,084,000
Petroleum—barrels	4,400,000	3,750,000	15,327,000	14,000,000
Sand and gravel—short tons	2,319,073	724,777	[4] 2,192,829	[4] 1,018,504
Stone—do	[5] 210	[5] 410	[5] 500	[5] 750
Miscellaneous [6]		340,422		312,049
Total value, eliminating duplications		7,239,647		17,750,726

[1] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[5] Exclusive of limestone in 1940 and of sandstone in 1941, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "2," "4," and "5" above.

Mineral production of Missouri, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Asphalt (native)—short tons	[1]	[1]	[1]	[1]
Barite—do	179,455	$1,216,069	212,718	$1,337,756
Cement—barrels	4,867,799	7,616,247	6,516,345	10,272,509
Chats—short tons	1,470,849	238,266	2,182,372	458,696
Clay:				
Products (other than pottery and refractories)		[2] 2,064,000		[2] 3,032,000
Raw (sold by producers)—short tons	498,150	1,400,932	805,813	1,798,342
Coal—do	[3] 3,096,741	[3] 6,320,770	[3] 3,145,288	[3] 7,013,745
Coke—do	[1 4]	[1 4]	[1 4]	[1 4]
Copper—pounds	1,370,000	154,810	2,800,000	330,400
Iron ore—				
Sold to furnaces, etc—short tons	56,243	123,234	15,019	35,543
Sold for paint—do	3,587	11,177	5,671	23,649
Lead—do	172,052	17,205,200	165,909	18,913,626
Lime—do	607,062	3,184,293	736,200	4,106,468
Manganese ore—do			[1]	[1]
Mineral paints (zinc and lead pigments)—do	[1 4]	[1 4]	[1 4]	[1 4]
Mineral waters—gallons sold	[5]	[5]	[5]	[5]
Natural gas—M cubic feet	310,000	166,000	196,000	100,000
Ores (crude), etc.:				
Lead—short tons	5,837,550	[6]	5,737,322	[6]
Zinc—do	201,055	[6]	158,334	[6]
Zinc-lead—do	418,795	[6]	896,938	[6]
Petroleum—barrels	44,000	34,000	47,000	41,000
Pyrites—long tons	29,325	74,088		
Sand and gravel—short tons	4,057,571	2,311,221	5,401,903	3,220,086
Sand and sandstone (ground)—do	[1]	[1]	[1]	[1]
Sand-lime brick—thousands of brick	[1 7]	[1 7]	[7]	[7]
Silver—troy ounces	260,314	185,112	367,688	261,467
Stone—short tons	6,085,790	6,176,867	6,501,460	7,048,207
Tripoli—do	[1]	[1]	[1]	[1]
Tungsten ore (60-percent concentrates)—do	13	[1]	[1]	[1]
Zinc—do	12,703	1,600,578	21,932	3,289,800
Miscellaneous [8]		1,876,041		2,364,610
Total value, eliminating duplications		50,324,566		61,545,052

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[8] Includes minerals indicated by "1" above.

Mineral production of Montana, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)—short tons	69	$3,000	(1)	(1)
Arsenious oxide—do	(1)	(1)	(1)	(1)
Asbestos—do	(1)	(1)		
Bismuth—pounds	(2)	(2)	(2)	(2)
Cement—barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[3] 155,000		[3] $231,000
Raw (sold by producers)—short tons	(1)	(1)	(1)	(1)
Coal:				
Bituminous—do	[4] 2,818,936	[4] 4,075,528	[4] 3,194,931	[4] 4,725,392
Lignite—do	48,264	86,000	58,793	105,000
Copper—pounds	252,782,000	28,564,366	256,072,000	30,216,496
Gems and precious stones		(5)		(5)
Gold—troy ounces	272,602	9,541,070	246,475	8,626,625
Graphite, crystalline—pounds			(1)	(1)
Gypsum (crude)—short tons	(1)	(1)	(1)	(1)
Lead—do	23,036	2,303,600	21,259	2,423,526
Lime—do	18,797	77,658	(1)	(1)
Manganese ore—do	21,664	(1)	(1)	(1)
Manganiferous ore—do	4,051	(1)	(1)	(1)
Mineral waters—gallons sold	(5)	(5)	(5)	(5)
Natural gas—M cubic feet	26,231,000	7,132,000	28,499,000	7,597,000
Natural gasoline and allied products:				
Natural gasoline—gallons	2,603,000	162,000	2,517,000	177,000
Liquefied petroleum gases—do	(2)	(2)	1,449,000	81,000
Ores (crude), etc.:				
Copper—short tons	3,287,803	(6)	3,791,202	(6)
Dry and siliceous (gold and silver)—do	1,028,523	(6)	940,067	(6)
Lead—do	29,454	(6)	33,029	(6)
Lead-copper—do	71	(6)	4	(6)
Zinc—do	174,181	(6)	182,745	(6)
Zinc-lead—do	579,209	(6)	695,202	(6)
Petroleum—barrels	6,728,000	6,660,000	7,526,000	8,000,000
Phosphate rock—long tons	64,239	184,844	105,108	318,588
Platinum metals (crude)—troy ounces	31	(1)	(1)	(1)
Pyrites—long tons	(1)	(1)	(1)	(1)
Sand and gravel—short tons	4,978,353	1,953,009	4,706,685	1,871,912
Silver—troy ounces	12,361,050	8,790,080	12,386,925	8,808,480
Stone—short tons	829,600	813,286	455,680	336,632
Talc—do			(1)	(1)
Tin (metallic equivalent)—pounds	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates)—short tons	50	(1)	(1)	(1)
Vermiculite—do	(1)	(1)	(1)	(1)
Zinc—do	52,587	6,625,962	60,710	9,106,500
Miscellaneous [7]		2,360,470		3,958,309
Total value, eliminating duplications		79,487,873		86,583,460

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

Mineral production of Nebraska, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement—barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $412,000		[2] $659,000
Raw (sold by producers)—short tons	10,417	5,781	11,969	6,048
Mineral waters—gallons sold	(3)	(3)	(3)	(3)
Petroleum—barrels	276,000	220,000	1,898,000	1,600,000
Pumice—short tons	(1)	(1)	7,512	54,513
Sand and gravel—do	3,051,706	1,072,935	3,176,701	1,273,066
Stone—do	832,890	906,563	[4] 328,690	[4] 660,573
Miscellaneous [5]		2,074,867		2,245,870
Total value, eliminating duplications		4,692,146		6,499,070

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by 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, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Andalusite short tons	[1]	[1]		
Antimony ore (concentrates) do	361	$22,100	[1]	[1]
Barite do	[1]	[1]	[1]	[1]
Bismuth pounds	[2]	[2]	[2]	[2]
Clay:				
Products (other than pottery and refractories)		[1 3]		[1 3]
Raw (sold by producers) short tons	[1]	[1]	[1]	[1]
Cobalt pounds			410	[1]
Copper do	156,908,000	17,730,604	157,822,000	$18,622,996
Diatomite short tons	[1]	[1]	[1]	[1]
Dumortierite do	[1]	[1]	[1]	[1]
Fluorspar do	5,803	[1]	8,967	[1]
Fuller's earth do	[1]	[1]	[1]	[1]
Gems and precious stones		[4]		[4]
Gold troy ounces	383,933	13,437,655	366,403	12,824,105
Graphite, amorphous short tons	[1]	[1]	[1]	[1]
Gypsum (crude) do	250,632	618,050	284,795	754,294
Iron ore do			241	645
Lead do	7,499	749,900	9,623	1,097,022
Lime do	[1]	[1]	[1]	[1]
Magnesite do	[1]	[1]	[1]	[1]
Magnesium oxide (hydrated) (brucite) do	[1]	[1]	[1]	[1]
Manganese ore do	235	[1]	[1]	[1]
Manganiferous ore do	5,167	[1]	[1]	[1]
Marl, calcareous do	[1]	[1]	[1]	[1]
Mercury flasks (76 pounds)	5,924	1,047,778	[1]	[1]
Mineral waters gallons sold	[4]	[4]	[4]	[4]
Ores (crude), etc.:				
Copper short tons	6,158,388	[5]	6,850,444	[5]
Dry and siliceous (gold and silver) do	2,044,000	[5]	1,783,923	[5]
Lead do	7,080	[5]	26,838	[5]
Lead-copper do	9	[5]		
Zinc do	1,968	[5]	1,488	[5]
Zinc-lead do	126,814	[5]	136,942	[5]
Sand and gravel do	1,803,924	543,036	2,170,145	894,721
Silver troy ounces	5,175,928	3,680,660	5,830,238	4,145,947
Stone short tons	171,670	189,143	183,170	226,827
Sulfur ore long tons	41	403	60	503
Talc and pinite short tons	[1]	[1]	13,178	126,433
Tungsten ore (60-percent concentrates) do	1,796	[1]	[1]	[1]
Zinc do	11,833	1,490,958	15,129	2,269,350
Miscellaneous [6]		3,060,242		5,378,167
Total value, eliminating duplications		42,570,529		46,341,010

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Includes minerals indicated by "[1]" above.

Mineral production of New Hampshire, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Beryllium concentrates short tons			[1]	[1]
Clay products (other than pottery and refractories)		[2] $204,228		[2] $389,000
Feldspar (crude) long tons	38,589	149,031	52,219	200,569
Gems and precious stones		[3]		[3]
Mica:				
Scrap short tons	[1]	[1]	[1]	[1]
Sheet pounds	[1]	[1]	[1]	[1]
Mineral waters gallons sold	[3]	[3]	[3]	[3]
Peat short tons	143	2,116	132	1,773
Sand and gravel do	2,132,525	266,338	1,894,074	336,538
Scythestones do	[1]	[1]	[1]	[1]
Silica (quartz) do			[1]	[1]
Stone do	[4] 51,250	[4] 409,616	[4] 167,270	[4] 373,157
Miscellaneous [5]		34,008		81,469
Total value, eliminating duplications		1,065,337		1,382,506

[1] Value included under "Miscellaneous."
[2] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] No canvass.
[4] Exclusive of basalt, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "[1]" and "[4]" above.

Mineral production of New Jersey, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement—barrels	[1]	[1]	[1]	[1]
Clay:				
Products (other than pottery and refractories)		[2] $6,489,000		[2] $7,052,000
Raw (sold by producers)—short tons	95,186	529,914	137,065	744,314
Coke—do	1,016,481	[1 3]	1,031,569	[1 3]
Ferro-alloys—do	[1 3]	[1 3]	[1 3]	[1 3]
Iron ore—do	777,278	3,328,467	746,536	3,437,082
Lime—do	28,854	206,326	[1]	[1]
Manganiferous residuum—do	172,990	[1]	[1]	[1]
Marl, greensand—do	6,697	389,888	11,120	619,664
Mineral paints (zinc and lead pigments)—do			[1 3]	[1 3]
Mineral waters—gallons sold	[4]	[4]	[4]	[4]
Ore (zinc)—short tons	556,031	[5]	585,463	[5]
Peat—do	10,056	51,565	11,697	55,969
Sand and gravel—do	4,918,350	3,846,902	5,964,869	4,897,039
Sand and sandstone (ground)—do	[1]	[1]	[1]	[1]
Sand-lime brick—thousands of brick	[1 6]	[1 6]	[6]	[6]
Silica (quartz)—short tons	[1]	[1]	[1]	[1]
Stone—do	2,705,170	2,888,339	3,206,050	3,782,036
Talc—do	[1]	[1]		
Zinc [7]—do	91,406	13,121,911	93,781	14,855,073
Miscellaneous [8]		9,814,738		11,230,738
Total value, eliminating duplications		33,653,732		39,074,518

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by 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] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[7] Value reported for zinc in New Jersey is estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[8] Includes minerals indicated by "[1]" above.

Mineral production of New Mexico, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Arsenious oxide—short tons	[1]	[1]	[1]	[1]
Bismuth—pounds	[1]	[1]	[1]	[1]
Clay:				
Products (other than pottery and refractories)		[2] $98,000		[2] $185,000
Raw (sold by producers)—short tons	11,378	18,322	13,458	22,934
Coal—do	[3] 1,110,615	[3] 3,304,046	[3] 1,251,120	[3] 3,788,488
Copper—pounds	139,696,000	15,785,648	146,956,000	17,340,808
Diatomite—short tons	[4]	[4]	[4]	[4]
Fluorspar—do	[4]	[4]	[4]	[4]
Fuller's earth—do	[4]	[4]	[4]	[4]
Gems and precious stones		[5]		[5]
Gold—troy ounces	35,943	1,258,005	27,845	974,575
Lead—short tons	3,822	382,200	4,668	532,152
Lime—do	[4]	[4]	[4]	[4]
Manganese ore—do	50	[4]		
Manganiferous ore—do	41,255	[4]	[4]	[4]
Mica:				
Scrap—do	[4]	[4]	[4]	[4]
Sheet—pounds	[4]	[4]	[4]	[4]
Mineral waters—gallons sold	[5]	[5]	[5]	[5]
Molybdenum—pounds	1,897,063	[4]	[4]	[4]
Natural gas—M cubic feet	63,990,000	10,317,000	64,655,000	11,339,000
Natural gasoline and allied products:				
Natural gasoline—gallons	55,713,000	879,000	69,115,000	2,049,000
Liquefied petroleum gases—do	[1]	[1]	11,885,000	228,000
Ores (crude), etc.:				
Copper—short tons	6,606,471	[6]	6,975,682	[6]
Dry and siliceous (gold and silver)—do	127,014	[6]	108,017	[6]
Lead—do	1,901	[6]	2,261	[6]
Zinc—do	123,126	[6]	148,359	[6]
Zinc-lead—do	231,391	[6]	295,907	[6]
Petroleum—barrels	39,129,000	32,500,000	39,569,000	37,200,000
Potassium salts—short tons	[4]	[4]	[7] 433,677	14,084,716
Pumice—do	[4]	[4]	[4]	[4]
Salt—do	13,915	41,573	16,641	51,514
Sand and gravel—do	[8] 2,364,939	[8] 1,141,380	[8] 1,948,587	[8] 1,269,813
Silver—troy ounces	1,407,839	1,001,130	1,328,317	944,581
Stone—short tons	362,020	223,680	118,180	111,709

See footnotes at end of table.

Mineral production of New Mexico, 1940–41—Continued

Product	1940		1941	
	Quantity	Value	Quantity	Value
Tin (metallic equivalent)—short tons	[4]	[4]	[4]	[4]
Tungsten ore (60-percent concentrates)—do	98	[4]	[4]	[4]
Zinc—do	30,313	$3,819,438	37,862	$5,679,300
Miscellaneous [9]		10,200,301		2,047,496
Total value, eliminating duplications		80,969,723		97,849,086

[1] Figures not available.
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value included under "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Equivalent as K_2O.
[8] "Government-and-contractor." Value of "Commercial" included under "Miscellaneous."
[9] Includes minerals indicated by "4" and "8" above.

Mineral production of New York, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Aluminum—short tons	89,589	[1] $32,700,000	[1 2]	[1 2]
Cement—barrels	[3] 8,251,038	[3] 11,687,089	11,446,292	[3] $16,073,726
Clay:				
Products (other than pottery and refractories)		[4] 5,820,000		[4] 8,111,000
Raw (sold by producers)—short tons	[2]	[2]	[2]	[2]
Coke—do	5,080,403	[1] 29,519,871	5,116,308	[1] 32,808,937
Diatomite—do	[2]	[2]	[2]	[2]
Emery—do	1,046	9,349	4,876	42,484
Feldspar (crude)—long tons	[2]	[2]	[2]	[2]
Ferro-alloys—short tons	259,303	[1] 30,719,756	[1 2]	[1 2]
Garnet, abrasive—do	[2]	[2]	[2]	[2]
Gems and precious stones		[5]		[5]
Graphite:				
Artificial—pounds	[1 2]	[1 2]	[1 2]	[1 2]
Crystalline—do			[2]	[2]
Gypsum (crude)—short tons	798,229	1,037,181	1,080,320	1,500,307
Iron:				
Ore—				
Sold to furnaces—do	[2]	[2]	[2]	[2]
Sold for paint—do	[2]	[2]	9,243	56,900
Pig—do	3,206,162	[1] 54,150,107	3,724,989	[1] 66,718,244
Lead—do	1,973	197,300	2,100	239,400
Lime—do	54,364	408,645	62,339	463,230
Marl, calcareous—do			[2]	[2]
Mica:				
Scrap—do	[2]	[2]	[2]	[2]
Sheet—pounds	[2]	[2]	[2]	[2]
Millstones		[2]		3,558
Mineral waters—gallons sold		[5]	[5]	[5]
Natural gas—M cubic feet	12,187,000	8,246,000	10,456,000	7,853,000
Natural gasoline—gallons	17,000	1,000	17,000	1,000
Ores (crude), etc.:				
Zinc—short tons	116,171	[6]	151,808	[6]
Zinc-lead—do	316,048	[6]	336,271	[6]
Peat—do	19,352	148,433	13,905	105,120
Petroleum—barrels	4,999,000	11,600,000	5,185,000	13,300,000
Pyrites—long tons	64,498	233,816	63,958	[2]
Salt—short tons	2,117,671	6,523,775	2,719,586	7,416,734
Sand and gravel—do	[7] 13,225,133	[7] 7,639,668	[7] 14,923,149	[7] 10,096,875
Sand-lime brick—thousands of brick	[2 8]	[2 8]	[8]	[8]
Silica (quartz)—short tons	[2]	[2]	[2]	[2]
Silver—troy ounces	35,720	25,401	37,734	26,833
Slate		479,053		685,145
Stone—short tons	9,782,120	10,398,401	10,406,740	10,806,450
Talc—do	113,611	1,402,524	153,560	1,917,732
Zinc—do	35,686	4,496,436	38,446	5,766,900
Miscellaneous [9]		6,080,854		78,083,628
Total value, eliminating duplications		76,119,505		91,582,704

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] Exclusive of natural cement, value for which is included under "Miscellaneous."
[4] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by 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] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[9] Includes minerals indicated by "2," "4," and "7" above.

Mineral production of North Carolina, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Aluminum—short tons	29,441	[1] $10,746,000	([1] [2])	([1] [2])
Asbestos—do	([2])	([2])	([2])	([2])
Bromine—pounds	([2])	([2])	([2])	([2])
Clay:				
Products (other than pottery and refractories)		[3] 4,629,000		[3] $5,356,000
Raw (sold by producers)—short tons	14,620	202,678	([2])	([2])
Copper—pounds	([2])	([2])	([2])	([2])
Feldspar (crude)—long tons	79,312	426,784	100,016	552,386
Flint lining for tube mills—short tons			([2])	([2])
Garnet, abrasive—do	([2])	([2])	([2])	([2])
Gems and precious stones		([4])		([4])
Gold—troy ounces	1,943	68,005	3,244	113,540
Kyanite—short tons	([2])	([2])	([2])	([2])
Lime—do	([2])	([2])	([2])	([2])
Lithium minerals—do	([2])	([2])	([2])	([2])
Manganese ore—do			([2])	([2])
Manganiferous ore—do	213	([2])	([2])	([2])
Marl, calcareous—do			([2])	([2])
Mica:				
Scrap—do	11,595	173,327	([2])	([2])
Sheet—pounds	1,002,646	218,154	([2])	([2])
Millstones		([2])		([2])
Mineral waters—gallons sold	([4])	([4])	([4])	([4])
Olivine—short tons	2,500	15,000	4,828	24,401
Ores (crude):				
Copper—do	20,311	([5])	19,402	([5])
Dry and siliceous (gold and silver)—do	7,927	([5])	14,344	([5])
Pebbles for grinding—do	([2])	([2])	6,099	102,895
Sand and gravel—do	3,213,855	1,439,457	4,473,297	2,345,165
Sand and sandstone (ground)—do	([2])	([2])		
Silica (quartz)—do	([2])	([2])	([2])	([2])
Silver—troy ounces	6,480	4,608	7,439	5,290
Stone—short tons	3,031,300	4,850,277	3,820,200	4,806,623
Talc and pyrophyllite—do	39,206	298,382	64,783	567,921
Vermiculite—do	1,040	8,070	([2])	([2])
Miscellaneous [6]		8,778,990		17,882,755
Total value, eliminating duplications		21,112,732		18,915,461

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Includes minerals indicated by "2" above.

Mineral production of North Dakota, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		([1] [2])		([1] [2])
Raw (sold by producers)—short tons	([1])	([1])	([1])	([1])
Coal—do	2,218,434	$2,587,000	2,308,888	$2,937,000
Mineral waters—gallons sold	([3])	([3])	([3])	([3])
Natural gas—M cubic feet			47,000	16,000
Sand and gravel—short tons	3,202,167	298,646	2,636,039	238,864
Stone—do	([1])	([1])	18,590	19,713
Miscellaneous [4]		101,705		116,050
Total value, eliminating duplications		2,987,351		3,327,627

[1] Value included under "Miscellaneous."
[2] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] No canvass.
[4] Includes minerals indicated by "1" above.

Mineral production of Ohio, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Bromine	pounds	[1]	[1]	[1]	[1]
Calcium chloride	short tons	[1]	[1]	[1]	[1]
Cement	barrels	[2] 6,841,129	[2] $9,202,414	[2] 8,021,857	[2] $10,657,677
Clay:					
Products (other than pottery and refractories)			[3] 24,711,000		[3] 27,556,000
Raw (sold by producers)	short tons	514,257	1,058,016	741,655	1,711,068
Coal	do	[4] 22,771,552	[4] 39,039,016	[4] 29,318,843	[4] 58,473,076
Coke	do	7,897,929	[5] 38,568,313	9,284,194	[5] 48,491,596
Ferro-alloys	do	189,499	[5] 8,793,122	[1 5]	[1 5]
Grindstones	do	8,539	278,274	13,296	426,929
Gypsum (crude)	do	[1]	[1]	[1]	[1]
Iron, pig	do	10,275,696	[5]193,283,920	12,995,298	[5] 268,660,861
Lime	do	1,284,877	10,180,785	1,549,246	12,482,106
Marl, calcareous	do	[1]	[1]	[1]	[1]
Mineral paints (zinc and lead pigments)	do	[1 5]	[1 5]	[1 5]	[1 5]
Mineral waters	gallons sold	[6]	[6]	[6]	[6]
Natural gas	M cubic feet	40,639,000	20,850,000	41,858,000	21,232,000
Natural gasoline	gallons	8,062,000	333,000	8,217,000	401,000
Peat	short tons	2,531	24,087	1,495	11,342
Petroleum	barrels	3,159,000	4,100,000	3,510,000	5,750,000
Salt	short tons	2,080,133	2,781,599	2,510,096	3,367,544
Sand and gravel	do	9,558,904	7,182,453	12,473,145	9,230,358
Sand and sandstone (ground)	do	[1]	[1]	[1]	[1]
Scythestones, whetstones, etc	do	[1]	[1]	[1]	[1]
Silica (quartz)	do			[1]	[1]
Stone	do	[7] 11,915,520	[7] 10,234,221	[7] 13,842,870	[7] 12,469,498
Strontium minerals	do	[1]	[1]		
Sulfuric acid [8]	do	[1 5]	[1 5]	[1 5]	[1 5]
Miscellaneous [9]			2,865,443		15,215,927
Total value, eliminating duplications			130,655,129		164,826,884

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[8] From zinc-roasting operation.
[9] Includes minerals indicated by "[1]," "[2]," and "[7]" above.

Mineral production of Oklahoma, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Asphalt (native)	short tons	[1]	[1]	[1]	[1]
Cement	barrels	[1]	[1]	[1]	[1]
Chats	short tons	2,152,877	$308,726	2,748,168	$383,797
Clay:					
Products (other than pottery and refractories)			[2] 532,000		[2] 838,000
Raw (sold by producers)	short tons	[1]	[1]	[1]	[1]
Coal	do	[3] 1,645,981	[3] 4,021,760	[3] 1,771,108	[3] 4,700,104
Gypsum (crude)	do	176,166	227,534	258,258	344,489
Iron ore	do	[1]	[1]	233	[1]
Lead	do	21,240	2,124,000	25,021	2,852,394
Lime	do	[1]	[1]	[1]	[1]
Manganese ore	do			[1]	[1]
Manganiferous ore	do			[1]	[1]
Mineral waters	gallons sold	[4]	[4]	[4]	[4]
Natural gas	M cubic feet	257,626,000	31,603,000	234,054,000	29,821,000
Natural gasoline and allied products:					
Natural gasoline	gallons	399,369,000	8,926,000	362,247,000	16,084,000
Liquefied petroleum gases	do	[5]	[5]	91,136,000	2,076,000
Ores (crude), etc.:					
Lead	short tons			15,589	[6]
Zinc	do	5,813,405	[6]	6,430,723	[6]
Zinc-lead	do	5,436,995	[6]	7,437,677	[6]
Petroleum	barrels	156,164,000	162,500,000	154,702,000	174,800,000
Pumice	short tons	[1]	[1]	[1]	[1]
Salt	do	[1]	[1]	10,743	42,737
Sand and gravel	do	1,030,435	284,010	1,513,988	627,864

See footnotes at end of table.

Mineral production of Oklahoma, 1940–41—Continued

Product	1940		1941	
	Quantity	Value	Quantity	Value
Stone short tons	1,311,640	$1,217,525	1,876,570	$1,945,753
Sulfuric acid [7] do	([8])	([8])	([8])	([8])
Tripoli do	([1])	([1])	([1])	([1])
Zinc do	162,935	20,529,810	166,602	24,990,300
Miscellaneous [9]		3,710,833		4,695,858
Total value, eliminating duplications		235,535,062		263,763,923

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] No canvass.
[5] Figures not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] From zinc smelting.
[8] Value not included in total value for State.
[9] Includes minerals indicated by "[1]" above.

Mineral production of Oregon, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates) short tons			([1])	([1])
Arsenious oxide do	([2])	([2])	([2])	([2])
Asbestos do			([1])	([1])
Cement barrels	([1])	([1])	([1])	([1])
Chromite short tons	([1])	([1])	([1])	([1])
Clay:				
Products (other than pottery and refractories)		[3] $397,000		[3] $458,000
Raw (sold by producers) short tons	([1])	([1])	([1])	([1])
Coal do	([1 4])	([1 4])	([1 4])	([1 4])
Copper pounds	176,000	19,888	166,000	19,588
Diatomite short tons	([1])	([1])	([1])	([1])
Ferro-alloys do			([1 5])	([1 5])
Gems and precious stones		([6])		([6])
Gold troy ounces	113,402	3,969,070	96,565	3,379,775
Lead short tons	35	3,500	59	6,726
Lime do	([1])	([1])	3,940	21,524
Manganese ore do			([1])	([1])
Mercury flasks (76 pounds)	9,043	1,599,436	([1])	([1])
Mineral waters gallons sold	([6])	([6])	([6])	([6])
Ores (crude), etc.:				
Copper short tons	146	([7])	629	([7])
Dry and siliceous (gold and silver) do	105,318	([7])	97,531	([7])
Lead do	5	([7])		
Platinum metals (crude) troy ounces	69	([1])	([1])	([1])
Pumice short tons	([1])	([1])	677	8,544
Sand and gravel do	[8] 1,622,921	[8] 859,943	3,968,395	2,159,470
Silica (quartz) do	1,600	10,000	([1])	([1])
Silver troy ounces	219,112	155,813	276,158	196,379
Stone short tons	[9] 2,757,820	[9] 2,234,928	2,836,390	2,436,783
Miscellaneous [10]		1,980,092		4,763,948
Total value, eliminating duplications		11,229,670		12,830,176

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1," "8," and "9" above.

Mineral production of Pennsylvania, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Asbestos short tons	(1)	(1)		
Cement barrels	[2] 27,499,786	[2] $38,350,998	[2] 32,868,220	[2] $45,383,766
Clay:				
Products (other than pottery and refractories)		[3] 11,031,000		[3] 12,550,000
Raw (sold by producers) short tons	899,173	2,189,509	1,234,367	3,045,688
Coal:				
Anthracite do	51,484,640	205,490,000	56,368,267	240,275,000
Bituminous do	[4] 116,602,999	[4] 237,333,374	[4] 130,239,683	[4] 296,912,296
Cobalt pounds	(1)	(1)	(1)	(1)
Coke short tons	17,412,024	[5] 69,599,076	21,523,472	[5] 97,735,965
Copper [6] pounds	(1)	(1)	(1)	(1)
Feldspar (crude) long tons	(1)	(1)	(1)	(1)
Ferro-alloys short tons	512,174	[5] 56,983,213	(1 5)	(1 5)
Gems and precious stones		(7)		(7)
Gold [6] troy ounces	1,840	64,400	2,422	84,770
Iron:				
Ore—				
Sold to furnaces short tons	(1)	(1)	(1)	(1)
Sold for paint do	(1)	(1)	4,039	15,630
Pig do	14,571,517	[5] 282,666,561	16,340,965	[5] 344,298,435
Lime do	833,038	5,622,725	1,005,039	7,263,779
Mica, scrap do			(1)	(1)
Mineral paints (zinc and lead pigments) do	(1 5)	(1 5)	(1 5)	(1 5)
Mineral waters gallons sold	(7)	(7)	(7)	(7)
Natural gas M cubic feet	90,725,000	41,733,000	92,819,000	42,974,000
Natural gasoline and allied products:				
Natural gasoline gallons	15,371,000	594,000	15,440,000	705,000
Liquefied petroleum gases do	(8)	(8)	571,000	42,000
Peat short tons	8,310	23,540	5,440	12,600
Petroleum barrels	17,353,000	39,700,000	16,750,000	42,500,000
Pyrites long tons	(1)	(1)	(1)	(1)
Sand and gravel short tons	8,431,656	8,000,225	10,515,940	9,936,898
Sand and sandstone (ground) do	(1)	(1)	(1)	(1)
Sand-lime brick thousands of brick	(1 9)	(1 9)	(9)	(9)
Silica (quartz) short tons	(1)	(1)	(1)	(1)
Silver [6] troy ounces	13,064	9,290	15,016	10,678
Slate		2,609,801		3,464,348
Soapstone short tons	(1)	(1)	(1)	(1)
Stone do	[10] 19,277,690	[10] 19,855,478	[10] 23,506,540	[10] 25,013,400
Sulfuric acid (60° Baumé) [11] do	299,751	[5] 2,739,724	351,722	[5] 2,986,120
Tripoli (rottenstone) do	(1)	(1)	(1)	(1)
Miscellaneous [12]		15,290,396		115,331,930
Total value, eliminating duplications		618,347,805		737,143,530

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] 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.
[7] No canvass.
[8] Figures not available.
[9] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[10] Exclusive of dimension basalt in 1940 and of marble in 1941, value for which is included under "Miscellaneous."
[11] From zinc smelting.
[12] Includes minerals indicated by "1," "2," and "10" above.

Mineral production of Rhode Island, 1940–41

Product	1940		1941	
	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	515,129	$333,612	649,289	$459,223
Stone do	[5] 201,380	[5] 511,620	212,580	493,715
Miscellaneous [6]		1,960,840		2,142,417
Total value, eliminating duplications		994,997		1,133,400

[1] Value included under "Miscellaneous."
[2] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of dimension basalt, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of South Carolina, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Barite—short tons	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $1,688,000		[2] $1,860,000
Raw (sold by producers)—short tons	152,529	1,306,438	181,322	1,604,047
Copper—pounds	800	90	1,000	118
Gems and precious stones		(3)		(3)
Gold—troy ounces	13,076	457,660	15,508	542,780
Mica:				
Scrap—short tons	(1)	(1)	(1)	(1)
Sheet—pounds	(1)	(1)	(1)	(1)
Mineral waters—gallons sold	(3)	(3)	(3)	(3)
Ore (dry and siliceous) (gold and silver)—short tons	126,607	(4)	135,288	(4)
Sand and gravel—do	515,247	260,857	1,125,725	611,469
Silver—troy ounces	8,047	5,722	6,525	4,640
Stone—short tons	[5] 1,233,610	[5] 1,570,689	2,055,090	2,574,797
Miscellaneous [6]		16,141		38,652
Total value, eliminating duplications		5,305,597		7,236,503

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of South Dakota, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Beryllium concentrates—short tons	74	$2,064	151	$7,067
Cement—barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		(1 2)
Raw (sold by producers)—short tons	40,481	274,714	57,139	401,758
Coal—do	66,085	88,000	70,825	108,000
Copper—pounds	12,000	1,356		
Feldspar (crude)—long tons	54,692	157,323	59,015	170,723
Gems and precious stones		(3)		(3)
Gold—troy ounces	586,662	20,533,170	600,637	21,022,295
Gypsum (crude)—short tons	(1)	(1)	(1)	(1)
Iron ore sold for paint—do	717	(1)	2,408	(1)
Lead—do	7	700		
Lime—do	(1)	(1)	(1)	(1)
Lithium minerals—do	(1)	(1)	3,636	76,775
Mica:				
Scrap—do	2,240	32,074	(1)	(1)
Sheet—pounds	107,062	12,509	(1)	(1)
Mineral waters—gallons sold	(3)	(3)	(3)	(3)
Natural gas—M cubic feet	9,000	3,000	7,000	2,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver)—short tons	1,667,289	(4)	1,711,744	(4)
Lead—do	81	(4)		
Sand and gravel—do	2,910,331	524,842	2,627,059	559,766
Sand-lime brick—thousands of brick	(1 5)	(1 5)	(5)	(5)
Silver—troy ounces	175,514	124,810	170,771	121,437
Stone—short tons	255,600	878,866	[6] 401,550	[6] 1,189,564
Tin (metallic equivalent)—do	2	1,710	(1)	(1)
Tungsten ore (60-percent concentrates)—do			(1)	(1)
Miscellaneous [7]		893,687		842,311
Total value, eliminating duplications		23,528,825		24,501,696

[1] Value included under "Miscellaneous."
[2] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[6] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of Tennessee, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Aluminum short tons	82,256	[1] $30,023,000	([1] [2])	([1] [2])
Barite do	70,767	503,204	104,511	$779,565
Cement barrels	3,766,807	5,655,635	5,623,800	8,520,284
Clay:				
Products (other than pottery and refractories)		[3] 1,869,000		[3] 2,401,000
Raw (sold by producers) short tons	89,582	491,271	159,304	832,507
Coal do	[4] 6,008,456	[4] 12,024,742	[4] 7,045,271	[4] 16,454,539
Coke do	99,705	[1] 618,746	150,393	[1] 1,118,725
Copper pounds	([2])	([2])	([2])	([2])
Ferro-alloys short tons	38,900	[1] 3,041,405	([1] [2])	([1] [2])
Flint lining for tube mills do			([2])	([2])
Fuller's earth do	([2])	([2])	([2])	([2])
Gold troy ounces	173	6,055	227	7,945
Iron:				
Ore—				
Sold to furnaces short tons	([2])	([2])		
Sold for paint do	189	([2])		
Pig do	([1] [2])	([1] [2])	([1] [2])	([1] [2])
Sinter from copper sulfide ore do	([2])	([2])	([2])	([2])
Lead do	573	57,300	23	2,622
Lime do	192,133	1,050,199	239,528	1,354,642
Manganese ore do	8,308	120,736	([2])	([2])
Manganiferous ore do	2,606	([2])	([2])	([2])
Mineral waters gallons sold	([5])	([5])	([5])	([5])
Natural gas M cubic feet	9,000	3,000	10,000	5,000
Ores (crude), etc.:				
Copper short tons	705,574	([6])	732,114	([6])
Lead do	8,709	([6])	469	([6])
Zinc do	1,206,786	([6])	1,300,347	([6])
Zinc-lead do	549	([6])	100	([6])
Petroleum barrels	24,000	23,000	12,000	15,000
Phosphate rock long tons	([2])	([2])	([2])	([2])
Pyrites do	([2])	([2])	([2])	([2])
Sand and gravel short tons	3,104,382	2,255,287	4,811,686	2,829,836
Silica (quartz) do	([2])	([2])	([2])	([2])
Silver troy ounces	38,610	27,456	39,161	27,848
Stone short tons	5,604,170	6,674,710	7,896,970	9,157,673
Sulfuric acid [7] do	([1] [2])	([1] [2])	([1] [2])	([1] [2])
Zinc do	34,796	4,384,296	36,170	5,425,500
Miscellaneous [8]		8,832,008		51,854,344
Total value, eliminating duplications		42,683,407		56,301,592

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] From copper smelting.
[8] Includes minerals indicated by "[2]" above.

Mineral production of Texas, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	158,220	$306,120	294,170	$550,206
Barite do	100	450	([1])	([1])
Bromine pounds			([1])	([1])
Cement barrels	7,383,600	12,198,800	9,842,260	16,362,293
Clay:				
Products (other than pottery and refractories)		[2] 3,173,000		[2] 4,121,000
Raw (sold by producers) short tons	92,719	407,873	137,937	331,873
Coal:				
Bituminous do	[3] 14,137	[3] 48,278	[3] 15,482	[3] 52,730
Lignite do	606,418	637,000	337,326	284,000
Copper pounds	60,000	6,780	12,000	1,416
Feldspar (crude) long tons			([1])	([1])
Flint lining for tube mills short tons			([1])	([1])
Fluorspar do			([1])	([1])
Fuller's earth do	34,039	277,229	77,033	713,085
Gems and precious stones		([4])		([4])

See footnotes at end of table.

Mineral production of Texas, 1940–41—Continued

Product		1940		1941	
		Quantity	Value	Quantity	Value
Gold	troy ounces	312	$10,920	306	$10,710
Gypsum (crude)	short tons	328,261	368,882	446,419	467,087
Helium	cubic feet	[5] 9,450,855	[5] 85,061	([1] [5])	([1] [5])
Iron ore	short tons	([1])	([1])	([1])	([1])
Lead	do	205	20,500	186	21,204
Lime	do	64,274	543,130	77,783	632,099
Magnesite	do	([1])	([1])	8,900	44,500
Magnesium	pounds			([1])	([1])
Magnesium sulfate (natural)	do	([1])	([1])	([1])	([1])
Mercury	flasks (76 pounds)	([1])	([1])	([1])	([1])
Mineral waters	gallons sold	([4])	([4])	([4])	([4])
Natural gas	M cubic feet	1,063,538,000	151,580,000	1,086,312,000	162,344,000
Natural gasoline and allied products:					
Natural gasoline and cycle products	gallons	932,040,000	20,322,000	1,180,221,000	44,066,000
Liquefied petroleum gases	do	([6])	([6])	378,598,000	4,416,000
Ores (crude), etc.:					
Copper	short tons	3	([7])	58	([7])
Dry and siliceous (gold and silver)	do	146,811	([7])	140,739	([7])
Lead	do	122	([7])	21	([7])
Pebbles for grinding	do			([1])	([1])
Petroleum	barrels	493,209,000	494,000,000	505,572,000	568,000,000
Pumice	short tons			([1])	([1])
Salt (sodium chloride)	do	402,165	792,214	656,569	1,713,508
Sand and gravel	do	6,930,975	3,446,085	12,134,312	6,681,277
Silica (quartz)	do			1,485	14,345
Silver	troy ounces	1,326,150	943,040	1,096,027	779,397
Sodium sulfate (natural)	short tons	([1])	([1])	75,029	957,354
Stone	do	2,737,690	2,581,358	3,497,720	2,908,364
Strontium minerals	do	([1])	([1])	1,959	31,294
Sulfur	long tons	2,008,968	32,143,480	2,842,988	45,487,808
Sulfur ore	do	150	1,800	300	1,500
Tripoli	short tons	([1])	([1])	([1])	([1])
Vermiculite	do	([1])	([1])		
Miscellaneous [8]			1,111,009		7,089,640
Total value, eliminating duplications			725,005,009		868,082,690

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] No canvass.
[5] Figures cover fiscal year ended June 30 of year stated.
[6] Figures not available.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

Mineral production of Utah, 1940–41

Product		1940		1941	
		Quantity	Value	Quantity	Value
Arsenious oxide	short tons	([1])	([1])	([1])	([1])
Asphalt (native)	do	32,000	$776,171	36,476	$856,966
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] 630,523		[3] 758,000
Raw (sold by producers)	short tons	27,506	98,153	25,366	54,019
Coal	do	[4] 3,575,586	[4] 7,871,939	[4] 4,076,779	[4] 9,509,973
Coke	do	226,347	([5])	246,851	([5])
Copper	pounds	463,728,000	52,401,264	533,676,000	62,973,768
Fluorspar	short tons	142	([1])	748	([1])
Fuller's earth	do			([1])	([1])
Gems and precious stones			([6])		([6])
Gold	troy ounces	355,494	12,442,290	356,501	12,477,535
Gypsum (crude)	short tons	45,421	60,055	61,813	78,147
Iron:					
Ore	do	365,680	([1])	397,607	([1])
Pig	do	([1] [5])	([1] [5])	([1] [5])	([1] [5])
Lead	do	75,688	7,568,800	69,601	7,934,514
Lime	do	49,413	306,357	56,221	352,306
Magnesite	do			([1])	([1])
Manganese ore	do	30	([1])	([1])	([1])
Manganiferous ore	do	2,354	13,134	([1])	([1])

See footnotes at end of table.

Mineral production of Utah, 1940–41—Continued

Product	1940		1941	
	Quantity	Value	Quantity	Value
Mercury—flasks (76 pounds)	53	$9,374	(1)	(1)
Molybdenum—pounds	4,285,688	(1)	(1)	(1)
Natural gas—M cubic feet	5,124,000	1,063,000	5,562,000	$1,145,000
Natural gasoline—gallons	722,000	28,000	808,000	45,000
Ores (crude), etc.:				
Copper—short tons	26,301,745	(7)	30,444,402	(7)
Dry and siliceous (gold and silver)—do	795,123	(7)	622,650	(7)
Lead—do	65,072	(7)	77,979	(7)
Lead-copper—do	8,510	(7)	5,276	(7)
Zinc—do	26	(7)	2,302	(7)
Zinc-lead—do	768,870	(7)	798,864	(7)
Zinc-lead-copper—do			1,344	(7)
Petroleum—barrels	3,000	3,000	4,000	4,000
Phosphate rock—long tons			1,340	8,535
Potassium salts—short tons	(1)	(1)	(1)	(1)
Salt (sodium chloride)—do	71,472	191,263	107,079	196,413
Sand and gravel—do	1,899,563	582,708	2,760,025	935,371
Silver—troy ounces	12,172,299	8,655,857	11,395,485	8,103,456
Sodium sulfate (natural)—short tons	(1)	(1)	(1)	(1)
Stone—do	1,024,660	693,127	408,140	340,551
Sulfur—long tons	(1)	(1)		
Sulfuric acid [8]—short tons	(1 5)	(1 5)	(1 5)	(1 5)
Tungsten ore (60-percent concentrates)—do	14	(1)	(1)	(1)
Vanadium—pounds	169,912	(1)	(1)	(1)
Zinc—short tons	43,788	5,517,288	42,049	6,307,350
Miscellaneous [9]		10,431,709		16,096,221
Total value, eliminating duplications		104,392,989		122,386,473

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[4] According to Bituminous Coal Division; value includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] From copper smelting.
[9] Includes minerals indicated by "1" above.

Mineral production of Vermont, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Asbestos—short tons	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		(1 2)
Raw (sold by producers)—short tons	(1)	(1)	(1)	(1)
Cobalt—pounds			1,399	(1)
Garnet, abrasive—short tons	(1)	(1)	(1)	(1)
Lime—do	61,026	$430,178	67,824	$479,219
Mica, scrap—do	290	2,964	(1)	(1)
Mineral waters—gallons sold	(3)	(3)	(3)	(3)
Nickel—short tons			(1)	(1)
Sand and gravel—do	4 873,325	4 217,661	4 601,918	4 127,149
Slate		1,555,230		1,921,923
Stone—short tons	5 135,680	5 3,681,752	185,840	4,190,112
Talc—do	38,516	423,368	57,248	663,468
Miscellaneous [6]		668,619		749,799
Total value, eliminating duplications		6,979,772		8,131,670

[1] Value included under "Miscellaneous."
[2] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] No canvass.
[4] "Government-and-contractor." Value of "Commercial" included under "Miscellaneous."
[5] Exclusive of crushed sandstone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1," "4," and "5" above.

Mineral production of Virginia, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Aplite (crude)—long tons	(1)	(1)	(1)	(1)
Barite—short tons	(1)	(1)	(1)	(1)
Cauxite—do	(1)	(1)	(1)	(1)
Cement—barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $2,602,000		[2] $3,369,000
Raw (sold by producers)—short tons	(1)	(1)	(1)	(1)
Coal—do	[3] 15,348,075	[3] 29,965,943	[3] 18,440,946	[3] 42,917,454
Coke—do	198,379	[4] 943,753	324,573	[4] 1,922,181
Feldspar (crude)—long tons	21,705	116,531	(1)	(1)
Ferro-alloys—short tons	(1 4)	(1 4)	(1 4)	(1 4)
Gold—troy ounces	458	16,030	240	8,400
Gypsum (crude)—short tons	(1)	(1)	(1)	(1)
Iron:				
Ore—do	(1)	(1)	371	(1)
Pig—do	(1 4)	(1 4)	(1 4)	(1 4)
Kyanite—do	(1)	(1)	5,461	116,952
Lead—do	2,285	228,500	3,390	386,460
Lime—do	178,036	1,044,229	224,293	1,359,281
Manganese ore—do	2,482	41,286	(1)	(1)
Manganiferous ore—do	5,106	[4] 30,069	(1)	(1)
Marl, calcareous—do	8,176	7,392	24,113	23,169
Mica:				
Scrap—do	(1)	(1)	(1)	(1)
Sheet—pounds	(1)	(1)	(1)	(1)
Millstones		(1)		(1)
Mineral waters—gallons sold	[5]	[5]	[5]	[5]
Natural gas—M cubic feet	80,000	81,000	106,000	94,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver)—short tons	2,480	[6]	540	[6]
Zinc—do			35	[6]
Zinc-lead—do	599,759	[6]	501,555	[6]
Phosphate rock—long tons	(1)	(1)	(1)	(1)
Pyrites—do	(1)	(1)	(1)	(1)
Salt—short tons	(1)	(1)	(1)	(1)
Sand and gravel—do	2,671,412	1,778,576	4,593,193	3,770,650
Sand and sandstone (ground)—do	(1)	(1)	(1)	(1)
Silica (quartz)—do	(1)	(1)		
Silver—troy ounces	271	193	135	96
Slate		(1)		(1)
Stone [7]—short tons	6,800,640	6,959,136	9,195,450	9,586,541
Talc and ground soapstone [7]—do	(1)	(1)	(1)	(1)
Titanium concentrates:				
Ilmenite—do	(1)	(1)	(1)	(1)
Rutile—do	(1)	(1)	(1)	(1)
Zinc—do	16,927	2,132,802	22,913	3,436,950
Miscellaneous [8]		10,966,418		12,083,722
Total value, eliminating duplications		50,003,672		71,340,934

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Soapstone used as dimension stone included in figures for stone.
[8] Includes minerals indicated by "1" above.

Mineral production of Washington, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Aluminum—short tons	4,994	[1] $1,823,000	([1] [2])	([1] [2])
Antimony ore (concentrates)—do			([2])	([2])
Arsenious oxide—do	([3])	([3])	([3])	([3])
Cement—barrels	([2])	([2])	([2])	([2])
Clay:				
Products (other than pottery and refractories)		[4] 1,241,000		[4] $1,132,000
Raw (sold by producers)—short tons	35,915	47,353	81,534	103,737
Coal—do	[5] 1,650,352	[5] 5,221,717	[5] 1,841,274	[5] 6,478,674
Coke—do	([1] [2])	([1] [2])		
Copper—pounds	19,224,000	2,172,312	17,372,000	2,049,896
Diatomite—short tons	([2])	([2])	([2])	([2])
Ferro-alloys—do			([1] [2])	([1] [2])
Fluorspar—do			104	([2])
Gems and precious stones		([6])		([6])
Gold—troy ounces	82,136	2,874,760	84,176	2,946,160
Graphite, crystalline—pounds			([2])	([2])
Iron ore—short tons	6,252	([2])	7,271	([2])
Lead—do	2,555	255,500	3,903	444,942
Lime—do	53,428	582,416	62,309	656,363
Magnesite—do	([2])	([2])	([2])	([2])
Magnesium sulfate (natural)—pounds	([2])	([2])		
Manganese ore—short tons			([2])	([2])
Manganiferous ore—do			([2])	([2])
Mercury—flasks (76 pounds)	([2])	([2])	([2])	([2])
Mineral waters—gallons sold	([6])	([6])	([6])	([6])
Molybdenum—pounds	4,624	([2])		
Natural gas—M cubic feet	36,000	37,000	1,000	2,000
Ores (crude), etc.:				
Copper—short tons	689,325	([7])	694,565	([7])
Dry and siliceous (gold and silver)—do	204,146	([7])	180,700	([7])
Lead—do	100	([7])	152	([7])
Zinc-lead—do	273,227	([7])	363,092	([7])
Peat—do	([2])	([2])	([2])	([2])
Pulpstones—do	180	11,130	150	16,065
Sand and gravel—do	6,987,761	4,278,251	5,583,285	2,476,834
Sand-lime brick—thousands of brick	([2] [8])	([2] [8])	([8])	([8])
Silver—troy ounces	365,175	259,680	402,030	285,888
Stone—short tons	2,347,190	1,941,820	2,148,970	1,757,873
Strontium minerals—do	([2])	([2])	([2])	([2])
Talc and ground soapstone—do	4	1,394	6	2,426
Tungsten ore (60-percent concentrates)—do	74	([2])	([2])	([2])
Zinc—do	11,560	1,456,560	14,320	2,148,000
Miscellaneous [9]		7,709,823		30,662,278
Total value, eliminating duplications		28,090,188		28,507,282

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] Figures not available.
[4] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[5] According to Bituminous Coal Division; value includes selling expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
[9] Includes minerals indicated by "2" above.

Mineral production of West Virginia, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Bromine—pounds	1,152,237	$179,011	1,048,178	$206,768
Calcium chloride—short tons	12,103	79,978	13,234	71,832
Cement—barrels	([1])	([1])	([1])	([1])
Clay:				
Products (other than pottery and refractories)		[2] 2,451,000		[2] 3,180,000
Raw (sold by producers)—short tons	55,853	103,989	70,885	133,300
Coal—do	[3] 126,437,621	[3] 231,603,534	[3] 140,250,248	[3] 313,255,559
Coke—do	2,133,003	[4] 6,170,849	2,245,307	[4] 7,626,823
Ferro-alloys—do	([1] [4])	([1] [4])	([1] [4])	([1] [4])
Grindstones and pulpstones—do	4,604	207,044	2,090	102,562

See footnotes at end of table.

Mineral production of West Virginia, 1940–41—Continued

Product	1940		1941	
	Quantity	Value	Quantity	Value
Iron, pig—short tons	941,299	(1 4)	1,032,148	(1 4)
Lime—do	278,300	$1,727,844	372,677	$2,350,362
Magnesium chloride (natural)—pounds			(1)	(1)
Manganese ore—short tons	245	(1)	(1)	(1)
Manganiferous ore—do			(1)	(1)
Marl, calcareous—do	(1)	(1)	(1)	(1)
Millstones				(1)
Mineral waters—gallons sold	(5)	(5)	(5)	(5)
Natural gas—M cubic feet	188,751,000	76,065,000	207,681,000	81,957,000
Natural gasoline and allied products:				
Natural gasoline—gallons	58,782,000	1,848,000	65,873,000	2,717,000
Liquefied petroleum gases—do	(6)	(6)	32,171,000	1,354,000
Petroleum—barrels	3,444,000	6,400,000	3,433,000	7,390,000
Rubbing stones—short tons			(1)	(1)
Salt—do	144,312	701,953	143,780	792,104
Sand and gravel—do	2,297,610	2,240,650	2,733,607	3,185,639
Sand and sandstone (ground)—do	(1)	(1)	(1)	(1)
Stone—do	7 3,719,950	7 3,818,788	7 4,547,200	7 5,988,840
Sulfuric acid 8—do	(1 4)	(1 4)	(1 4)	(1 4)
Miscellaneous 9		31,257,639		48,275,238
Total value, eliminating duplications		329,891,960		425,626,303

1 Value included under "Miscellaneous."
2 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
3 According to Bituminous Coal Division; value includes selling expenses.
4 Value not included in total value for State.
5 No canvass.
6 Figures not available.
7 Exclusive of dimension limestone in 1940 and of dimension sandstone in 1941, value for which is included under "Miscellaneous."
8 From zinc smelting.
9 Includes minerals indicated by "1" and "7" above.

Mineral production of Wisconsin, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Cement—barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		2 $326,000		2 $578,000
Raw (sold by producers)—short tons			(1)	(1)
Coke—do	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore—				
Sold to furnaces—do	1,375,181	3,290,389	1,665,189	3,998,287
Sold for paint—do	670	(1)		
Lead—do	445	44,500	1,225	139,650
Lime—do	65,632	542,749	79,077	659,324
Marl, calcareous—do	(1)	(1)	(1)	(1)
Mineral waters—gallons sold	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Zinc—short tons	190,326	(5)	157,068	(5)
Zinc-lead—do			54,905	(5)
Peat—do			(1)	(1)
Pebbles for grinding—do			(1)	(1)
Pyrites—long tons	(1)	(1)	(1)	(1)
Sand and gravel—short tons	6,742,882	2,304,197	9,263,237	3,398,039
Sand and sandstone (ground)—do	(1)	(1)	(1)	(1)
Sand-lime brick—thousands of brick	(1 6)	(1 6)	(6)	(6)
Silica (quartz)—short tons	(1)	(1)	(1)	(1)
Stone—do	4,330,360	5,030,263	4,376,720	5,666,120
Zinc—do	5,770	727,020	6,238	935,700
Miscellaneous 7		5,356,657		6,830,786
Total value, eliminating duplications		13,553,683		17,020,722

1 Value included under "Miscellaneous."
2 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by 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 1940: Figures obtained through cooperation with Bureau of the Census; 1941: No canvass by Bureau of the Census and no estimate made.
7 Includes minerals indicated by "1" above.

Mineral production of Wyoming, 1940–41

Product	1940		1941	
	Quantity	Value	Quantity	Value
Beryllium concentrates.....short tons			[1]	[1]
Cement.....barrels	[1]	[1]	[1]	[1]
Clay:				
Products (other than pottery and refractories)		[2] $193,000		[2] $194,000
Raw (sold by producers).....short tons	91,714	976,844	145,574	1,369,057
Coal.....do	[3] 5,808,042	[3] 11,944,261	[3] 6,646,330	[3] 13,916,228
Copper.....pounds	4,000	452	8,000	944
Feldspar (crude).....long tons	7,833	29,128	11,846	43,484
Gems and precious stones		[4]		[4]
Gold.....troy ounces	740	25,900	478	16,730
Gypsum (crude).....short tons	5,415	8,393	[1]	[1]
Iron ore.....do	931,072	[1]	1,104,154	[1]
Mica, scrap.....do			[1]	[1]
Mineral waters.....gallons sold	[4]	[4]	[4]	[4]
Natural gas.....M cubic feet	27,346,000	5,221,000	29,284,000	5,687,000
Natural gasoline and allied products:				
Natural gasoline.....gallons	33,380,000	1,271,000	33,920,000	1,876,000
Liquefied petroleum gases.....do	[5]	[4]	1,560,000	62,000
Ores (crude), etc.:				
Copper.....short tons	30	[6]	42	[6]
Dry and siliceous (gold and silver).....do	783	[6]	117	[6]
Petroleum.....barrels	25,711,000	20,600,000	29,878,000	25,700,000
Sand and gravel.....short tons	1,676,954	594,111	2,003,663	840,933
Silver.....troy ounces	114	81	94	67
Sodium sulfate (natural).....short tons	[1]	[1]	[1]	[1]
Stone.....do	405,140	375,463	838,050	737,455
Tantalite-columbite.....pounds			250	219
Vermiculite.....short tons	[1]	[1]	[1]	[1]
Miscellaneous [7]		1,833,900		2,307,237
Total value, eliminating duplications		43,073,533		52,751,354

[1] Value included under "Miscellaneous."
[2] 1940: Estimate by Bureau of Mines based on figures issued by Bureau of the Census as somewhat incomplete; 1941: Estimate by Bureau of Mines as no general canvass by Bureau of the Census.
[3] According to Bituminous Coal Division; value includes selling expenses.
[4] No canvass.
[5] Figures not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

PART II. METALS

GOLD AND SILVER

By C. E. NEEDHAM

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GENERAL SUMMARY

Gold and silver, beset by regulations, labor shortages, and economic factors, made a poor showing in many countries in 1942, and output in the United States dropped to the lowest quantity since 1935. World production of gold slumped an estimated 10 percent and silver about 5 percent from 1941, although information from many foreign countries on both metals is so scanty that many estimates have little value. Output of gold in North America declined about 16 percent. Production in the United States was reduced 26 percent, Canada 10 percent, and Newfoundland 26 percent; Mexico, however, reported a very slight increase. South America recorded a decrease of about 10 percent. The world's greatest gold-producing nation, the Union of South Africa, maintained its production at a high figure in spite of difficulties, and output decreased only about 2 percent.

Silver output in the United States dropped less in proportion than gold but dropped 21 percent from 1941. The increased tonnage of base-metal ores maintained production of silver better than of gold. Production in Canada held up well, and output differed but little from 1941; in Mexico it increased over 8 percent and climbed to the highest figure since 1931. Production in Central and South America remained much as in 1941; in fact, South America is believed to have made a slight increase. Output in the Western Hemisphere as a whole decreased about 5 percent.

Salient statistics of gold and silver in the United States, 1925–29 (average) and 1939–42 [1]

	Average (1925–29)	1939	1940	1941	1942
Mine production, ounces:					
Gold	2,170,798	4,673,042	4,869,949	4,750,865	3,457,110
Silver	61,511,087	64,373,281	70,549,362	67,258,997	54,090,765
Number of mines producing gold and silver:					
Lode	2,187	5,354	5,393	4,542	2,619
Placer	1,243	4,036	4,176	3,349	1,758
Ore produced, short tons:					
Gold ore	7,014,646	16,886,630	16,550,095	15,117,117	9,487,907
Gold-silver ore	597,075	1,212,734	948,171	1,447,371	1,163,970
Silver ore	799,061	1,367,164	1,201,469	1,074,543	996,823
Percentage derived from—					
Dry and siliceous ores:					
Gold	57	60	56	54	50
Silver	21	47	41	41	37
Base metal ores:					
Gold	23	12	13	14	21
Silver	79	53	58	59	62
Placers:					
Gold	20	29	31	31	29
Silver	[2]	[2]	[2]	[2]	[2]
Net industrial consumption: [3]					
Gold, dollars	27,938,073	7,460,600	13,306,032	37,001,620	47,294,810
Silver, ounces	28,747,779	44,613,005	44,498,903	72,432,318	101,398,695
Imports, dollars:					
Gold	201,971,673	3,574,658,840	4,749,467,203	982,442,027	315,779,716
Silver	64,264,486	85,307,095	58,433,866	47,053,413	41,103,149
Exports, dollars:					
Gold	251,428,995	508,063	4,994,899	64,280	102,126
Silver	87,559,828	14,629,792	3,674,385	5,673,361	1,999,490
Monetary stocks:					
Gold, dollars	4,339,000,000	17,644,000,000	21,995,000,000	22,737,000,000	22,726,000,000
Silver, ounces	1,417,000,000	2,927,000,000	3,135,000,000	3,280,000,000	3,334,000,000
Price, average, dollars per ounce:					
Gold	20.67+	35.00	35.00	35.00	35.00
Silver	.600+	.678+	.711+	.711+	.711+
World production, ounces: [3]					
Gold	18,988,557	39,534,430	41,067,101	40,332,204	37,000,000
Silver	254,377,085	265,926,968	272,510,428	262,854,226	249,663,000

[1] Philippine Islands and Puerto Rico excluded.
[2] Less than 0.5 percent.
[3] U. S. Bureau of the Mint, except Bureau of Mines estimate for 1942 world production.

GOVERNMENT REGULATIONS AND THEIR EFFECTS

Gold.—The marked slump in gold output in the United States in 1942 was traceable to the effects of the war program. Even as early as 1941, labor began to leave the mines to seek higher wages in defense industries, and the movement became much more pronounced in 1942. Another factor in the decreased production was the order from the War Production Board early in 1942 that excluded gold and silver mines from the priority benefits of Preference Rating Order P–56. Thus, shortages of labor and equipment, coupled with increased taxes and fixed prices for gold and silver, were already rapidly forcing down production late in 1941 and early in 1942.

On October 8, 1942, the War Production Board issued its Limitation Order L–208, the essential part of which reads as follows:

(a) *Definitions.*—For the purposes of this order (1) "Nonessential mine" means any mining enterprise in which gold is produced, whether lode or placer, located

in the United States, its Territories or possessions, unless the operator of such mining enterprise is the holder of a serial number for such enterprise which has been issued under Preference Rating Order P–56.

(2) With respect to any nonessential mine, "effective date" means October 8, 1942, or the date of cancellation by the Director General for Operations of the serial number for such mining enterprise, whichever is the later.

(b) *Restrictions upon production.*—(1) On and after the effective date, each operator of a nonessential mine shall immediately take all such steps as may be necessary to close down, and shall close down, in the shortest possible time, the operations of such mine.

(2) In no event on or after seven days from the effective date shall any operator of a nonessential mine acquire, consume, or use any material, facility, or equipment to break any new ore or to proceed with any development work or any new operations in or about such mine.

(3) In no event on or after sixty days from the effective date shall any operator of a nonessential mine acquire, consume, or use any material, facility, or equipment to remove any ore or waste from such mine, either above or below ground, or to conduct any other operations in or about such mine, except to the minimum amount necessary to maintain its buildings, machinery, and equipment in repair and its access and development workings safe and accessible.

(4) The provisions of this order shall not apply to any lode mine which produced 1,200 tons or less of commercial ore in the year 1941, provided the rate of production of such mine, after the effective date, shall not exceed 100 tons per month, nor to any placer mine which treated less than 1,000 cubic yards of material in the year 1941, provided that the rate of treatment of such placer mine, after the effective date, shall not exceed 100 cubic yards per month.

The Board also asked the mines affected to submit complete data covering the minimum number of workers and the minimum quantity of critical materials needed to keep the mines on a basis sufficient to pay stand-by expenses, together with information on the ages of employees and whether stand-by operations could be maintained with men above military age.

On November 25, Order L–208 was amended so that equipment of types listed on Schedule A, Order P–56, could no longer be sold without permission from the War Production Board, and the equipment was to be inventoried and reported by January 15, 1943, or within 60 days after revocation of a P–56 serial number. The lists submitted were to indicate the prices of machinery that the owner was willing to sell or rent so that the Board could distribute the available units to other mines where the output of needed metals could be considerably increased.

On December 8 the Board announced that regulations had been eased slightly so that a number of mines were granted permission to remove and mill broken ore or gravel with a small crew of men for 6 months, provided that such operations would not consume substantial amounts of critical materials and would employ only men who were not eligible for military service or not needed in mining operations elsewhere.

The avowed purpose of Order L–208 and its amendment was to provide additional manpower and equipment for mines producing metals more vitally needed than gold—particularly copper mines. To induce such a shift of labor the War Manpower Commission ruled that no former gold miner could obtain a new job west of the Mississippi without the approval of the United States Employment Service, and this Service was instructed to assign former gold miners only to nonferrous mining jobs, except in cases of undue hardship.

In 1941 Order L–208 would have affected over 250 lode mines and possibly 700 placers in the United States and Alaska, operations that employed over 20,000 men. However, by October 1942 so many of

these men had joined the armed forces or had gone into the numerous war industries that the number employed was very greatly reduced. Of those remaining, many for various reasons were unsuited to be transferred to other mining camps or were needed to maintain equipment and properties during the closing period.

Order L–208 provoked much discussion, both for and against the order. One group contended vigorously that many gold-mining communities were isolated and their economic life was more vulnerable than that of industrial centers; that so few men could be made available for other work by the closing order that the cost would outweigh the gain; that the Government continued to supply gold miners in other countries and to buy their output while the gold mines in the United States were singled out from a host of industries regarded as nonessential and made the victims of direct action; and that gold miners and their families could contribute much greater net gain to the war program under a much less drastic order.

The other group asserted with equal intensity that the order testified eloquently to the uselessness of gold as a means of financing our war program; that our continued acceptance of gold from South Africa, Canada, and Russia was due primarily to a desire not to disrupt the domestic economy of our Allies or to put additional obstacles in the way of their paying for needed American goods; that no such political expediency made it necessary to continue producing gold from domestic mines; that it was folly to waste manpower by extracting more gold from the earth and interring it in Government vaults; that localized disturbances to the domestic economy brought about by closing the gold mines would be severe but that they would be insignificant compared with the Nation-wide industrial dislocations resulting from conversions to a wartime basis; and that the closing of gold mines should be followed by increased production of critical metals so urgently needed for war materials.

Silver.—Gold did not stand alone with respect to regulation and heated discussion—silver came in for an even greater share, and scarcely a month went by that some action was not taken or attempted. Feeling ran high at times and was vigorously expressed on the floors of Congress, in committee rooms, through the press, and over the radio.

Early in the year agitation became strong for silver to do its full share in the war, and to further this objective Secretary Morgenthau announced in February that he had recommended that all silver legislation be struck off the books to get silver into greater productive service.

The Treasury Department held at this time about 47,000 tons (1,360,000,000 ounces) of "free" or unallocated silver—that is, silver not needed as coin or as a reserve against outstanding silver certificates, which, when lent, must be returned; it cannot be consumed. On April 7 the Attorney General ruled that the Treasury Department could legally issue this silver to war-production plants for nonconsumptive purposes, and on May 6 an agreement was made for leasing unpledged bullion to the Defense Plant Corporation and for delivering it as needed for manufacture into nonconsumable forms.

Silver was included under the General Maximum Price Regulation issued on April 28 by the Office of Price Administration, and the provision became effective May 11 for bullion and May 18 for articles

sold at retail. But the ceiling price of 35⅝ cents per ounce on bullion from foreign countries did not apply in Mexico, and soon considerable bullion was being purchased there at a substantial premium and imported into the United States.

Increased demands by both essential and nonessential users and decline in supplies from normal sources soon created a shortage of the metal, so that early in July the Bureau of Industrial Conservation recommended that silver no longer be used as a substitute for other scarce metals. The situation rapidly became worse, and on July 21 silver was placed on the restricted list of imports by the War Production Board. Under this provision the private importation, sale, processing, or shipment of silver beyond the place of initial storage was prohibited, except by special authorization from the Board.

On July 29, the Board ruled (Conservation Order M–199) that after October 1 no foreign silver could be purchased or processed for certain nonessential civilian uses, except to fill orders with a preference rating of A–3 or higher. Also, from July 29 to October 1 no manufacturer might purchase or put into process for such restricted uses foreign silver in excess of 1 month's supply, based on his average consumption for 1941 or the first half of 1942.

Effective August 10, the Office of Price Administration established a ceiling price of 35⅝ cents an ounce on all imports of silver bullion. This attempt at price control proved unsatisfactory, so that another order was issued, effective August 31, whereby importers were authorized to pay up to 45 cents an ounce for Mexican silver. Corresponding price increases, authorized in September, for all silver bullion, for semifabricated products containing silver, and for scrap silver established generally a price of 45 cents an ounce for foreign silver.

Likewise, late in August the Office of Price Administration issued an order providing that semifabricating companies, makers of silver sheets, blanks, and similar articles, could pay the Treasury price of 71.11 cents an ounce for silver and pass the increased cost to the fabricating consumer; the previous price level had been fixed on a basis of silver costing 35⅝ cents an ounce.

On September 17 Secretary Morgenthau announced that the Treasury had 5,000,000 ounces of "silver ordinary," that is, silver not acquired under silver monetary legislation, which could be sold outright at 45 cents an ounce to industrial users with high priority ratings on recommendation of the War Production Board. Priority orders on hand failed to absorb all this silver.

Demands for the release of Treasury silver continued to grow during the year. The Silver Users Emergency Committee, formed early in September, was very active in influencing Congress and the public toward proposed legislation that would make available to both essential and nonessential industries the ample supply of Treasury silver not actually in the form of coinage. At no time, however, did the committee advocate repeal of the Silver Purchase Act.

The sentiments of certain groups were crystallized in a number of bills introduced in Congress late in 1942 and early in 1943. On September 14 Senator Green introduced a bill (S. 2768) designed to remove the restrictions on the use of silver after purchase in order that it might be used for consumptive as well as nonconsumptive purposes, provided that no silver was to be sold at less than its cost to the

United States or at less than the then current market price, whichever was higher; also, that the Government should maintain sufficient silver to cover all outstanding silver certificates. The Green bill was amended to include minor changes, but the Senate adjourned without passing the bill in any form. The Celler bill, introduced on September 17, proposed the repeal of all provisions of the Silver Purchase Acts of 1934 and 1939, but, like the Green bill, it failed to pass.

Several bills on silver legislation were offered in January 1943, among them the Green bill (S. 35), in much the same form as in 1942; the Celler bill (H. R. 823), essentially a Green bill for the House of Representatives; the Treadway bill (H. R. 102), calling for outright repeal of the Silver Purchase Acts; and the Murdock bill (S. 192), under which fabricators might purchase silver to be used exclusively for consumption purposes from stocks owned by the Government.

Frequent and heated arguments on the silver question came from the press and over the radio. One group took the stand that to continue to buy silver at prices above the world market for monetary purposes was so glaringly stupid that steps should be taken immediately to repeal the Silver Purchase Acts; that the orders on silver issued by the Office of Price Administration continued to maintain the subsidy to our silver mines by making semifabricators pay the subsidy themselves and pass the charge to the customers; that the orders increased the cost of silver to our armament industries; that they were a concession to the Mexican Government, which profited thereby because we failed to make proper use of the ample supply held by our own Treasury; that the Green bill was endorsed by the Treasury, the armed services, the War Production Board, and many others; that as a substitute for tin, copper, cadmium, nickel, aluminum, antimony, tungsten, and other metals, the Government silver hoard was a valuable stock pile but kept by the Treasury this hoard was useless; that used in airplane and other engines this silver would help sweep the Japanese from the seas; in vital parts for tanks and trucks, it would help annihilate Hitler; but buried at West Point, it was a monument to folly.

The other group stoutly held that the enemies of silver were seeking to use the intrinsic value of the metal for war purposes as a vehicle to strike down silver as money; that history teaches that silver is the oldest and best monetary metal and that it is the only legal money of the United States today; that as an economic weapon at the peace table, our great supply of silver will be equally as potent as in war; that an abundance of silver had been coming on the market to meet the demands of American war industries; that complaints of insufficient silver came not from war industries but from manufacturers of nonessential articles who were out to make a larger profit in advocating the enactment of a law that would give them the privilege of buying United States Treasury silver that was acquired solely for use as money; and that so much silver is now a byproduct of base-metal mining that to lower the price of silver would deal a serious blow to the economic stability of the base-metal mining industry.

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, 1938–42, and approximate distribution of source, by States and Territories, in 1942

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

State or Territory	Gold [1]		Silver [2]	
	Fine ounces	Value	Fine ounces	Value
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	6,003,105	210,108,700	69,585,734	49,483,189
1941	5,976,419	209,174,600	72,336,029	51,438,954
1942:				
Alabama	1	35		
Alaska	503,040	17,606,400	143,100	101,760
Arizona	256,521	8,978,235	6,982,808	4,965,552
California	894,148	31,295,180	1,480,560	1,052,843
Colorado	289,623	10,136,805	3,964,072	2,818,896
Georgia	27	945	3	2
Idaho	98,795	3,457,825	14,195,091	10,094,287
Illinois			283	201
Michigan			54,227	38,561
Missouri			27,533	19,579
Montana	156,557	5,479,495	10,897,784	7,749,535
Nevada	299,876	10,495,660	4,339,118	3,085,595
New Mexico	17,446	610,610	893,360	635,278
New York			37,306	26,529
North Carolina	4,396	153,860	8,297	5,900
Oregon	50,718	1,775,130	137,947	98,096
Pennsylvania	2,648	92,680	18,577	13,210
Philippine Islands	158,726	5,555,410	231,197	164,407
South Carolina	8,102	283,570	5,254	3,736
South Dakota	535,461	18,741,135	192,121	136,619
Tennessee	129	4,515	33,161	23,581
Texas	277	9,695	791,039	562,517
Utah	390,700	13,674,500	11,276,521	8,018,859
Virginia	99	3,465	31	22
Washington	74,481	2,606,835	381,458	271,259
Wyoming	35	1,225	7	5
	3,741,806	130,963,210	56,090,855	39,886,830

[1] Gold valued at $35 a fine ounce.
[2] Silver valued as follows: 1938, $0.646+; 1939, $0.678787+; 1940–42, $0.7111+.

Gold and silver produced in the United States, 1792–1942

[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
1873–1942	211,700,035	4,982,088,500	3,666,522,549	2,755,210,678
	271,166,983	6,211,375,500	3,785,400,249	2,913,365,078

[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 1940–42 at $0.7111+.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.770.

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 1942. From

Price of silver in London and in New York, 1941–42

[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			
1941	*Pence*	*Pence*	*Pence*	*Dollars*	*Dollar*	*Dollar*
January	23 3/8	23 1/16	23.2727	4.0342	0.42291	0.35062
February	23 7/16	23 1/4	23.3406	4.0297	.42367	.35062
March	23 1/2	23 3/16	23.4464	4.0319	.42582	.35062
April	23 1/2	23 1/2	23.5000	4.0248	.42605	.35062
May	23 1/2	23 3/8	23.4574	4.0310	.42593	.35062
June	23 7/16	23 3/8	23.4000	4.0316	.42496	.35062
July	23 1/2	23 1/4	23.3967	4.0323	.42496	.35062
August	23 1/2	23 7/16	23.4594	4.0318	.42604	.35062
September	23 1/2	23 1/2	23.5000	4.0327	.42688	.35062
October	23 1/2	23 1/2	23.5000	4.0329	.42690	.35062
November	23 1/2	23 1/2	23.5000	4.0342	.42704	.35084
December	23 1/2	23 1/2	23.5000	4.0350	.42713	.35437
1942						
January	23 1/2	23 1/2	23.5000	4.0350	.42713	.35437
February	23 1/2	23 1/2	23.5000	4.0350	.42713	.35437
March	23 1/2	23 1/2	23.5000	4.0348	.42711	.35437
April	23 1/2	23 7/16	23.4970	4.0350	.42707	.35437
May	23 1/2	23 1/2	23.5000	4.0350	.42713	.35437
June	23 1/2	23 1/2	23.5000	4.0350	.42713	.35437
July	23 1/2	23 1/2	23.5000	4.0350	.42713	.35437
August	23 1/2	23 1/2	23.5000	4.0350	.42713	.35437
September	23 1/2	23 1/2	23.5000	4.0350	.42713	.45062
October	23 1/2	23 1/2	23.5000	4.0350	.42713	.45062
November	23 1/2	23 1/2	23.5000	4.0350	.42713	.45062
December	23 1/2	23 1/2	23.5000	4.0350	.42713	.45062
Average, calendar year 1941			23.4390	4.0318	.42568	.35095
Average, calendar year 1942			23.4998	4.0350	.42713	.38645

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+; 1940–42, $0.711111111+.

UNITED STATES AND WORLD MONETARY STOCKS

According to figures published in the Federal Reserve Bulletin, the gold reserves of the United States totaled $22,726,000,000 at the end of 1942, a decline of $11,000,000 during the year. This reversal of trend was caused by net sales to foreign countries exceeding the flow of domestic gold.

Figures are not available for the gold reserves held at the end of 1942 by central banks and governments in many other countries of the world. However, by using the data available for 1942 and making certain assumptions based on the latest figures available for past years, it is believed that the total reserves of the world amount to approximately $33,000,000,000, including stabilization funds. On this basis, the reserves of the United States constitute about 70 percent of the world total.

United States Treasury silver holdings at the close of 1942 approximated 3,334,000,000 ounces, a gain of about 54,000,000 ounces over 1941. The holdings for 1942 represent nearly 115,000 tons of the metal.

The Twenty-seventh Annual Review of the Silver Market, 1942, by Handy & Harman, contains the following paragraphs regarding silver purchases and coinage:

> At the end of the year gold holdings of the United States were practically unchanged from the 1941 closing figures. Therefore, the year's addition of even a scant 60,000,000 ounces to the silver holdings permitted some slight progress toward the goal set by the Silver Purchase Act that "one-fourth of the total monetary value of the gold and silver stocks shall be in silver." The proportion of silver at December 31, 1942, was 16 percent, an advance of 1/10 percent since December 31, 1941.
>
> *Coinage.*—Information from London indicates that the Royal Mint coined British Treasury silver acquired from the Indian Government, but the amount is unknown. Maria Theresa thalers, for export to Abyssinia, were minted, as well as some Colonial and domestic coinage. We are also advised that the Royal Mint of Canada purchased silver from that country's producers for current coinage purposes, and that the Bank of Mexico bought metal, part of which was to be minted for a South American country.
>
> According to an official statement, the amount of silver received at the United States mints during the first eleven months of 1942 for the purpose of foreign

[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.

coinage manufacture was 8,991,000 fine ounces, some of which was bought outside of the United States. The identity of the countries obtaining this coinage was withheld.

A new high record for domestic silver coinage was made in 1942, the 11-month figure of 69,100,000 ounces being 16,900,000 ounces greater than the previous full year's record established in 1941. Of the total, 66,376,000 ounces were consumed in subsidiary coinage which excludes nickels and pennies, and 2,744,000 ounces were used in the new "silver" nickels. These latter coins contain 35 percent silver, 56 percent copper, and 9 percent manganese.

Under legislation enacted toward the end of December, Secretary Morgenthau established specifications for a new, wartime 1-cent coin, of the same design as the present penny, but made of zinc-coated steel. Minting of the new pennies will commence about February 1, 1943, and subsequently a 3-cent piece, also authorized under the recent law, may be put into circulation if the demand for minor coins continues.

CONSUMPTION AND USES

Gold.—The desirable properties and uses of gold in industry were described in considerable detail in the Gold and Silver chapter, Minerals Yearbook, 1941. In 1942 the war program called for substantially greater quantities of gold wire in instruments used in measuring the speeds of aircraft engines, gold-plated anodes for sound-transmitting apparatus, gold-alloy hair springs for use in highly accurate timepieces and marine chronometers, gold lining for special pieces of base-metal equipment used in chemical plants, gold-lined equipment for the artificial silk industry, and gold chloride for use in making colored film. Greater use of gold in the war program is necessarily restricted by the high price of the metal, and under present conditions it cannot hope to substitute in any great amount for critical base metals.

Normally, 5 to 10 percent of the world output of gold is consumed by industry; the remaining 90 to 95 percent is used for monetary purposes. Industry in the United States in 1941 consumed approximately 2,000,000 ounces of gold, both old and new metal. This amount was divided about as follows: Jewelry, 950,000 ounces; watch cases, 75,000 ounces; gold leaf, 60,000 ounces; electrical and industrial equipment, instruments, and medical and dental supplies, 915,000 ounces.[3]

Silver.—Consumption of industrial silver continued to mount rapidly in 1942, rising to an estimated gross amount of about 120,500,000 ounces.[3] Distribution by uses is estimated to have been as follows:

Silverware	34,000,000	Brazing alloys	(1)
Photographic goods	19,600,000	Solder	(1)
Jewelry	16,500,000	Chemical products, n. e. s.	(1)
Bearings	10,600,000	Miscellaneous	21,300,000
Contacts	9,300,000		
Insignia	7,000,000	Total	120,500,000
Dental and medical	2,200,000		

[1] Included elsewhere.

Greatest gains were in the use of silver for bearings, solders, brazing alloys, electrical contacts, photographic goods, insignia, and dental and medical supplies. These uses are expected to require much greater quantities of the metal in 1943 (except for insignia), but consumption of silver in jewlery and silverware will drop greatly.

[3] War Production Board, data as of May 14, 1943.

Nearly 60 percent of the silver consumed in the United States in 1942 probably went into war production; this proportion will be even greater in 1943. The large quantities used for solders and brazing alloys, electrical appliances, bearings, and other articles played a vital part in the production of virtually every airplane, tank, submarine, battleship, cargo ship, and field kitchen and in many kinds of instruments, guns, bombs, torpedoes, shells, and other weapons. Much silver was also used in highly important military photography, and smaller amounts for medical and dental work.

Much progress was made in utilizing the minimum 1,000,000,000 ounces (34,286 short tons) of "free" or nonconsumable silver loaned by the Treasury to the Defense Plant Corporation, under agreement of May 6, 1942, and allocated by the War Production Board. Late in 1942 the Board announced that all such silver either had been loaned to war industries or commitments had been made for its use, and by January 1943 some 22,000 tons had been shipped from the vaults. By far the greatest part of the metal went into bus bars for use in aluminum and magnesium plants, saving a substantial tonnage of copper.

The following table shows the net industrial consumption of gold and silver in the United States for the 10-year period 1933–42, inclusive, in terms of dollars for gold and fine ounces for silver. The quantity of each metal reclaimed and recovered from various sources is deducted from that issued for industrial use to give the net amount.

Net industrial consumption of gold and silver in the United States, 1933–42[1]

Year	Gold (dollars)			Silver (fine ounces)		
	Returned from industrial use	Issued for industrial use	Net industrial consumption	Returned from industrial use	Issued for industrial use	Net industrial consumption
1933	22,805,960	17,013,260	−5,792,700	18,532,880	29,343,451	10,810,571
1934	75,927,285	14,232,795	−61,694,490	28,186,178	39,678,603	11,492,425
1935	58,390,675	25,929,497	−32,461,178	35,903,107	41,192,023	5,288,916
1936	35,875,770	32,967,937	−2,907,833	16,703,353	35,842,674	19,139,321
1937	36,407,945	39,622,338	3,214,393	23,564,986	51,292,270	27,727,284
1938	30,480,835	30,156,754	−324,081	18,438,847	38,620,473	20,181,626
1939	31,328,360	38,788,960	7,460,600	24,972,260	69,585,265	44,613,005
1940	27,872,355	41,178,387	13,306,032	22,563,729	67,062,632	44,498,903
1941	30,975,490	67,977,110	37,001,620	20,361,256	92,793,574	72,432,318
1942	28,447,685	75,742,495	47,294,810	30,020,529	131,419,224	101,398,695

[1] U. S. Bureau of the Mint.

IMPORTS AND EXPORTS[4]

Value of gold and silver imported into and exported from the United States, 1941–42, by classes

	Imports	Exports	Excess of imports over exports
1941			
Gold:			
Contained in ore and base bullion	$103,492,789	$37,004	$103,455,785
Bullion refined	877,321,316	19,162	877,302,154
United States coin	728	8,114	[1] 7,386
Foreign coin	1,627,194		1,627,194
	982,442,027	64,280	982,377,747

[1] Excess of exports.

[4] Figures compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Value of gold and silver imported into and exported from the United States, 1941–42, by classes—Continued

	Imports	Exports	Excess of imports over exports
1941—Continued			
Silver:			
Contained in ore and base bullion	$17,605,811	$1,401	$17,604,410
Bullion refined	29,256,903	2,957,847	26,299,056
United States coin	188,996	176,000	12,996
Foreign coin	1,703	2,538,113	[1] 2,536,410
	47,053,413	5,673,361	41,380,052
1942			
Gold:			
Contained in ore and base bullion	47,413,550	22,685	47,390,865
Bullion refined	268,005,947	79,441	267,926,506
United States coin	290		290
Foreign coin	359,929		359,929
	315,779,716	102,126	315,677,590
Silver:			
Contained in ore and base bullion	12,711,949	1,635	12,710,314
Bullion refined	28,002,573	504,105	27,498,468
United States coin	163,085	26,000	137,085
Foreign coin	225,542	1,467,750	[1] 1,242,208
	41,103,149	1,999,490	39,103,659

[1] Excess of exports.

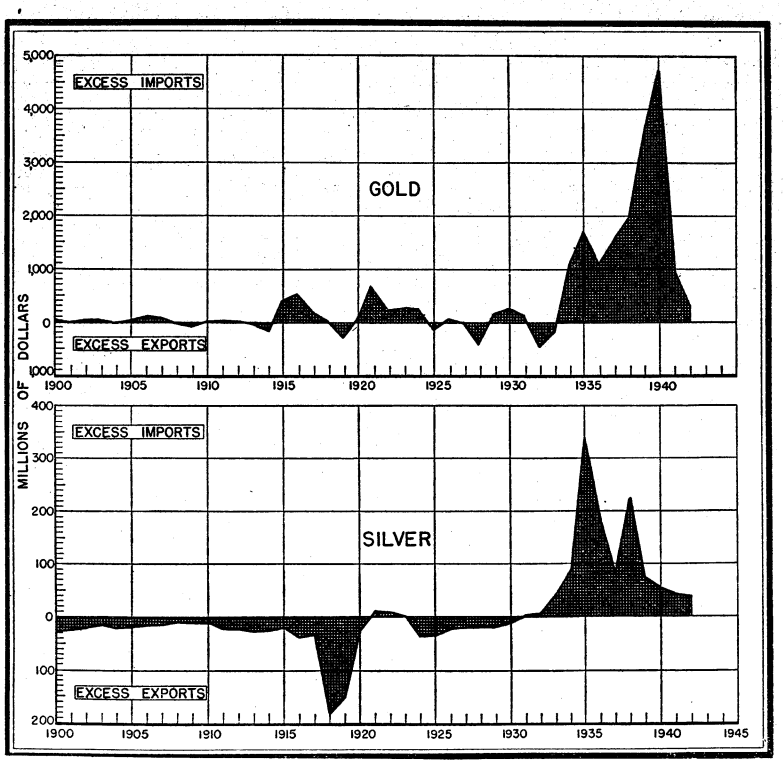

FIGURE 1.—Gold and silver imports and exports, with net movements, 1900–1942.

DOMESTIC SUPPLY

The following tables show the sources of domestic supply of gold and silver, by percent, for 1936–42. It is noted that during this period dry and siliceous ores and placer gravels supplied 86 to 90 percent of total United States gold production, exclusive of the Philippine Islands and Puerto Rico; base-metal ores supplied the remaining 10 to 14 percent. On the whole, placers have increased in relative importance in gold production since 1928, and dry and siliceous ores have steadily decreased in relative importance since 1932.

In the production of silver dry and siliceous ores are less important than in the production of gold, and placers are almost of no consequence. In only 1 year during the past 20 years (1938) have dry and siliceous ores supplied as much as half of the total United States output of silver. The low point was reached in 1928, when these ores supplied only 19 percent, and base-metal ores 81 percent.

Mine production of gold in the United States, 1936–42, by percent from sources, and in total fine ounces [1] [2]

Year	Percent from—						Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1936	23.9	64.0	10.0	0.5	[3]	1.6	3,782,669
1937	24.6	60.8	12.0	.6	[3]	1.9	4,117,078
1938	27.9	62.1	8.0	.4	[3]	1.6	4,267,469
1939	28.6	59.8	10.1	.3	[3]	1.3	4,673,042
1940	31.0	55.6	11.0	.4	[3]	2.0	4,869,949
1941	31.3	54.3	11.8	.5	[3]	2.0	4,750,865
1942	29.3	50.0	17.0	.7	[3]	2.9	3,457,110

[1] Philippine Islands and Puerto Rico excluded.
[2] 1922–35 data are shown on p. 132, Minerals Yearbook, 1937, Review of 1936.
[3] Less than 0.1 percent.

Mine production of silver in the United States, 1936–42, by percent from sources, and in total fine ounces [1] [2]

Year	Percent from—						Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1936	0.2	43.0	28.5	6.2	[3]	22.2	61,152,534
1937	.2	45.0	28.5	6.7	0.8	18.9	71,408,625
1938	.2	51.6	25.8	5.5	[3]	17.0	61,705,837
1939	.3	47.0	28.6	4.6	.1	19.4	64,373,281
1940	.3	41.3	29.3	4.5	[3]	24.6	70,549,362
1941	.3	41.2	27.9	5.6	.3	24.7	67,258,997
1942	.3	37.3	27.8	5.5	1.2	28.0	54,090,765

[1] Philippine Islands and Puerto Rico excluded.
[2] 1922–35 data are shown on p. 134, Minerals Yearbook, 1937, Review of 1936.
[3] Less than 0.1 percent.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The second table in this report presents the official refinery figures for production of gold and silver in the United States from 1938 to 1942, 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.

Compared with the mine reports, the mint reports for the 38 years show a total excess of gold of 297,374 ounces (a difference of 0.21 percent) and a total excess of silver of 12,848,477 ounces (a difference of 0.58 percent).

Gold and silver produced in the United States, 1905–42, in fine ounces, according to mint and mine returns, in terms of recovered metals

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
1905-37	114,224,734	1,898,028,783	114,024,647	1,887,909,257
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
1941	5,976,419	72,336,029	5,881,798	68,483,333
1942	3,741,806	56,090,855	3,615,836	54,321,962
	140,647,046	2,223,826,249	140,349,672	2,210,977,772

UNITS OF MEASUREMENTS

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 29 largest gold producers in the United States (Philippine Islands and Puerto Rico excluded) in 1942, none of which produced less than 17,000 ounces, was 2,086,084 fine ounces (60 percent

of the total). Six of the companies working placer mines (five with floating connected-bucket dredges and one with a dragline dredge) recovered 421,818 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 17,000 ounces each was 1,371,026 ounces.

Largest producers of gold in the United States in 1942, in order of output [1]

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co	South Dakota	Whitewood	Dry and siliceous gold ore.
2	Utah Copper Co	Utah	West Mountain	Copper ore.
3	United States Smelting, Refining & Mining Co.	Alaska	Fairbanks and Nome	Dredging gravel.
4	Phelps Dodge Corporation	Arizona	Ajo, Copper Mountain, Verde, Warren.	Copper ore, dry and siliceous gold ore, dry and siliceous silver ore.
5	Golden Cycle Corporation [2]	Colorado	Cripple Creek, etc	Dry and siliceous gold ore.
6	Yuba Consolidated Gold Fields.	California	Callahan, Oroville, Yuba River.	Dredging gravel.
7	Alaska Juneau Gold Mining Co.	Alaska	Juneau	Dry and siliceous gold ore.
8	Natomas Co	California	Folsom	Dredging gravel.
9	Empire Star Mines Co., Ltd	do	Browns Valley, Grass Valley-Nevada City.	Dry and siliceous ore.
10	Idaho Maryland Mines Corporation.	do	Grass Valley-Nevada City.	Do.
11	Howe Sound Co	Washington	Chelan Lake	Copper ore.
12	Getchell Mine, Inc	Nevada	Potosi	Dry and siliceous ore.
13	Nevada Consolidated Copper Corporation.	do	Robinson	Copper ore.
14	Lava Cap Gold Mining Corporation.	California	Grass Valley-Nevada City.	Dry and siliceous ore.
15	Consolidated Coppermines Corporation.	Nevada	Robinson	Copper ore.
16	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Zinc-lead ore, lead ore, dry and siliceous gold-silver ore.
17	Alaska-Pacific Consolidated Mining Co.	Alaska	Willow Creek	Dry and siliceous gold ore.
18	Mammoth-St. Anthony, Ltd	Arizona	Old Hat	Zinc-lead ore, dry and siliceous gold ore.
19	Manhattan Gold Dredging Co.	Nevada	Manhattan	Dredging gravel.
20	Talache Mines, Inc	Idaho	Middle Boise	Dry and siliceous gold ore.
21	Capital Dredging Co	California	Folsom	Dredging gravel.
22	Bald Mountain Mining Co	South Dakota	Trojan	Dry and siliceous gold ore.
23	Dayton Dredging Co	Nevada	Silver City	Dredging gravel.
24	United States Smelting, Refining & Mining Co. (Gold Road).	Arizona	San Francisco	Dry and siliceous gold ore.
25	Golden Queen Mining Co	California	Mojave	Dry and siliceous ore.
26	Telluride Mines, Inc	Colorado	Upper San Miguel	Dry and siliceous gold-silver ore.
27	Knob Hill Mines, Inc	Washington	Republic	Dry and siliceous gold ore.
28	Anaconda Copper Mining Co.	Montana	Summit Valley or Butte.	Copper ore, zinc-lead ore, dry and siliceous silver ore.
29	Cactus Mines Co	California	Mojave	Dry and siliceous ore.

[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.

LEADING SILVER PRODUCERS

The output of silver from the 48 leading silver-producing companies in 1942, none of which produced less than 180,000 ounces, was 43,426,353 ounces—80 percent of the total mine output of the United States (Philippine Islands and Puerto Rico excluded); the remaining 10,523,543 ounces (placer production excluded) came from about 2,600 lode mines, many of which derive a substantial net income from the silver content.

Largest producers of silver in the United States in 1942, in order of output

Rank	Operator	State	Mining district	Source of silver
1	Anaconda Copper Mining Co.	Montana	Summit Valley or Butte.	Copper ore, zonc-lead ore, dry and siliceous silver ore.
2	Sunshine Mining Co	Idaho	Evolution	Dry and siliceous silver ore.
3	Phelps Dodge Corporation	Arizona	Ajo, Copper Mountain, Verde, Warren.	Copper ore, dry and siliceous gold ore, dry and siliceous silver ore.
4	Utah Copper Co	Utah	West Mountain	Copper ore.
5	United States Smelting, Refining & Mining Co.	do	Ophir and West Mountain.	Zinc-lead-copper ore, zinc-lead ore, lead ore, dry and siliceous gold-silver ore.
6	Bunker Hill & Sullivan Mining & Concentrating Co.	Idaho	Yreka	Zinc-lead ore, lead ore, dry and siliceous silver ore.
7	Coeur d'Alene Mines Corporation.	do	Evolution	Dry and siliceous silver ore.
8	Tintic Standard Mining Co	Utah	Tintic	Lead ore, dry and siliceous gold-silver ore, dry and siliceous silver ore.
9	Federal Mining & Smelting Co.	Idaho	Hunter and Yreka	Zinc-lead ore.
10	Hecla Mining Co	do	Lelande	Zinc-lead ore, lead ore.
11	Silver King Coalition Mines Co.	Utah	Uintah	Do.
12	Emperius Mining Co.[1]	Colorado	Creede	Dry and siliceous silver ore.
13	Polaris Mining Co	Idaho	Evolution	Do.
14	Anaconda Copper Mining Co. (Flathead and West Flathead mines).	Montana	Hog Heaven	Lead ore, dry and siliceous silver ore.
15	American Metal Co. (Presidio mine).	Texas	Shafter	Dry and siliceous silver ore.
16	Desert Silver, Inc	Nevada	Silver Peak	Dry and siliceous ore.
17	Triumph Mining Co	Idaho	Warm Springs	Zinc-lead ore.
18	Park City Consolidated Mines Co.	Utah	Blue Ledge	Do.
19	New Park Mining Co	do	Park City	Do.
20	Magma Copper Co	Arizona	Pioneer	Copper ore, zinc ore.
21	Shattuck-Denn Mining Corporation.	do	Big Bug and Warren	Copper ore, zinc-lead ore, dry and siliceous gold ore, dry and siliceous silver ore.
22	Sherman Lead Co	Idaho	Lelande	Lead ore.
23	Philipsburg Mining Co	Montana	Flint Creek	Dry and siliceous gold ore, dry and siliceous silver ore.
24	Lexington Mining Co	do	Montana (Neihart)	Lead ore, dry and siliceous silver ore.
25	New Jersey Zinc Co., Empire Zinc Division.	Colorado	Battle Mountain	Zinc-lead ore, dry and siliceous silver ore.
26	Anaconda Copper Mining Co. (Emma and Ophir).	Montana	Summit Valley or Butte.	Zinc-lead ore.
27	Cactus Mines Co	California	Mojave	Dry and siliceous ore.
28	Park Utah Consolidated Mines Co.	Utah	Park City	Zinc-lead ore, lead ore.
29	American Smelting & Refining Co. (Trench and Flux Unit).	Arizona	Harshaw	Zinc-lead ore.
30	Chief Consolidated Mining Co.	Utah	Tintic	Zinc-lead ore, lead ore, dry and siliceous gold-silver ore.
31	Shenandoah-Dives Mining Co.	Colorado	Animas	Zinc-lead ore.
32	Lessees of the Tonopah Mining Co. of Nevada.	Nevada	Tonopah	Dry and siliceous ore.
33	Midnight Mining Co	Colorado	Roaring Fork	Dry and siliceous silver ore.
34	Lava Cap Gold Mining Corporation.	California	Grass Valley-Nevada City.	Dry and siliceous ore.
35	Bristol Silver Mines Co	Nevada	Jack Rabbit	Copper ore.
36	Sullivan Mining Co	Idaho	Hunter	Zinc-lead ore.
37	Combined Metals Reduction Co. (West Calumet mine).	Utah	Rush Valley	Zinc-lead ore, lead ore.
38	St. Joseph Lead Co	Montana	Barker	Zinc-lead ore.

[1] Comprises output from all the Creede district including custom ore from sublessees.

Largest producers of silver in the United States in 1942, in order of output—Continued

Rank	Operator	State	Mining district	Source of silver
39	Shoshone Mines, Inc	California	Resting Springs	Lead ore.
40	Combined Metals Reduction Co. (Butterfield mine).	Utah	West Mountain	Zinc-lead ore, dry and siliceous gold ore.
41	DeLamar Milling Corporation.	Idaho	Carson or French Creek.	Dry and siliceous gold-silver ore.
42	Telluride Mines, Inc	Colorado	Upper San Miguel	Do.
43	Combined Metals Reduction Co.	Nevada	Pioche	Zinc-lead ore.
44	Mike Horse Mining & Milling Co.	Montana	Heddleston	Do.
45	Blackhawk Consolidated Mines Co.	New Mexico	Mogollon	Dry and siliceous gold-silver ore.
46	Golden Queen Mining Co	California	Mojave	Dry and siliceous ore.
47	Tamarack & Custer Consolidated Mining Co.	Idaho	Placer Center	Zinc-lead ore.
48	Dayrock Mining Co	do	do	Lead ore.

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1941 and 1942. 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, 1941–42, by States

State	Lode		Placer		Total	
	1941	1942	1941	1942	1941	1942
Alabama	2	1			2	1
Alaska	56	38	799	453	855	491
Arizona	805	503	184	163	989	666
California	835	434	724	428	1,559	862
Colorado	579	311	324	68	903	379
Georgia	7	3	11	15	18	18
Idaho	329	201	524	236	853	437
Illinois	4	2			4	2
Michigan	1	2			1	2
Missouri	3	3			3	3
Montana	612	369	325	170	937	539
Nevada	799	434	78	49	877	483
New Mexico	145	78	103	48	248	126
New York	1	1			1	1
North Carolina	5	7	2	1	7	8
Oregon	91	48	153	83	244	131
Pennsylvania	1	1			1	1
South Carolina	7	4			7	4
South Dakota	10	5	41	13	51	18
Tennessee	4	3			4	3
Texas	9	7			9	7
Utah	167	119	12	6	179	125
Virginia	1	2	1	1	2	3
Washington	61	37	56	18	117	55
Wyoming	8	6	12	6	20	12
	4,542	2,619	3,349	1,758	7,891	4,377

MINE PRODUCTION

SUMMARY

The following table gives the mine production of gold and silver in 1941 and 1942, 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; 1940 over 1939, 5 percent; but 1941 decreased from 1940, 2 percent; and 1942 decreased from 1941, 27 percent. The total gain in 1940 over 1933 was 128 percent. The output of silver decreased 20 percent in 1942 from 1941 but was 133 percent above that in 1933.

Mine production of gold and silver in the United States, 1941–42, by regions and States, in terms of recovered metals [1]

Region and State	Gold					Silver				
	Fine ounces		Increase or decrease (percent)	Value (at $35 per ounce)		Fine ounces		Increase or decrease (percent)	Value (at $0.71111+ per ounce)	
	1941	1942		1941	1942	1941	1942		1941	1942
Western States and Alaska:										
Alaska	694,467	487,621	−30	$24,341,345	$17,066,735	191,522	119,704	−37	$136,193	$85,123
Arizona	315,392	253,651	−20	11,038,720	8,877,785	7,498,260	7,064,467	−6	5,332,096	5,023,621
California	1,408,793	847,997	−40	49,307,755	29,679,895	2,154,188	1,450,440	−33	1,531,867	1,031,424
Colorado	380,029	268,627	−29	13,301,015	9,401,945	7,301,697	3,096,211	−58	5,192,318	2,201,750
Idaho	149,816	95,020	−37	5,243,560	3,325,700	16,672,410	14,644,890	−12	11,855,936	10,414,144
Montana	246,475	146,892	−40	8,626,625	5,141,220	12,386,925	11,188,118	−10	8,808,480	7,955,995
Nevada	366,403	295,112	−19	12,824,105	10,328,920	5,830,238	3,723,435	−36	4,145,947	2,647,776
New Mexico	27,845	11,961	−57	974,575	418,635	1,328,317	676,170	−49	944,581	480,832
Oregon	96,565	46,233	−52	3,379,775	1,618,155	276,158	87,376	−68	196,379	62,134
South Dakota	600,637	522,098	−13	21,022,295	18,273,430	170,771	186,937	+9	121,437	132,933
Texas	306	236	−23	10,710	8,260	1,096,027	672,781	−39	779,397	478,422
Utah	356,501	391,544	+10	12,477,535	13,704,040	11,395,485	10,574,955	−7	8,103,456	7,519,968
Washington	84,176	75,396	−10	2,946,160	2,638,860	402,030	369,038	−8	285,888	262,427
Wyoming	478	23	−95	16,730	805	94	52	−45	67	37
	4,728,883	3,442,411	−27	165,510,905	120,484,385	66,704,122	53,854,574	−19	47,434,042	38,296,586
Eastern States:										
Alabama	30	1	−97	1,050	35	3		−100	2	
Georgia	311	30	−90	10,885	1,050	38	7	−82	27	5
New York						37,734	40,012	+6	26,833	28,453
North Carolina	3,244	4,077	+26	113,540	142,695	7,439	8,259	+11	5,290	5,873
Pennsylvania	2,422	2,499	+3	84,770	87,465	15,016	15,501	+3	10,678	11,023
South Carolina	15,508	7,824	−50	542,780	273,840	6,525	5,064	−22	4,640	3,601
Tennessee	227	159	−30	7,945	5,565	39,161	34,671	−11	27,848	24,655
Virginia	240	109	−55	8,400	3,815	135	1,793	+1,228	96	1,275
	21,982	14,699	−33	769,370	514,465	106,051	105,307	−1	75,414	74,885
Central States:										
Illinois						20,340	104	−99	14,464	74
Michigan						60,796	61,674	+1	43,233	43,857
Missouri						367,688	69,106	−81	261,467	49,142
						448,824	130,884	−71	319,164	93,073
	4,750,865	3,457,110	−27	166,280,275	120,998,850	67,258,997	54,090,765	−20	47,828,620	38,464,544

[1] Philippine Islands and Puerto Rico excluded.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1942 [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	498,879	0.168	0.25	124,668	0.078	3.04	34,395	0.030	12.28
California	2,062,599	.183	.49	621	.271	13.84	13,331	.021	5.20
Colorado	932,145	.202	.31	192,709	.130	2.07	88,132	.027	16.21
Idaho	142,952	.248	.91	173,389	.043	2.07	458,533	.001	16.42
Montana	322,140	.215	.51	77,231	.106	6.34	134,153	.025	11.73
Nevada	897,769	.152	.29	337,974	.078	3.66	81,667	.037	11.26
New Mexico	5,718	.202	.77	29,997	.137	8.91	2,116	.054	20.54
Oregon	29,055	.260	.81	1,580	.083	10.97	1,035	.195	38.12
South Dakota	1,454,387	.359	.12						
Texas							100,052	.002	6.67
Utah	126,405	.163	.28	224,420	.071	3.92	83,409	.037	11.51
Washington	93,957	.282	1.77						
Wyoming	59	.186	.02						
Total, Western States	6,566,065	.230	.36	1,162,589	.083	3.47	996,823	.014	13.70
Alaska	2,815,287	.049	.02	1,381	.017	.60			
Eastern States	106,555	.111	.07						
	9,487,907	.174	.26	1,163,970	.083	3.47	996,823	.014	13.70

State	Copper ore			Lead ore			Lead-copper ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona	[2] 32,856,971	0.004	0.15	25,898	0.084	3.92	473	0.032	5.07
California	393,944	.001	.18	29,857	.165	8.31	5	.600	60.20
Colorado	208	.212	15.33	6,418	.226	9.62	22	1.091	22.41
Idaho	2,210	.069	12.39	313,317	.001	3.52	83	------	148.84
Montana	4,338,714	.004	1.43	15,936	.149	11.37			
Nevada	7,904,443	.010	.07	32,081	.045	13.54	7	------	6.29
New Mexico	7,631,752	.001	.02	694	.209	5.26	618	.006	5.77
Oregon	58	.034	.29						
South Dakota									
Texas	506	.002	4.13	140	------	23.13			
Utah	33,611,061	.009	.08	75,758	.128	10.38	41	------	10.27
Washington	717,124	.067	.25	161	------	4.42	5	------	110.60
Wyoming				25	------	2.04			
Total, Western States	87,456,991	.007	.17	500,285	.045	5.85	1,254	.037	16.05
Alaska									
Eastern States	843,995	.003	.07	4,627	------				
	88,300,986	.007	.17	504,912	.045	5.79	1,254	.037	16.05

See footnotes at end of table.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1942 [1]—Continued

State	Zinc ore			Zinc-lead, zinc-copper, and zinc-lead-copper ores [3]			Total ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona	106,400	0.011	1.87	273,047	0.031	3.09	[2] 33,920,731	0.007	0.21
California	2,089	.004	1.10	752	.007	2.05	2,503,198	.153	.56
Colorado	590	.010	4.26	577,162	.049	1.56	1,797,386	.137	1.72
Idaho	20,561	.011	6.21	1,789,659	.004	2.99	2,900,704	.017	5.05
Montana	[4] 218,235	[5]	.30	571,871	.012	4.36	[4] 5,678,280	.019	1.97
Nevada	47,522	.011	1.84	81,916	.011	2.50	9,383,379	.026	.39
New Mexico	330,239	.001	.44	220,378	.001	.24	8,221,512	.001	.08
Oregon							31,728	.249	2.53
South Dakota				9,997	.017	.75	1,464,384	.357	.13
Texas							100,698	.002	6.68
Utah	16,710	[5]	.14	[6] 843,851	.060	6.18	[6] 34,981,655	.011	.30
Washington				411,690	[5]	.06	[7] 1,222,937	.061	.30
Wyoming							84	.131	.62
Total, Western States	742,346	.003	.85	4,780,323	.021	3.16	102,206,676	.022	.52
Alaska							2,816,668	.049	.02
Eastern States	2,364,229			846,820	[5]	.05	[8] 4,166,226	.004	.03
	3,106,575	.001	.20	5,627,143	.018	2.69	109,189,570	.022	.49

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes 4,199,268 tons of copper ore leached from which no gold or silver was recovered.
[3] Includes zinc-copper ore from Arizona and zinc-lead-copper ore from Utah.
[4] Includes 204,362 tons of current slag fumed which contained no gold.
[5] Less than 0.0005 ounce per ton.
[6] Includes 87,831 tons of zinc-lead slag.
[7] Excludes 180,000 tons of current tailings from copper ore cyanided, not included in total ore treated in State.
[8] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Gold and silver, produced in the Western States of the United States, 1848–1942, and in Alaska, 1880–1942, in terms of recovered metals

[Original research, 1848–1903, by Chas. W. Henderson; 1904–42, by western offices, Economics and Statistics Service]

State	Period	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
Alaska	1880–1942	25,639,651	$610,402,387	19,682,372	$14,000,794
Arizona	1860–1942	10,427,940	252,473,055	275,752,505	204,905,390
California	1848–1942	101,110,756	2,240,980,112	104,482,628	84,367,327
Colorado	1858–1942	38,565,382	843,665,334	721,046,775	560,682,926
Idaho	1863–1942	7,724,178	173,485,633	484,219,847	332,614,231
Montana	1862–1942	16,827,410	373,412,562	724,391,028	529,152,667
Nevada	1859–1942	25,070,558	556,031,206	584,429,765	536,926,177
New Mexico	1848–1942	2,160,741	48,960,128	65,952,746	51,631,038
Oregon	1852–1942	5,667,021	126,308,778	5,177,158	4,759,521
South Dakota	1876–1942	20,560,041	501,198,644	9,533,213	6,781,561
Texas	1885–1942	8,277	223,640	33,186,537	23,352,715
Utah	1864–1942	9,449,773	230,967,095	691,875,106	504,275,236
Washington	1860–1942	1,957,121	47,254,558	11,591,928	8,203,574
Wyoming	1867–1942	77,914	1,835,318	74,632	51,752
Total, Western States and Alaska	1848–1942	265,246,763	6,007,198,450	3,731,396,240	2,861,704,909

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 1942. 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[5] in excess of iron) gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed ores are called "dry" ores regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content (chiefly the "porphyry coppers") and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry and siliceous ores" thus, by elimination, include both dry siliceous and irony, but chiefly siliceous, ores valuable for their gold and silver content, regardless of method of treatment, and dry fluxing ores carrying considerable quantities of iron and manganese oxides, or iron sulfide, and very small quantities of gold and silver. Dry and siliceous gold ores are those that by inspection are overwhelmingly of gold content; a similar qualification applies to silver ores; decision as to "gold-silver" ore is made arbitrarily on a basis of value, using the rule that the metal of lower value is not used in the bimetal classification unless its value is equal to or over one-quarter of the combined value of gold and silver.

The lead, zinc, and zinc-lead ores in most districts in the Eastern

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

and Central States carry no appreciable quantity of gold or silver; such ores are excluded from this report unless otherwise indicated.

Mine production of gold in the United States in 1942, 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		1						1
Alaska	350,122	137,499						487,621
Arizona	2,836	94,310	144,764	2,174	15	1,152	8,400	253,651
California	464,926	377,702	436	4,916	3	9	5	847,997
Colorado	22,617	216,166	44	1,451	24	6	28,319	268,627
Georgia	15	15						30
Idaho	44,580	43,277	153	313		222	6,475	95,020
Montana	41,242	80,993	15,261	2,368		101	6,927	146,892
Nevada	47,354	166,302	78,548	1,432		537	939	295,112
New Mexico	1,247	5,381	4,815	145	4	238	131	11,961
North Carolina	1	3,975	101					4,077
Oregon	38,336	7,895	2					46,233
Pennsylvania			[3] 2,499					[3] 2,499
South Carolina		7,824						7,824
South Dakota	33	521,900					165	522,098
Tennessee			159					159
Texas		235	1					236
Utah	32	39,580	291,806	9,727	6	50,393		391,544
Virginia	53	46					10	109
Washington	356	26,524	48,399				117	75,396
Wyoming	12	11						23
	1,013,762	1,729,636	586,988	22,526	46	2,271	101,881	3,457,110

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

Mine production of silver in the United States in 1942, by States and sources, in fine ounces, in terms of recovered metals [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores [2]	Total
Alaska	50,906	68,798						119,704
Arizona	398	925,306	4,993,551	101,469	2,397	198,954	842,392	7,064,467
California	40,635	1,086,247	71,175	248,240	301	2,304	1,538	1,450,440
Colorado	4,202	2,121,150	3,189	61,717	493	2,514	902,946	3,096,211
Georgia	1	6						7
Idaho	10,471	8,017,492	27,390	1,103,683	12,354	127,670	5,345,830	14,644,890
Illinois							104	104
Michigan			61,674					61,674
Missouri				69,106				69,106
Montana	6,937	2,227,610	6,212,356	181,267		64,830	2,495,118	11,188,118
Nevada	19,980	2,418,913	558,330	434,355	44	87,425	204,388	3,723,435
New Mexico	135	315,135	156,613	3,653	3,565	144,792	52,277	676,170
New York							40,012	40,012
North Carolina		2,505	5,754					8,259
Oregon	7,141	80,218	17					87,376
Pennsylvania			[3] 15,501					[3] 15,501
South Carolina		5,064						5,064
South Dakota	[3]	179,389					7,545	186,937
Tennessee			34,671					34,671
Texas		667,454	2,089	3,238				672,781
Utah		1,875,712	2,698,515	786,550	421	2,278	5,211,479	10,574,955
Virginia	1	31					1,761	1,793
Washington	59	165,960	176,348	712	553		25,406	369,038
Wyoming		1		51				52
	140,869	20,156,991	15,017,173	2,994,041	20,128	630,767	15,130,796	54,090,765

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

Gold and silver produced in the United States from ore and old tailings in 1942, by States and by methods of recovery, in terms of recovered metals [1]

State	Total ore and old tailings treated (short tons)	Ore and old tailings 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 (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces).	Short tons	Gold (fine ounces)	Silver (fine ounces)
Western States and Alaska:												
Alaska	2,816,668	2,814,884	----------	115,304	21,928	1,781	3,004	22,192	46,869	3	3	1
Arizona	[2] 29,721,463	509,347	34,334	46,040	103,946	27,102,358	1,322,817	105,078	2,668,316	2,075,424	99,697	4,291,807
California	2,503,198	1,381,907	625,564	277,714	424,360	435,332	21,602	91,986	659,415	60,395	13,371	326,030
Colorado	1,797,386	926,909	----------	146,365	29,108	822,304	140,590	91,219	2,446,104	48,173	8,426	616,797
Idaho	2,900,704	111,772	----------	16,971	11,835	2,762,323	406,954	30,649	14,319,082	26,609	2,820	303,502
Montana	[3] 5,678,280	234,051	17,888	28,017	66,409	4,977,953	681,716	41,382	9,318,651	[3] 448,388	36,251	1,796,121
Nevada	9,383,379	1,151,807	81,085	142,585	1,513,648	8,007,455	328,060	83,961	956,058	143,032	21,212	1,233,749
New Mexico	8,221,512	29,302	----------	3,365	226,829	8,107,858	337,736	5,652	341,552	84,352	1,697	107,654
Oregon	31,728	4,728	2,675	1,683	299	18,348	1,424	2,263	32,431	5,977	3,951	47,505
South Dakota	1,464,384	1,454,387	----------	520,719	179,164	9,997	605	1,346	7,770	----------	----------	----------
Texas	100,698	96,481	----------	213	545,360	----------	396	22	119,344	4,217	1	8,077
Utah	[4] 34,981,655	96,302	----------	7,521	218	34,336,812	1,187,858	338,510	7,851,851	[4] 548,541	45,481	2,722,886
Washington	1,222,937	71,357	----------	4,207	18,178	1,130,075	71,492	65,422	323,029	21,505	5,411	27,772
Wyoming	84	59	----------	11	1	----------	----------	----------	----------	25	----------	51
	[5] 100,824,076	8,883,293	761,546	1,310,715	3,141,283	87,712,596	4,504,254	879,682	39,090,472	3,466,641	238,321	11,481,952
Eastern States	[6] 4,166,226	106,062	35	11,421	7,399	[6] 3,960,833	703,771	2,668	91,945	99,296	541	5,961
	[7] 104,990,302	8,989,355	761,581	1,322,136	3,148,682	[6] 91,673,429	5,208,025	882,350	39,182,417	3,565,937	238,862	11,487,913

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Excludes 4,199,268 tons of copper ore leached from which no gold or silver was recovered.
[3] Includes 204,362 tons of slag from which silver was recovered.
[4] Includes 87,831 tons of slag from which silver was recovered.
[5] Excludes copper ore leached from Arizona; includes slag from Montana and Utah.
[6] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania, which Bureau of Mines is not at liberty to publish.
[7] Excludes copper ore leached from Arizona; includes slag from Montana and Utah; excludes magnetite 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, 1938–42 [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
1938	984,620	223,058	962,788	4,275,154	23.1	0.4	22.6	7.0	26.4	92.4	27.9	0.2
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
1941	916,113	214,665	1,005,031	5,157,702	19.3	.3	21.1	7.7	28.3	91.7	31.3	.3
1942	623,319	140,192	698,817	3,008,490	18.0	.2	20.2	5.6	32.5	93.9	29.3	.3

[1] Illinois, Michigan, Missouri, 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 1942, 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	2,814,884	115,304	21,928				23.65	18.32		
Arizona	765	327	146	539,154	45,713	103,800	.13	(2)	18.02	1.47
California	785,945	144,004	29,010	1,006,361	133,710	395,350	16.98	2.00	15.77	27.26
Colorado	717,716	60,233	15,906	272,889	86,132	13,202	22.42	.51	32.06	.43
Idaho	109,072	16,580	8,531	2,700	391	3,304	17.45	.06	.41	.02
Montana	12,773	956	207	239,166	27,061	66,202	.65	(2)	18.42	.59
Nevada	89,857	8,521	7,239	1,167,244	134,064	1,506,409	2.89	.19	45.43	40.46
New Mexico	500	170	42	28,802	3,195	226,787	1.42	.01	26.71	33.54
Oregon	565	437	95	6,838	1,246	204	.95	.11	2.70	.23
South Dakota	1,275,138	276,298	56,852	1,433,306	244,421	122,312	52.92	30.41	46.82	65.43
Texas				96,085	213	545,360			90.25	81.06
Utah	1,475	95	61	94,827	7,426	157	.02	(2)	1.90	(2)
Washington	125	264	87	247,732	3,943	18,091	.35	.02	5.23	4.90
Wyoming	59	11	1				47.83	1.92		
Eastern States	371	119	87	105,726	11,302	7,312	.81	.08	76.89	6.94
	5,809,245	623,319	140,192	5,240,830	698,817	3,008,490	18.03	.26	20.21	5.58

[1] Illinois, Michigan, Missouri, 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 68 percent of the total output from placers in the United States (Philippine Islands and Puerto Rico excluded) in 1942 and 58 percent in 1941. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1942 is recorded as 19,074,071 ounces, originating by States as follows: California, 11,566,916 ounces; Alaska, 5,158,064 (including the production from two Becker-Hopkins single-dipper dredges and some gold by hydraulicking); Montana, 691,083; Idaho, 612,291; Colorado, 455,195;

Oregon, 467,046; and other States, 123,476. The output in 1942 was 689,069 ounces from 102 dredges, of which California produced 310,937 ounces from 44 dredges; Alaska, 249,868 ounces from 31 dredges; Idaho, 36,631 ounces from 10 dredges; Montana, 31,283 ounces from 7 dredges; Oregon, 21,641 ounces from 6 dredges; and Colorado, 14,523 ounces from 3 dredges.

Connected-bucket floating gold dredges operated in the United States, 1941–42, by companies and districts

ALASKA

Company	Address	District	Number of dredges	
			1941	1942
Standard Mines, Inc.[1]	Ferry	Bonnifield-Nenana	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	Council	Council-Bluff	1	1
Camp Creek Dredging Co	do	do	1	1
Council Dredging Co	do	do	1	------
Inland Dredging Co	do	do	1	1
Ophir Gold Dredging Co	do	do	1	------
Brinker-Johnson Co	Fairbanks	Fairbanks	1	1
United States Smelting, Refining & Mining Co., Fairbanks Department.	do	do	8	7
Arctic Circle Exploration, Inc	Candle	Fairhaven	2	2
Dry Creek Dredging Co	Deering	do	1	1
Forsgren Dredging Co	do	do	1	1
Boundary Dredging Co	Boundary	Fortymile	1	------
Wade Creek Dredging Co	Fairbanks	do	1	------
Bristol Bay Mining Co	Goodnews Bay	Goodnews Bay	1	------
North American Dredging Co	Flat	Iditarod	1	1
J. E. Riley Investment Co	do	do	1	1
Ganes Mining Co	Ophir	Innoko	1	1
Moss & Larson Mining Co	do	do	1	1
Nels J. Vibe	do	do	1	1
Castleton & Keenan (Kougarok Consolidated Placers, Inc.).	Nome	Kougarok	1	1
Fox Bar Dredging Co	do	do	1	1
Ungalik Syndicate	do	Koyuk	1	------
American Creek Dredging Co	do	Nome	1	------
Casa de Paga Gold Co	do	do	1	1
Lee Brothers Dredging Co	Solomon	do	2	1
Osborn Creek Dredging Co	Nome	do	1	------
Tolbert Scott	do	do	1	------
United States Smelting, Refining & Mining Co., Nome Department.	do	do	4	2
Livengood Placers, Inc	Livengood	Tolovana	1	------
Nome Creek Mining Co	Fairbanks	do	1	------
New York Alaska Gold Dredging Co	Nyac	Tuluksak-Aniak	2	2
			47	31

[1] Single-dipper dredge.

Connected-bucket floating gold dredges operated in the United States, 1941–42, by companies and districts—Continued

CALIFORNIA

Company	Address	District	Number of dredges	
			1941	1942
Poverty Hill Partnership	San Francisco	Brandy City [2]	1	1
Lancha Plana Gold Dredging Co	Lockeford	Butte Creek [3]		1
Etna Gold Dredging Co	Callahan	Callahan	1	
Yuba Consolidated Gold Fields	San Francisco	do	1	1
Gold Hill Dredging Co	do	Camanche	2	2
Cosumnes Gold Dredging Co	do	Cosumnes River	1	1
Capital Dredging Co	do	Folsom	2	2
Lancha Plana Gold Dredging Co	do	do	1	1
Natomas Co	do	do	7	7
French Gulch Dredging Co	do	French Gulch	1	1
Cal Oro Gold Dredging Co	do	Greenhorn	1	
Thurman Gold Dredging Co	do	Igo	1	1
Arroyo Seco Gold Dredging Co	do	Ione	1	
Lancha Plana Gold Dredging Co	Ione	do [3]	1	
California Gold Dredging Co	San Francisco	Jenny Lind	1	
Junction City Mining Co	Junction City	Junction City	1	1
Yreka Gold Dredging Co	San Francisco	Klamath Rico	1	1
La Grange Gold Dredging Co	do	La Grange	1	1
Tuolumne Gold Dredging Co	do	do	1	1
Yuba Consolidated Gold Fields	do	do	1	1
Roseville Gold Dredging Co	do	Ophir	1	1
Gold Hill Dredging Co	do	Oroville	1	1
Oroville Gold Dredging Co	Oroville	do	1	1
Yuba Consolidated Gold Fields	San Francisco	do	4	4
Klamath Dredging Co	Orleans	Orleans		1
Rand Gold Dredging Associates	San Francisco	Randsburg		1
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	do	do	2	2
Yuba Consolidated Gold Fields	do	do	1	
Carrville Gold Co	do	Trinity Center	1	1
Yuba Consolidated Gold Fields	do	Yuba River	6	6
			47	44

COLORADO

Timberline Dredging Co	Fairplay	Beaver Creek	1	1
Blue River Co	Breckenridge	Breckenridge		1
South Platte Dredging Co	Fairplay	Fairplay	1	1
			2	3

IDAHO

Fisher-Baumhoff Co. (2 Dredges)	Centerville	Boise Basin	2	2
Boise King Placers	Twin Springs	Middle Boise	1	1
Northwest Goldfields	Harvard	Hoodoo	1	1
Idaho-Canadian Dredging Co	Idaho City	Boise Basin	1	1
Snake River Mng. Co	Sunbeam	Yankee Fork	1	1
H. & H. Mines	Elk City	Elk City	1	1
Idaho Warren Dredging Co	North Fork	Gibbonsville	1	1
W. W. Prather	Warren	Warren		1
Mt. Vernon Gold Mng. Co	Elk City	Elk City	1	1
Warren Dredging Co	Warren	Pierce	2	
Quartz Creek Dredging Co	Pierce	do	1	
			12	10

[2] Port Wine district in 1941.
[3] Dredge No. 3 was reconstructed and called Dredge No. 5 and moved from Ione district, Amador County, to Butte Creek district, Butte County.

Connected-bucket floating gold dredges operated in the United States, 1941–42, by companies and districts—Continued

MONTANA

Company	Address	District	Number of dredges	
			1941	1942
Winston Bros. Co	Helena	Clancey	1	1
Porter Bros. Corporation	do	First Chance	1	1
Perry-Schroeder Mining Co	do	Missouri River	1	1
Emigrant Dredging Co	Emigrant	Emigrant	1	1
Star Pointer Exploration Co	Bearmouth	First Chance	1	1
Gold Creek Mng. Co	Deer Lodge	Washington	1	1
Homer Wilson (Norwegian Dredge)	Harrison	Norris & Norwegian	1	1
			7	7

NEVADA

Manhattan Gold Dredging Co	San Francisco	Manhattan	1	1

OREGON

Western Gold Dredging Co	San Francisco	Canyon	1	1
Pleasant Creek Mining Corporation	Seattle	Gold Hill	1	1
Porter and Co	Granite	Granite	1	1
Sunshine Mining Co. (Burnt River Division)	Baker	Greenhorn	1	1
Timms Gold Dredging Co	Bates	do	1	1
Sumpter Valley Dredging Co	Sumpter	Sumpter	1	1
Murphy-Murray Dredging Co	Rouge River	Gold Hill	1	
			7	6

Gold produced in the United States by connected-bucket floating dredges, 1938–42, in fine ounces

Year	Dredges	California	Alaska	Other States [1]	Total
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
1941	123	418,282	307,087	141,636	867,005
1942	102	310,937	249,868	128,264	689,069

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

OTHER PLACER-MINING METHODS

From 1932 through 1942 dragline and power-shovel excavators operated in connection with dry-land floating amalgamating and sluicing plants have been widely used in placer mining. In 1942 approximately 28 percent of the total output of placer gold, excluding that of Alaska and the Philippine Islands, was recovered at such plants, and 5 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.

EMPLOYMENT AND PRODUCTION

Statistics on employment and production in the gold and silver industry are presented for the first time in Minerals Yearbook. Data are given for 1941 only; figures for 1942 are incomplete. Mine and mill employees are classified according to the methods described in this volume in the chapter on Employment and Accidents in the Mineral Industries. Gold, gold-silver, and silver ores are classified on the basis of the methods described in the earlier pages of the chapter on Gold and Silver.

Employment and production in gold and silver lode mines in the United States in 1941

GOLD ORE

State or region	Number of mines	Employment									
		Average number of men					Man-hours				
		Mine			Mill	Total	Mine			Mill	Total
		Underground	Surface [1]	Total			Underground	Surface [1]	Total		
Western States:											
Arizona	471	1,004	265	1,269	174	1,443	1,563,070	443,594	2,006,664	481,173	2,487,837
California	764	4,558	1,389	5,947	929	6,876	9,071,197	2,690,599	11,761,796	2,140,381	13,902,177
Colorado	381	1,658	568	2,226	535	2,761	3,470,782	1,267,834	4,738,616	1,191,904	5,930,520
Idaho	172	821	232	1,053	207	1,260	1,544,103	450,320	1,994,423	334,464	2,328,887
Montana (incl. Wyoming)	349	1,009	230	1,239	206	1,445	1,797,535	490,681	2,288,216	479,456	2,767,672
Nevada	442	1,176	693	1,869	330	2,199	1,835,593	965,266	2,800,859	828,307	3,629,166
New Mexico	43	72	13	85	5	90	65,541	17,280	82,821	12,500	95,321
Oregon	82	393	58	451	42	493	669,668	108,993	778,661	68,340	847,001
South Dakota	10	1,369	984	2,353	270	2,623	3,001,984	2,125,996	5,127,980	601,443	5,729,423
Utah	24	411	65	476	35	511	780,472	166,339	946,811	81,216	1,028,027
Washington	32	143	52	195	40	235	245,597	74,544	320,141	99,108	419,249
Total	2,770	12,614	4,549	17,163	2,773	19,936	24,045,542	8,801,446	32,846,988	6,318,292	39,165,280
Alaska	54	832	360	1,192	336	1,528	2,083,040	975,840	3,058,880	754,768	3,813,648
Eastern States	21	52	115	167	37	204	54,380	366,838	421,218	105,434	526,652
	2,845	13,498	5,024	18,522	3,146	21,668	26,182,962	10,144,124	36,327,086	7,178,494	43,505,580

State or region	Production											
	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value [2]	Percent of total value from—			Man-hours			
	Produced	Milled				Gold	Silver	Base metals	Per ton of ore		Per ounce of gold and silver	
									Mined	Milled	Mined	Milled
Western States:												
Arizona	800,804	774,538	130,298	213,360	$5,005,719	91.1	3.0	5.9	2.51	0.62	5.84	1.88
California	3,848,038	3,828,911	646,386	985,692	23,376,410	96.8	3.0	.2	3.06	.56	7.21	1.34
Colorado	1,234,025	1,225,243	277,160	401,609	10,218,342	94.9	2.8	2.3	3.84	.97	6.98	1.84
Idaho	330,354	325,343	62,657	245,418	2,385,221	91.9	7.3	.8	6.04	1.03	6.47	1.13
Montana (incl. Wyoming)	695,598	642,238	140,167	390,653	5,225,582	93.9	5.3	.8	3.29	.75	4.31	1.68
Nevada	1,250,607	1,215,961	205,453	518,177	7,575,143	94.9	4.9	.2	2.24	.68	3.87	1.33
New Mexico	18,305	13,923	4,360	18,036	186,119	82.0	6.9	11.1	4.52	.90	3.70	1.06
Oregon	87,748	80,216	33,542	96,607	1,259,716	93.2	5.5	1.3	8.87	.85	5.98	.60
South Dakota	1,711,744	1,711,739	600,544	170,764	21,140,472	99.4	.6	-------	3.00	.35	6.65	.78
Utah	328,576	252,595	42,171	130,260	1,635,388	90.3	5.7	4.0	2.88	.32	5.49	4.51
Washington	178,121	139,731	37,508	175,011	1,444,066	90.9	8.6	.5	1.80	.71	1.51	.64
Total	10,483,920	10,210,438	2,180,246	3,345,587	79,452,178	96.0	3.0	1.0	3.13	.62	5.94	1.34
Alaska	4,480,364	4,480,332	203,855	123,850	7,312,993	97.6	1.2	1.2	.68	.17	9.33	2.31
Eastern States	152,833	152,833	19,033	9,081	672,762	99.0	1.0	-------	2.76	.69	14.98	3.75
	15,117,117	14,843,603	2,403,134	3,478,518	87,437,933	96.2	2.8	1.0	2.40	.48	6.18	1.41

See footnotes at end of table.

Employment and production in gold and silver lode mines in the United States in 1941—Continued

GOLD-SILVER ORE

State or region	Number of mines	Employment									
		Average number of men					Man-hours				
		Mine			Mill	Total	Mine			Mill	Total
		Underground	Surface [1]	Total			Underground	Surface [1]	Total		
Western States:											
Arizona	68	259	70	329	21	350	320,806	59,060	379,866	55,166	435,032
California	21	205	58	263	50	313	339,322	78,952	418,274	100,000	518,274
Colorado	48	282	91	373	123	496	569,537	230,646	800,183	272,440	1,072,623
Idaho	16	23	44	67	27	94	28,222	86,116	114,338	69,708	184,046
Montana	76	208	48	256	4	260	317,082	91,832	408,914	8,000	416,914
Nevada	141	778	169	947	128	1,075	1,369,123	295,479	1,664,602	355,846	2,020,448
New Mexico	22	180	32	212	28	240	417,056	74,384	491,440	78,070	569,510
Oregon	5	23	9	32	7	39	51,535	18,625	70,160	13,000	83,160
Utah	33	262	69	331	-------	331	421,084	115,816	536,900	----------	536,900
Washington	5	5	----------	5	-------	5	470	----------	470	----------	470
Total	435	2,225	590	2,815	388	3,203	3,834,237	1,050,910	4,885,147	952,230	5,837,377
	435	2,225	590	2,815	388	3,203	3,834,237	1,050,910	4,885,147	952,230	5,837,377

State or region	Production											
	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value [2]	Percent of total value from—			Man-hours			
	Produced	Milled				Gold	Silver	Base metals	Per ton of ore		Per ounce of gold and silver	
									Mined	Milled	Mined	Milled
Western States:												
Arizona	138,611	100,860	13,187	526,518	$926,065	49.8	40.4	9.8	2.74	0.55	0.70	0.30
California	117,983	112,107	28,716	736,469	1,530,966	65.6	34.2	.2	3.55	.89	.55	.15
Colorado	270,267	264,943	27,067	622,763	1,611,065	58.8	27.5	13.7	2.96	1.03	1.23	.43
Idaho	82,465	81,202	5,566	296,475	409,383	47.6	51.5	.9	1.39	.86	.38	.27
Montana	121,902	7,859	11,277	700,663	1,113,635	35.4	44.7	19.9	3.35	1.02	.57	.46
Nevada	416,981	332,993	50,693	2,424,067	3,576,384	49.6	48.2	2.2	3.99	1.07	.67	.22
New Mexico	89,430	84,711	11,598	728,462	924,930	43.9	56.0	.1	5.50	.92	.66	.11
Oregon	9,783	7,363	2,583	166,126	212,141	42.6	55.7	1.7	7.17	1.77	.42	.17
Utah	199,866	----------	12,091	946,277	1,543,265	27.4	43.6	29.0	2.69	--------	.56	--------
Washington	87	----------	32	1,216	2,139	52.4	40.4	7.2	5.40	--------	.38	--------
Total	1,447,375	992,038	162,810	7,149,036	11,849,973	48.1	42.9	9.0	3.38	.96	.67	.23
	1,447,375	992,038	162,810	7,149,036	11,849,973	48.1	42.9	9.0	3.38	.96	.67	.23

See footnotes at end of table.

Employment and production in gold and silver lode mines in the United States in 1941—Continued

SILVER ORE

State or region	Number of mines	Employment									
		Average number of men					Man-hours				
		Mine			Mill	Total	Mine			Mill	Total
		Underground	Surface [1]	Total			Underground	Surface [1]	Total		
Western States:											
Arizona	72	147	39	186	1	187	112,596	32,688	145,284	2,000	147,284
California	19	9	25	34	2	36	10,206	14,679	24,885	2,000	26,885
Colorado	46	95	22	117	27	144	163,702	37,030	200,732	62,800	263,532
Idaho	31	853	125	978	75	1,053	1,811,858	257,506	2,069,364	157,043	2,226,407
Montana	69	218	51	269	31	300	391,899	116,260	508,159	72,712	580,871
Nevada	129	355	76	431	21	452	463,864	67,560	531,424	40,656	572,080
New Mexico	13	13		13	1	14	2,350		2,350	55	2,405
Oregon [3]											
Texas	4	242	20	262	55	317	591,440	50,664	642,104	156,000	798,104
Utah	34	277	37	314		314	436,492	133,309	569,801		569,801
Washington	8	9	2	11	1	12	5,565	1,920	7,485	2,000	9,485
Total	425	2,218	397	2,615	214	2,829	3,989,972	711,616	4,701,588	495,266	5,196,854
	425	2,218	397	2,615	214	2,829	3,989,972	711,616	4,701,588	495,266	5,196,854

State or region	Production										
	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value [2]	Percent of total value from—			Man-hours		
	Produced	Milled				Gold	Silver	Base metals	Per ton of ore		Per ounce of gold and silver
									Mined	Milled	Mined	Milled
Western States:												
Arizona	36,375	3,992	713	455,936	$374,732	6.7	86.5	6.8	3.99	0.50	0.32	0.06
California	2,262	2,152	27	19,225	17,814	5.3	76.7	18.0	11.00	.93	1.29	.11
Colorado	68,471	45,729	967	1,200,260	1,025,659	3.3	83.2	13.5	2.93	1.37	.17	.08
Idaho	490,691	480,902	433	9,869,309	7,672,103	.2	91.5	8.3	4.22	.33	.21	.02
Montana	122,684	47,882	5,170	1,823,971	1,644,374	11.0	78.9	10.1	4.14	1.52	.28	.08
Nevada	116,335	86,326	5,002	1,242,526	1,074,020	16.3	82.3	1.4	4.57	.47	.43	.05
New Mexico	282	50	8	7,732	6,255	4.5	87.9	7.6	8.33	1.10	.30	.09
Oregon												
Texas [3]	140,739	140,503	304	1,095,750	811,917	1.3	96.0	2.7	4.56	1.11	.59	.14
Utah	94,208		3,895	1,256,541	1,327,120	10.8	67.3	21.9	6.05		.45	
Washington	2,492	2,300	53	10,723	9,701	19.1	78.6	2.3	3.00	.87	.69	.22
Total	1,074,539	809,836	16,572	16,981,973	13,963,695	4.2	86.5	9.3	4.38	.61	.28	.04
	1,074,539	809,836	16,572	16,981,973	13,963,695	4.2	86.5	9.3	4.38	.61	.28	.04

See footnotes at end of table.

Employment and production in gold and silver lode mines in the United States in 1941—Continued

SUMMARY

State or region	Number of mines	Employment									
		Average number of men					Man-hours				
		Mine			Mill	Total	Mine			Mill	Total
		Underground	Surface [1]	Total			Underground	Surface [1]	Total		
Western States:											
Arizona	[4] 594	1,410	374	1,784	196	1,980	1,996,472	535,342	2,531,814	538,339	3,070,153
California	[4] 803	4,772	1,472	6,244	981	7,225	9,420,725	2,784,230	12,204,955	2,242,381	14,447,336
Colorado	[4] 465	2,035	681	2,716	685	3,401	4,204,021	1,535,510	5,739,531	1,527,144	7,266,675
Idaho	[4] 217	1,697	401	2,098	309	2,407	3,384,183	793,942	4,178,125	561,215	4,739,340
Montana (incl. Wyo.)	[4] 490	1,435	329	1,764	241	2,005	2,506,516	698,773	3,205,289	560,168	3,765,457
Nevada	[4] 698	2,309	938	3,247	479	3,726	3,668,580	1,328,305	4,996,885	1,224,809	6,221,694
New Mexico	[4] 73	265	45	310	34	344	484,947	91,664	576,611	90,625	667,236
Oregon	87	416	67	483	49	532	721,203	127,618	848,821	81,340	930,161
South Dakota	10	1,369	984	2,353	270	2,623	3,001,984	2,125,996	5,127,980	601,443	5,729,423
Texas	4	242	20	262	55	317	591,440	50,664	642,104	156,000	798,104
Utah	91	950	171	1,121	35	1,156	1,638,048	415,464	2,053,512	81,216	2,134,728
Washington	45	157	54	211	41	252	251,632	76,464	328,096	101,108	429,204
Total	[4] 3,577	17,057	5,536	22,593	3,375	25,968	31,869,751	10,563,972	42,433,723	7,765,788	50,199,511
Alaska	54	832	360	1,192	336	1,528	2,083,040	975,840	3,058,880	754,768	3,813,648
Eastern States	21	52	115	167	37	204	54,380	366,838	421,218	105,434	526,652
	[4] 3,652	17,941	6,011	23,952	3,748	27,700	34,007,171	11,906,650	45,913,821	8,625,990	54,139,811

State or region	Production											
	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value [2]	Percent of total value from—			Man-hours			
	Produced	Milled				Gold	Silver	Base metals	Per ton of ore		Per ounce of gold and silver	
									Mined	Milled	Mined	Milled
Western States:												
Arizona	975,790	879,390	144,198	1,195,814	$6,306,516	80.0	13.5	6.5	2.59	0.61	1.89	1.14
California	3,968,283	3,943,170	675,129	1,741,386	24,925,190	94.8	5.0	.2	3.08	.57	5.05	.98
Colorado	1,572,763	1,535,915	305,194	2,224,632	12,855,066	83.1	12.3	4.6	3.65	.99	2.27	.74
Idaho	903,510	887,447	68,656	10,411,202	10,466,707	23.0	70.7	6.3	4.62	.63	.40	.05
Montana (incl. Wyo.)	940,184	697,979	156,614	2,915,287	7,983,591	68.7	26.0	5.3	3.41	.80	1.04	.47
Nevada	1,783,923	1,635,280	261,148	4,184,770	12,225,547	74.8	24.3	.9	2.80	.75	1.12	.40
New Mexico	108,017	98,684	15,966	754,230	1,117,304	50.0	48.0	2.0	5.34	.92	.75	.13
Oregon	97,531	87,579	36,125	262,733	1,471,857	85.9	12.7	1.4	8.70	.93	2.84	.42
South Dakota	1,711,744	1,711,739	600,544	176,764	21,140,472	99.4	.6	-------	3.00	.35	6.65	.78
Texas	140,739	140,503	304	1,095,750	811,917	1.3	96.0	2.7	4.56	1.11	1.83	.14
Utah	622,650	252,595	58,157	2,333,078	4,505,773	45.2	36.8	18.0	3.30	.32	.86	4.51
Washington	180,700	142,031	37,593	186,950	1,455,906	90.4	9.1	.5	1.82	.71	1.46	.79
Total	13,005,834	12,012,312	2,359,628	27,476,596	105,265,846	78.5	18.6	2.9	3.26	.65	1.42	.35
Alaska	4,480,364	4,480,332	203,855	123,850	7,312,993	97.6	1.2	1.2	.68	.17	9.33	2.31
Eastern States	152,833	152,833	19,033	9,081	672,762	99.0	1.0	-------	2.76	.69	14.98	3.75
	17,639,031	16,645,477	2,582,516	27,609,527	113,251,601	79.8	17.3	2.9	2.60	.52	1.52	.38

[1] Includes open-cut workers.
[2] Includes value of base metals recovered.
[3] Included with gold-silver ore from Oregon.
[4] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

Employment and production in gold placer mines in the United States in 1941

State of region	Number of mines	Employment								Production			
		Average number of men				Man-hours				Gold (ounces)	Silver (ounces)	Total value	Man-hours per ounce gold and silver
		Dredging	Hydraulicking	Other [1]	Total	Dredging	Hydraulicking	Other	Total				
Western States:													
Arizona	184	70	1	194	265	142,240	360	116,880	259,480	11,931	2,205	$419,153	18.35
California	724	3,817	453	852	5,122	7,137,253	576,694	981,123	8,695,070	718,013	65,475	25,177,015	11.10
Colorado	324	276	131	254	661	444,804	142,632	204,784	792,220	30,377	5,687	1,067,239	21.96
Idaho	524	437	245	438	1,120	740,496	193,663	270,554	1,204,713	72,395	17,408	2,546,204	13.41
Montana	325	435	36	257	728	709,993	31,684	239,093	980,770	61,611	10,035	2,163,521	13.69
Nevada	78	110	3	196	309	250,483	552	169,852	420,887	36,897	14,033	1,301,374	8.26
New Mexico	103	33	----------	96	129	45,740	----------	115,908	161,648	2,488	284	87,282	58.31
Oregon	153	541	179	115	835	1,029,120	146,034	89,888	1,265,042	60,430	11,205	2,123,018	17.66
South Dakota	41	----------	1	48	49	----------	160	21,560	21,720	93	7	3,260	217.20
Utah	12	14	1	17	32	13,280	128	14,928	28,336	629	90	22,079	39.41
Washington	56	26	----------	62	88	11,280	----------	22,392	33,672	540	90	18,964	53.45
Wyoming	12	20	----------	15	35	19,200	----------	3,208	22,408	447	50	15,681	45.09
Total	2,536	5,779	1,050	2,544	9,373	10,543,889	1,091,907	2,250,170	13,885,966	995,851	126,569	34,944,790	12.37
Alaska	799	2,424	971	570	3,965	3,796,336	776,800	684,000	5,257,136	491,581	67,544	17,253,366	9.40
Eastern States	14	13	----------	17	30	25,878	----------	6,960	32,838	203	15	7,116	150.63
	3,349	8,216	2,021	3,131	13,368	14,366,103	1,868,707	2,941,130	19,175,940	1,487,635	194,128	52,205,272	11.40

Summary—Employment and production in all gold and silver mines in the United States in 1941

State or region	Number of mines	Employment		Production						
		Men	Man-hours	Gold (ounces)	Silver (ounces)	Total value [2]	Percent of total value from—			Man-hours per ounce gold and silver mined
							Gold	Silver	Base metals	
Western States:										
Arizona	[3] 778	2,049	2,791,294	156,129	1,198,019	$6,725,669	81.2	12.7	6.1	2.06
California	[3] 1,527	11,366	20,900,025	1,393,142	1,806,861	50,102,205	97.3	2.6	.1	6.53
Colorado	[3] 789	3,377	6,531,751	335,571	2,230,319	13,922,305	84.4	11.4	4.2	2.54
Idaho	[3] 741	3,218	5,382,838	141,051	10,428,610	13,012,911	37.9	57.0	5.1	.50
Montana	[3] 815	2,492	4,186,059	218,225	2,925,322	10,147,112	75.3	20.5	4.2	1.33
Nevada	[3] 776	3,556	5,417,772	298,045	4,198,803	13,526,921	77.1	22.1	.8	1.20
New Mexico	[3] 176	439	738,259	18,454	754,514	1,204,586	53.6	44.5	1.9	.95
Oregon	240	1,318	2,113,863	96,555	273,938	3,594,875	94.0	5.4	.6	5.70
South Dakota	51	2,402	5,149,700	600,637	170,771	21,143,732	99.4	.6	----------	6.67
Texas	4	262	642,104	304	1,095,750	811,917	1.3	96.0	2.7	.58
Utah	103	1,153	2,081,848	58,786	2,333,168	4,527,852	45.4	36.6	8.0	.87
Washington	101	299	361,768	38,133	187,040	1,474,870	90.5	9.0	.5	1.60
Wyoming [4]	12	35	22,408	447	50	15,681	99.8	.2	----------	45.09
Total	6,113	31,966	56,319,689	3,355,479	27,603,165	140,210,636	83.8	14.0	2.2	1.81
Alaska	853	5,157	8,316,016	695,436	191,394	24,566,359	99.1	.6	.3	9.37
Eastern States	35	197	454,056	19,236	9,096	679,878	99.0	1.0	----------	16.03
	7,001	37,320	65,089,761	4,070,151	27,803,655	165,456,873	86.1	11.9	2.0	2.04

[1] Includes employees in underground placers, small-scale hand operations, and surface shops and yards.
[2] Includes value of base metals recovered.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Placer mines only; data on lode mines included with Montana.

WORLD ASPECTS

WORLD PRODUCTION

According to the Bureau of the Mint, the world output of gold and silver from 1493 to 1941 is 1,415,496,883 fine ounces of gold valued at $33,321,716,914 and 17,507,210,287 fine ounces of silver valued at $15,543,504,556 (see figs. 2 and 3).

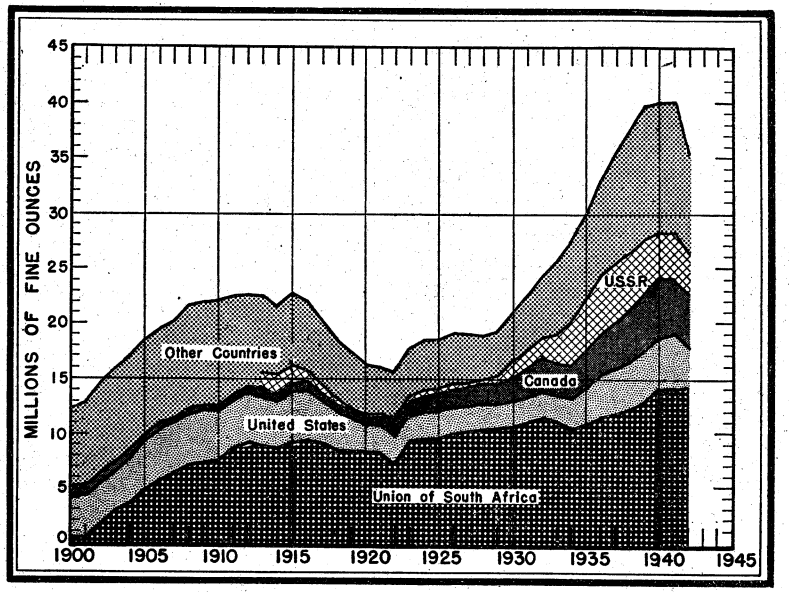

FIGURE 2.—World production of gold, 1900–42. (Figures for 1942 are preliminary.)

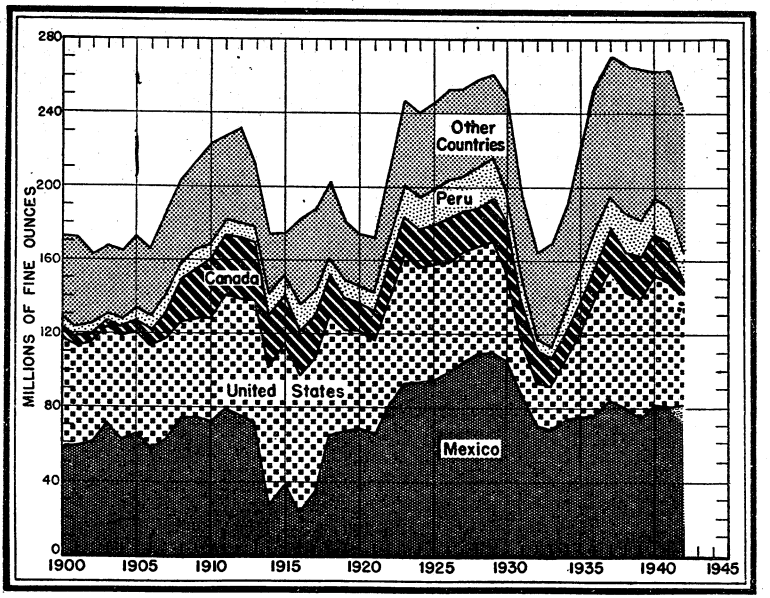

FIGURE 3.—World production of silver, 1900–42. (Figures for 1942 are preliminary.)

World production of gold, 1938–42, by countries, in fine ounces [1]

Country	1938	1939	1940	1941	1942
North America:					
United States:					
Continental [2]	4,245,368	4,620,567	4,862,979	4,832,067	3,583,080
Puerto Rico	9	35		20	
Canada	4,725,117	5,094,379	5,311,145	5,345,179	4,829,815
Central America and West Indies:					
Costa Rica	17,994	13,261	13,538	[3] 12,760	(4)
Cuba	[5] 3,889	[5] 3,851	[5] 1,251	[5] 607	[5] 195
Dominican Republic (exports)	5,275	6,304	6,914	15,614	(4)
Guatemala	5,466	5,058	4,447	2,560	(4)
Honduras	21,879	22,216	23,173	22,822	22,089
Nicaragua	44,301	100,182	164,355	209,430	(4)
Panama	6,879	3,774	2,634	2,115	(4)
Salvador	[6] 12,065	[6] 16,424	[6] 51,195	[6] 32,593	[6] 30,197
Other countries [3]	48,300	(4)	(4)	(4)	(4)
Mexico	923,819	841,642	883,117	799,975	801,325
Newfoundland	24,246	20,316	21,786	21,194	15,750
	10,085,000	10,798,000	11,397,000	11,347,000	9,557,000
South America:					
Argentina	8,423	12,249	12,860	17,136	(4)
Bolivia	[7] 9,255	[7] 7,884	[5] 11,749	[5] 8,158	[5] 5,905
Brazil	216,600	290,096	318,935	[3] 260,000	(4)
Chile	294,033	329,453	342,830	268,838	187,336
Colombia	520,717	570,017	631,927	656,019	(4)
Ecuador	74,042	85,352	52,942	70,264	(4)
Guiana:					
British	38,482	38,473	35,745	29,138	18,572
French	40,638	37,606	32,561	[5] 34,281	[5] 25,607
Netherlands (Surinam)	14,154	14,812	5,921	[8] 12,000	(4)
Peru	260,326	269,355	281,529	285,189	(4)
Uruguay	657	1,608	1,762	1,364	(4)
Venezuela	114,985	146,608	146,792	130,382	(4)
	1,592,000	1,802,000	1,886,000	1,773,000	1,593,000
Europe:					
Bulgaria	200	6,690	7,330	(4)	(4)
Czechoslovakia	10,000	10,000	[3] 10,000	(4)	(4)
Finland	3,858	4,822	(4)	(4)	(4)
France	87,354	[5] 85,000	(4)	(4)	(4)
Germany	8,650	(4)	(4)	(4)	(4)
Austria					
Hungary	5,655	5,079	(4)	(4)	(4)
Italy	5,016	(4)	(4)	(4)	(4)
Norway	55	(4)	(4)	(4)	(4)
Portugal	6,186	5,948	[3] 10,000	(4)	
Rumania	157,924	211,496	130,760	(4)	
Spain	6,955	[3] 30,000	[3] 15,000	(4)	(4)
Sweden	234,122	216,149	197,995	(4)	[3] 270,200
Switzerland	1,125	1,447	(4)	(4)	(4)
U. S. S. R. [9]	5,236,000	(4)	5,787,000	(4)	(4)
United Kingdom	2,428	(4)	(4)		
Yugoslavia	78,318	71,503	[5] 75,000	(4)	(4)
	5,844,000	5,665,000	6,310,000	[3] 4,500,000	(4)
Asia:					
Burma	1,209	(9)	(9)	(9)	(9)
China	(4)	(4)	[3] 377,000	(4)	(4)
Manchuria [7]	(4)	(4)	(4)	(4)	(4)
Chosen	948,447	975,000	(4)	(4)	(4)
Cyprus	[5] 29,245	[5] 16,393	13,621	(4)	(4)
India, British	321,138	[9] 316,504	[9] 289,357	[9] 285,945	[9] 257,000
Indochina	8,745	8,070	8,038	(4)	(4)
Japan	[3] 760,000	[3] 836,000	(4)	(4)	(4)
Malay States:					
Federated	40,209	40,283	35,689	(4)	(4)
Straits Settlements	5	8	6	(4)	(4)
Unfederated	581	880	479	(4)	(4)
Netherlands Indies	76,443	81,183	89,942	(4)	(4)
Philippine Islands	903,265	1,040,146	1,140,126	1,144,332	158,726
Sarawak	18,520	17,261	12,285	(4)	(4)
Taiwan	145,000	(4)	(4)	(4)	(4)
Thailand (Siam)	13,620	12,711	12,717	(4)	(4)
	3,666,000	3,889,000	4,024,000	3,943,000	(4)

See footnotes at end of table.

World production of gold, 1938–42, by countries, in fine ounces [1]—Continued

Country	1938	1939	1940	1941	1942
Africa:					
Bechuanaland	19,111	17,219	18,015	14,509	15,441
Belgian Congo	455,264	494,642	618,565	[10] 561,030	[10] 499,944
Ruanda and Urundi	17,994	29,386	(4)	(10)	(10)
Camerouns, French	15,542	(4)	(4)	(4)	(4)
Egypt	2,162	3,877	7,344	2,868	(4)
French Equatorial Africa	40,028	(4)	(4)	(4)	(4)
French West Africa (exports)	127,220	(4)	133,394	(4)	(4)
Gold Coast	674,927	782,271	866,326	886,000	(4)
Kenya Colony	70,500	77,000	77,243	(4)	(4)
Liberia (exports)	1,902	6,536	9,661	20,370	(4)
Madagascar	13,770	[3] 14,000	11,580	10,995	(4)
Morocco, French	7,491	(4)	(4)	(4)	(4)
Nigeria	24,815	25,794	25,617	(4)	(4)
Portuguese East Africa	11,654	13,386	13,386	[3] 13,500	(4)
Rhodesia:					
Northern	1,092	4,645	(4)	(4)	(4)
Southern	814,078	795,613	826,485	790,442	760,030
Sierra Leone	30,012	33,657	32,676	(4)	(4)
South-West Africa	1,796	1,619	1,358	304	(4)
Sudan	8,866	7,510	6,606	(4)	(4)
Swaziland	1,246	983	1,080	(4)	(4)
Tanganyika	81,857	130,366	143,693	144,312	(4)
Uganda	20,502	15,115	11,060	9,505	(4)
Union of South Africa	12,161,392	12,819,344	14,037,741	14,386,361	14,120,617
Other countries	(4)	(4)	(4)	(4)	(4)
	14,629,000	15,490,000	16,933,000	17,198,000	16,709,000
Oceania:					
Australia:					
New South Wales	88,707	87,189	89,839	88,091	77,248
Northern Territory	12,378	16,586	22,423	(4)	(4)
Queensland	151,432	147,248	154,011	(4)	(4)
South Australia	5,292	3,930	3,270	1,679	(4)
Victoria	144,243	156,522	163,662	149,768	(4)
Western Australia	1,167,791	1,214,238	1,191,481	1,109,318	848,180
Fiji	92,362	110,000	111,338	118,681	(4)
New Guinea	236,133	246,214	294,794	(4)	(4)
New Zealand	152,050	178,955	195,665	190,000	(4)
Papua	33,249	28,164	35,000	(4)	(4)
Tasmania	22,200	19,984	19,171	19,908	(4)
	2,106,000	2,209,000	2,281,000	2,075,000	1,724,000
	37,922,000	39,853,000	42,831,000	40,836,000	37,000,000

[1] Preliminary world gold production table prepared with revisions and adjustments by B. B. Waldbauer, Foreign Minerals Division, and Frederick Betz, Metal Economics Division, Bureau of Mines, in cooperation with the Office of the Director of the Mint. Figures used were derived in part from the Statistical Yearbook of the League of Nations and from the American Bureau of Metal Statistics. No official statistics are issued by Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable. In some countries accurate figures are not possible to obtain owing to clandestine trade in gold.

[2] Refinery production.

[3] Approximate production.

[4] Data not available. Estimate included in total.

[5] Exports.

[6] Imports into United States.

[7] Purchases by the State Central Bank.

[8] Conjectural figure published by the American Bureau of Metal Statistics (New York), Annual Issue.

[9] Beginning with 1939, Burmese production included with British India.

[10] Beginning with 1941, production of Ruanda and Urundi included with Belgian Congo.

World production of silver, 1938–42, by countries, in fine ounces[1]

Country	1938	1939	1940	1941	1942
North America:					
United States[2]	61,688,834	63,871,972	68,286,535	71,075,932	55,859,658
Canada	22,219,195	23,163,629	23,833,752	21,754,798	20,671,986
Central America and West Indies:					
Honduras	3,335,070	4,118,864	3,899,164	3,488,677	3,478,831
Other countries[3]	965,000	681,000	(4)	(4)	(4)
Mexico	81,018,809	75,870,575	82,640,074	78,363,961	84,864,616
Newfoundland	1,663,623	1,421,060	1,494,066	1,657,342	1,106,121
	170,891,000	169,127,000	180,754,000	176,941,000	166,581,000
South America:					
Argentina	2,636,361	3,125,756	3,242,200	3,978,400	(4)
Bolivia (exports)	6,373,660	7,241,312	5,626,380	7,348,695	8,121,438
Brazil	25,585	27,075	24,694	21,170	(4)
Chile	1,375,530	1,180,902	1,515,563	1,242,240	(4)
Colombia	192,880	242,628	260,310	271,115	(4)
Ecuador	89,111	103,331	105,000	116,836	(4)
Guiana, British	5,060	(4)			(4)
Peru	20,552,816	18,802,075	19,916,774	15,101,300	(4)
	31,251,000	30,728,000	30,691,000	28,100,000	28,512,000
Europe:					
Bulgaria (estimated)	13,000	(4)	(4)	(4)	(4)
Czechoslovakia	1,190,326	(4)	(4)	(4)	(4)
Finland	57,900	61,000	(4)	(4)	(4)
France	[3] 565,000	[3] 565,000	(4)	(4)	(4)
Germany	7,010,000	(4)	(4)	(4)	(4)
Austria					
Greece[3]	335,000	(4)	(4)	(4)	(4)
Hungary	46,632	51,600	(4)	(4)	(4)
Italy	812,481	880,000	(4)	(4)	(4)
Norway	250,776	295,787	(4)	(4)	(4)
Poland	62,244	(4)	(4)	(4)	(4)
Portugal	16,742	(4)	(4)	(4)	(4)
Rumania	819,876	712,731	500,204	(4)	745,543
Spain	237,658	(4)	(4)	(4)	(4)
Sweden	1,123,861	1,122,865	745,894	(4)	(4)
U. S. S. R.[3]	8,022,000	(4)	(4)	(4)	(4)
United Kingdom	107,985	70,818	(4)	(4)	(4)
Yugoslavia	2,524,123	2,293,634	(4)	(4)	(4)
	23,196,000	21,978,000	[5] 20,000,000	(4)	(4)
Asia:					
Burma	5,920,000	6,175,000	(4)	(4)	(4)
China	(4)	(4)	(4)	(4)	(4)
Chosen	(4)	(4)	(4)	(4)	(4)
Cyprus	[6] 199,719	[6] 103,953	58,341	(4)	(4)
Federated Malay States	3,500	(4)	(4)	(4)	(4)
Hong Kong	111,070	(4)	(4)	(4)	(4)
India, British	22,295	22,745	(4)	(4)	(4)
Indochina	2,411	1,672	1,736	(4)	(4)
Japan	[3] 10,100,000	(4)	(4)	(4)	(4)
Netherlands Indies	579,297	618,026	1,506,166	(4)	(4)
Philippine Islands	1,167,612	1,350,099	1,299,199	1,260,097	231,197
Sarawak	1,660	700			(4)
Taiwan	(4)	(4)			(4)
Turkey[7]	350,000	575,000	575,000	(4)	(4)
	21,623,000	23,115,000	22,868,000	(4)	(4)
Africa:					
Algeria	[7] 90,000	[7] 85,000	(4)	(4)	(4)
Bechuanaland	1,127	813	1,207	949	1,267
Belgian Congo	3,121,559	2,800,000	3,536,582	(4)	(4)
Gold Coast	23,000	(4)	(4)	(4)	(4)
Kenya Colony	11,200	[3] 12,000	13,626	(4)	(4)
Morocco, French	208,980	(4)	(4)	(4)	(4)
Nigeria	(4)	(4)	(4)	(4)	(4)
Portuguese East Africa	1,808	2,319	1,901	[3] 2,000	(4)
Rhodesia:					
Northern	88,237	80,137	(4)	(4)	(4)
Southern	166,417	173,556	186,080	170,364	163,776
Sierra Leone	1,271	(4)	(4)	(4)	(4)
South-West Africa	[8] 673,500	587,000	[7] 460,000	(4)	(4)
Tanganyika	16,473	27,999	35,492	40,143	(4)
Tunisia	61,149	(4)	(4)	(4)	(4)
Uganda	1,981	1,376	1,015	1,005	(4)
Union of South Africa	1,135,374	1,182,516	1,292,284	[7] 1,461,000	(4)
	5,652,000	5,389,000	6,130,000	(4)	(4)

See footnotes at end of table.

World production of silver, 1938–42, by countries, in fine ounces [1]—Continued

Country	1938	1939	1940	1941	1942
Oceania:					
Australia:					
New South Wales	9,558,550	8,584,719	[7] 9,000,000	[4]	[4]
Queensland	3,533,490	3,885,963	[7] 3,450,000	[4]	[4]
South Australia	503	541	2,715	4,660	[4]
Victoria	5,898	6,285	[3] 6,500	[4]	[4]
Western Australia	271,346	287,439	274,741	255,000	[4]
Fiji	12,380	[4]	23,020	[7] 30,382	[4]
New Guinea	[8] 104,000	[7] 175,015	199,084	[7] 125,000	[4]
New Zealand	357,709	390,342	415,330	[7] 400,000	[4]
Tasmania	1,219,550	1,278,116	1,608,681	1,326,738	[4]
	15,063,000	14,620,000	14,980,000	[4]	[4]
	267,676,000	264,957,000	275,423,000	[9] 262,854,000	[3] 249,663,000

Preliminary world silver production table prepared with revisions and adjustments by B. B. Waldbauer, Foreign Minerals Division, and Frederick Betz, Metal Economics 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] Conjectural figure published by the American Bureau of Metal Statistics.
[6] Exports.
[7] American Bureau of Metal Statistics (New York), Annual Issue.
[8] Imperial Institute (London), Statistical Summary.
[9] Annual Report of the Director of the Mint (1942).

REVIEW BY COUNTRIES

Data on gold and silver mining in countries outside the United States were even less complete in 1942 than in 1941. Naturally, the Philippine Islands, with their production of over 1,000,000 ounces of gold in 1941, were removed completely from the picture, and many other countries have such rigid censorship regulations that little or no information has been released since 1939.

CANADA

Labor shortage was a primary problem in Canadian gold mines in 1942, but shortage of equipment was severely felt also. Operators were forced to eliminate all but essential development and to hire old men, women, and boys in an effort to keep the Mines open. Thousands left the gold camps to join the armed forces or to work in industrial centers farther south. It is reported that Porcupine lost 10,000 of its 41,000 people and Kirkland Lake 16,000 of its 23,000. By the end of the year half of the gold mines in British Columbia and 16 or 17 in Ontario and Quebec were closed. Output of ore at the great Hollinger mine in Ontario dropped from 5,200 tons daily to 3,500 tons. In the fall, about 600 men from Ontario gold mines were transferred to the Sudbury nickel mines, but the movement appears to have been only partly successful. It is stated that 25 percent of the men quit in a short time because of inadequate housing facilities, lack of qualifications for the Sudbury camp, different mining conditions, and inability to meet physical standards. However, these difficulties were being overcome, and indications were that the transfer of gold miners to base-metal mines would be more successful in the future.

No order as drastic as L–208 was issued by the Canadian Government. In contrast with the United States, Canada appeared to have adopted the policy of gradual curtailment of gold mining, no doubt

in recognition of the great dependence of Canadian economy on the gold industry and the utter ruin that whole communities would face by a sudden shut-down. In July the Government issued an order prohibiting the opening of new gold mines and limiting monthly tonnage in mines then open to the average of the first 4 months of the year. A few months later the Premier stated that action must be taken to curtail gold production further, that plans would be carried out in step with war requirements, and that due regard would be given the industry so that it would function soundly in the postwar period. This policy, together with Allied successes on the war front, created a general feeling of optimism, so that gold stocks on the Toronto exchange remained strong throughout the year.

Gold output in Canada in 1942 declined over 500,000 ounces from 1941, but despite this decrease the value of gold was 47 percent of the value of all metals produced and 33 percent of the value of all minerals produced in the Dominion. Gold lodes supplied 85 percent of the total gold; placers and base-metal deposits, 15 percent. Gold and silver production in 1942 was distributed among the various provinces as follows:

Province:	*Gold, fine ounces*	*Silver, fine ounces*
Ontario	2, 756, 922	4, 426, 977
Quebec	1, 101, 533	1, 649, 292
British Columbia	470, 254	10, 617, 278
Saskatchewan	173, 361	2, 603, 748
Manitoba	138, 666	845, 849
Northwest Territories	97, 039	22, 433
Yukon	79, 058	506, 002
Nova Scotia	12, 950	404
Alberta	32	3
Total	4, 829, 815	20, 671, 986

Ontario produced about 57 percent of Canadian output of gold in 1942. The gold-bearing quartz veins of the Porcupine and Kirkland Lake regions supplied 77 percent of the Province total and about 50 percent of the Dominion lode production. These two camps have increased their reserves in recent years, and the ore bodies show no signs of exhaustion. Gold ore milled in the Province in 1942 totaled 10,548,849 tons compared with 12,129,513 tons in 1941; 14 mills closed during the year.

MEXICO

The Republic of Mexico continued to hold first place as the world's leading silver producer in 1942 and contributed over 43 percent of the silver produced in the Western Hemisphere, compared with about 38 percent in 1941.

Hidalgo again was the leading State in Mexico in silver production, its output amounting to about 10 percent of the world output. Credit for this is due mainly to Real del Monte y Pachuca, the world's largest silver mine.

Chihuahua, Zacatecas, and San Luis Potosí also were large producers of silver, most of which was a byproduct from the smelting of zinc-lead ores. Six large base-metal mines in Chihuahua were important producers: The American Smelting and Refining Co. (three mines), El Potosí Mining Co., the San Francisco Mines of Mexico, Ltd., and the Moctezuma Lead Co. In Zacatecas two large base-metal mines—the Fresnillo Co. and Peñoles S. A.—were credited with

most of the State's output of silver. The Fresnillo Co. produces about three times as much silver as any other base-metal mine in Mexico. In San Luis Potosí, silver from base metals is produced mainly at the mines of the American Smelting & Refining Co. at Charcas, the Kildun y Anexas at Matehuala, and the María de la Paz y Anexas at La Paz. The base-metal mine of the American Smelting & Refining Co. at Angangueo in Michoacán continued to be a large producer of silver.

During the last decade, base-metal ores in Mexico have assumed increasing importance as sources of silver, whereas the importance of silver ore has declined. In 1935, about 75 percent of the silver in the Republic was derived from silver ore, which now contributes only about 55 percent; base-metal ores have risen not quite to 45 percent.

As in the past, gold production was not outstanding in Mexico in 1942. The largest gold mine is Dos Estrellas en El Oro y Tlalpujahua, S. C. L. in Michoacán, although the silver mine Real del Monte y Pachuca surpasses it in gold output.

CENTRAL AMERICA[6]

Costa Rica.—Mining in Costa Rica is virtually limited to gold mining. All producing districts are on the western slope of the mountains facing the Gulf of Nicoya. All the operations are small, the mills having a daily capacity of 5 to 50 tons of ore. Four companies mined substantial quantities of ore in 1942—the Abangarez holdings, the Compañia mine, the Juchem and Sanford operations, and the Bonanza mine (Rudin Co.). Total production for the country in 1942 approximated a value of $500,000. This is not a large amount, but it is a very important item in the economy of this little country.

Honduras.—Some quantity of gold and silver is mined in Honduras. Only two producers are recorded: The New York & Honduras Rosario Mining Co. at San Juancito and the Cia. Minera Agua Fria, S. A., near Delhi.

The Rosario mine, operating for 62 years, has a 500-ton mill and in 1941 produced 3,500,000 ounces of silver and 23,000 ounces of gold. The Agua Fria mine was opened in 1935; it has a 100-ton mill and in 1941 produced 12,000 ounces of gold and 16,000 ounces of silver. Ore reserves are relatively small.

Nicaragua.—1942 was the sixth consecutive year in which Nicaragua has led all Central American countries in gold production. The eight important operating companies, listed in order of output, were as follows: La Luz de Los Angeles; the Neptune Gold Mining Co.; Compañia Minera La India; Impresa de Nicaragua; Compañia Minera del Javali (operating continuously for 80 years); San Juan Mines, Inc.; Compañia Minas Matagalpa; and Compañia de San Gregorio. Quartz ores are the most important sources of gold. Transportation is the major problem in prospecting for gold ores and developing them.

SOUTH AMERICA

Golding mining declined in a number of South American countries in 1942 because of difficulty in getting machinery and supplies from the United States, a shortage of ships for transporting ores and con-

[6] Much that follows on Central and South America is taken from a series of articles on Gold and Silver in Latin America: Eng. and Min. Jour., vol. 143, No. 8, August 1942, pp. 75–115.

centrates to United States smelters, wage competitions in certain other industries, fear of foreign capital to make investments at this time, and the uncertain attitude of the United States toward a gold policy. This decline tended to disrupt to some extent the internal economies of several of these countries by reducing the amount of foreign exchange available for imports.

Argentina.—Formerly most of the gold in Argentina came from placers along the Andes, but more recently lodes have been developed and now produce 65 to 70 percent of the total output. Production is still small. The most important mine is El Oro, in the Province of La Rioja.

Brazil.—Although some gold is mined in nearly every State in Brazil, the major part comes from Minas Gerais. The Morro Velho, the largest producer, continued to increase its ore reserves and is now reported to have 8,000,000 tons blocked out. Progress was made also in minimizing the high temperature in this mine, the deepest in the world, by installing an extensive cooling and ventilating plant. The Morro Velho mill has a daily capacity of 1,000 tons of ore, which in 1942 averaged 11 grams of gold per ton.

Chile.—Before 1932, Chile's annual output of gold totaled only 30,000 ounces, derived largely from copper ores and concentrates. Since that date, the industry has expanded rapidly until it has reached or exceeded 300,000 ounces during at least 3 years. Lode deposits have increased in importance, and placers have declined. Much encouragement has been given small operators; as a result, thousands of gold mines have been discovered and worked since 1932. Most of the gold veins are found in the Coast Range or along the longitudinal valley running the length of the country and are genetically related to the great granodiorite intrusions so common in Chile. Generally the mines are shallow and work only the zone of secondary enrichment; the ore falls in grade in the primary zone at depth. The Provinces of Atacama and Coquimbo yield the bulk of production. In 1942 gold mining in Chile employeed about 30,000 men.

Colombia.—Gold, next to coffee, is the most important source of revenue in Colombia. It is stated that in 1942, 80,000 men were engaged in gold mining and 500,000 people derived a living from the industry in one way or another. The importance of gold in the economy of the country thus becomes very evident. The Department of Antioquia produced 60 percent of the total gold; the Intendencia of Chocó ranked second.

Slightly more than half of the gold output in Colombia comes from placers; the rest from gold lodes. In placer operations the larger companies use dredging; the smaller ones hydraulicking. Most of the dredges are along the San Juan, Porce, Cauca, and Supia Rivers. About 52 percent of the output comes from a few large but well-equipped foreign companies; 14 percent from medium-size companies, mostly Colombian-operated; and 34 percent from small operators. Silver and platinum are important byproducts of gold mining.

Ecuador.—As in 1941, the Portovelo mine (opened in 1896) of the South American Development Co. and the Macuchi mine of the Cotopaxi Exploration Co. produced the bulk of Ecuador's output of gold and silver. No information is available on the six other companies that did exploratory work in 1941.

Peru.—Peru easily takes first place among South American countries in output of silver. In 1942, about 60 percent of the output was derived from lead and copper ores. The Cerro de Pasco Copper Corporation was the largest producer and handled the ores of many smaller operators as well as its own. In output of gold, about 61 percent was supplied by gold lodes, 30 percent by base-metal ores, and 9 percent by placers. The gold-mining industry employed 9,000 of the Nation's 27,000 mining laborers and supplied 24 percent of the revenue accruing to the mining industry.

Venezuela.—In 1942, about 95 percent of Venezuela gold output came from the mines of the New Goldfields and the French Mocupia in the Callao district. Small operations declined, largely because of the attraction of diamond mining on Surukun River in the Great Savannah. Difficult transportation is a serious handicap to prospecting for gold in Venezuela.

AFRICA

South Africa.—The objective of South Africa was to maintain gold production during 1942 at the 1941 level, but rising costs and the reluctance of the United States and Great Britain to allocate supplies and shipping space pushed output down slightly. South Africa continued to lead by a wide margin all countries in the world in gold production. Output was 14,120,617 ounces compared with 14,386,361 ounces in 1941, a decline of less than 2 percent. To produce this quantity of gold, 66,979,700 tons of ore were treated, compared with 67,255,450 tons in 1941. The tenor of the ore has been steadily declining from 0.224 ounce of gold per ton in 1938 to 0.210 ounce per ton in 1942.

OCEANIA

Australia.—The position of Australian gold mines was reported to be uncertain in 1942. Operators claimed that the attitude of the Government was unsatisfactory in that it was first stated that the gold industry was vital to the Commonwealth and must be continued; yet the industry had been denuded of its best men for other work or for the armed forces; and the Government had established no sound policy to serve as a basis for planning and building in the future. Production in Western Australia slumped nearly 24 percent from the 1941 output.

New Guinea.—Information on New Guinea for 1942 is meager, but it is known that some gold mines were forced to close early in the year when buildings and equipment were destroyed by the invading Japanese army.

Tasmania.—For a number of years Tasmania has produced more than a million ounces of silver annually. Base-metal ores are the principal source, zinc-lead ores supplying over 70 percent. Base-metal ores also contribute most of the gold—zinc-lead ores 53 percent and copper ores 40 percent.

COPPER

By T. H. Miller and H. M. Meyer

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GENERAL SUMMARY

Copper may not have been the most critical metal in the war economy in 1942; but several authorities so termed it, and without question it was one of the top three on the list. On the whole, trends in the copper industry in 1942 were merely continuations and accentuations of those in evidence during 1941. Domestic mine and smelter production rose again in 1942, were each 13 percent above 1941, and were the largest annual amounts ever reported. Receipts of refined copper from abroad also continued to rise, and they established a new high record. Exports of copper, though above those in 1941, were again notably low as compared with most years in the twentieth century. Prices remained unchanged at ceilings fixed in 1941, but bonus payments offset the high cost of operations at some mines. Despite Government consumption-restriction orders on copper and efforts of the Government and others to encourage substitution of more abundant materials, military and essential civilian needs again could not be met. Consumption once more reached staggering heights, never previously attained.

Efforts of various Government agencies were directed more sharply than ever before toward increasing copper production from mines and scrap materials, toward greater imports (particularly of the higher grades of product), toward preventing consumption for all unnecessary purposes and reducing it wherever else possible, and toward confining exports to the essential needs of our allies.

Aids in expanding the domestic output included exploratory work and drilling operations in promising areas by the Geological Survey and Bureau of Mines, liberalization of the lending policy of the Reconstruction Finance Corporation in connection with mine development, plant construction by the Defense Plant Corporation, bonus payments by the Metals Reserve Co. for production over established quotas, and priority assistance of the War Production Board to the undisturbed flow of necessary materials for productive operations.

Many of these factors are described in greater length later in this report. On the other side of the picture, reduction in unnecessary consumption was attained principally through orders issued by the War Production Board, at times in cooperation with other agencies. As a result of W. P. B. limitation orders, the use of copper has been discontinued in thousands of civilian products, and the Army, Navy, and Maritime Commission have cooperated by reducing copper requirements for many necessary items. Copper exports are also under strict control. An example of a noteworthy saving of copper is given in the report of the Communications Equipment Division of W. P. B., which states that only about 12,000 tons will be needed in the wire-communications industry for maintenance and operation of the domestic telephone and telegraph networks during 1943. It was estimated that an equal amount of copper in the form of scrap would be returned to the Nation's stock pile by this industry. The companies were said to have used 35,000 tons in 1942 and between 90,000 and 100,000 tons in 1941.

As a result of the conservation measures mentioned, inventories of thousands of tons of copper and copper products were frozen, and the Government arranged to purchase these stocks through the Copper Recovery Corporation, formed in May 1942. A report released in May 1943 stated that the original estimates of idle and excessive copper to be recovered ranged from 400 to 500 million pounds. Thus far, according to the report, 114,000 firms had been approached under the program, and plans were being made to reach 98,000 plumbers, building contractors, and their suppliers. A total of 197 million pounds had been allocated, of which 56 million were sold for use in unchanged form, 93½ million were allocated for remelting, 30 million were directed into the regular scrap markets, and owners were authorized to retain 17 million for essential production.

The Metals Reserve Co. and the Board of Economic Warfare provided for the purchase of available foreign copper, particularly in Western Hemisphere countries; and the Maritime Commission secured all possible shipping facilities, concentrating primarily on providing space for bringing into the country at the least all possible amounts of refined and blister copper.

Salient statistics of the copper industry in the United States, 1925–29 (average) and 1939–42, in short tons

	Average (1925–29)	1939	1940	1941	1942
New copper produced—					
From domestic ores, as reported by—					
Mines	885,826	728,320	878,086	958,149	1,080,062
Ore produced:					
Copper ore	59,505,871	[1] 55,239,098	[1] 69,278,476	[1] 78,452,504	[2]
Average yield of copper, percent	1.44	1.25	1.20	1.15	[2]
Smelters	892,730	712,675	909,084	966,072	1,087,991
Percent of world total	51	30	[2]	[2]	[2]
Refineries	890,767	704,873	927,239	975,408	1,064,792
From foreign ores, matte, etc., refinery reports	317,287	304,642	386,317	419,901	349,769
Total new refined, domestic and foreign	1,208,054	1,009,515	1,313,556	1,395,309	1,414,561
Secondary copper recovered from old scrap only	347,512	286,900	333,890	412,699	427,122
Copper content of copper sulfate produced by refiners	4,601	4,868	5,643	6,984	8,076
Total production, new and old and domestic and foreign	1,560,167	1,301,283	1,653,089	1,814,992	1,849,759
Imports (unmanufactured)[3]	391,212	336,297	491,342	735,545	757,974
Refined [3]	59,236	16,264	68,337	346,994	395,039
Exports of metallic copper [4]	522,616	427,517	427,650	158,893	212,309
Refined (ingots, bars, rods, etc.)	482,868	396,406	377,108	114,753	132,467
Stocks at end of year	307,200	355,500	334,500	317,500	319,500
Refined copper	86,100	95,500	91,500	77,500	84,000
Blister and materials in solution	221,100	260,000	243,000	240,000	235,500
Withdrawals from total supply on domestic account:					
Total new copper	778,123	714,873	1,008,785	1,641,550	1,670,633
Total new and old copper	1,288,700	1,215,000	1,541,000	2,368,000	2,598,000
Price, average cents per pound	14.7	10.4	11.3	11.8	[5] 11.8
World smelter production, new copper	1,761,000	[6] 2,405,000	[2]	[2]	[2]

[1] Includes old tailings.
[2] Figures not yet available.
[3] Data include copper imported for immediate consumption plus material entering country under bond.
[4] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper," for which figures of quantity not recorded.
[5] Exclusive of bonus payments of the Metals Reserve Co.
[6] Approximate.

Although our total supplies of copper failed by a substantial margin to fill our own total demands, it was imperative that consideration be given to the essential requirements of our Allies; according to Lend-Lease authorities, 7.2 percent of our total new supply (production plus imports) for 1942 was exported.

Another important step in balancing supplies and requirements was the increasing use of substitutes. In this connection, Lt. Gen. Brehon B. Somervell, commanding the Army Service Forces, recently said:

> In the 2 years 1942–43 we shall save 400,000,000 pounds of copper, probably our most precious metal today, by using steel in cartridge cases instead of brass. Nearly 50 producers now are making steel shell cases. In addition, by substitution and other engineering changes, we shall save 75,000,000 pounds of copper * * *.

Because more copper was available for use than ever before, because of the successful efforts to reduce consumption of copper in many ways through curtailing uses and substitution, and because it was almost impossible to accept the fact that even modern warfare could require such enormous quantities of this metal, some observers felt that the copper problems had been solved. In contradiction of this attitude H. O. King, chief of the Copper Branch, War Production Board, said early in 1943:

> Recent statements quoted in the press have conveyed the impression that the supply of copper is adequate to meet all military and essential civilian require-

ments. Widespread aceeptance of such statements would constitute a threat to our entire war production program. The supply of copper is not adequate and never will be while this war is on. * * *

As we got deeper into war, the Office of War Information determined that it was inadvisable to release information on many raw materials, and both trade and Government statistics were involved. Publication of Bureau of Mines monthly copper mine figures was discontinued following the statement for January 1942. Trade data on smelter and refinery production and stocks, and fabricators' figures on consumption and stocks were not revealed after May. Domestic sales data were not released after June.

In January 1942 the Copper and Zinc Branch of the War Production Board was separated into two branches, and in February, Harry O. King was named to head the Copper Branch. King had previously been in Government service as the division administrator of National Recovery Administration, from which he resigned to become managing director of the Copper Code Authority. A Copper Producers Advisory Committee was formed later, with King as its chairman and the following members from industry: K. C. Brownell, vice president, American Smelting & Refining Co.; Robert E. Dwyer, vice president, Anaconda Copper Mining Co.; Carl T. Ulrich, vice president, Kennecott Copper Corporation; J. F. McClelland, vice president, Phelps Dodge Corporation; A. J. McNab, vice president, Magma Copper Co.; B. N. Zimmer, vice president, American Metal Co.; and A. E. Petermann, vice president, Calumet & Hecla Consolidated Copper Co. Early in 1943 a Combined Copper Committee was set up by the Combined Production and Resources Board and the Combined Raw Materials Board to assemble and review data on supplies and requirements of the United States, the United Kingdom, and Canada in order that available metal be most efficiently utilized. King was made chairman of this committee.

INVESTIGATIONS OF THE BUREAU OF MINES AND GEOLOGICAL SURVEY

Prospecting for copper ores was begun in July 1942, when allotments for exploration projects were made from funds appropriated to the Bureau of Mines for investigation of critical and essential minerals. At the close of the calendar year 1942, 12 exploration projects had been established, involving diamond drilling at 9 deposits, surface trenching at 2, and underground sampling at 1. One project was completed in 1942.

Among results of the prospecting in 1942 were: (1) The establishment of additional reserves of indicated ore at the Elizabeth mine of the Vermont Copper Co., Orange County, Vt., amounting to 300,000 tons averaging over 2 percent copper. Production is expected to begin in March 1943; (2) the discovery of about 75,000 tons of indicated ore containing 2.06 percent copper and 0.3 percent cobalt at the Uncle Sam mine, Blackbird district, Lemhi County, Idaho; (3) the finding of some ore at depth in the Christmas mine, Gila County, Ariz.

In the laboratory, favorable tests were made: (1) To separate tungsten from copper minerals at the Empire mine, Custer County, Idaho; (2) to float selectively copper and cobalt minerals at the Uncle Sam mine, Lemhi County, Idaho; (3) to treat ores from the Hidden Treasure mine, Missoula County, Mont.

During the calendar year 1943 the Bureau of Mines plans to continue prospecting at the Elizabeth mine, Uncle Sam mine, and Christmas mine and to explore additional deposits when investigations now in progress are completed. The Bureau also intends to investigate the possibilities for re-treating mill tailings at several plants.

In the latter half of 1942 the Geological Survey greatly expanded its studies of copper deposits, in accordance with its program of investigating deposits of minerals currently needed for war production. Although emphasis was focused on detailed studies in minor districts that offer favorable possibilities for increased production, many brief examinations of individual copper deposits also were made during the year, often at the request of other Government agencies. Geologic investigations were made of copper deposits in the continental United States, Alaska, and several Latin American republics.

At the end of 1942 investigations in the United States were in progress in the Elizabeth mine, Vermont; Michigan; Pastura, N. Mex.; Christmas mine and Old Hat district, Arizona; the Penn mine, California; Glacier Peak, Wash.; Mackay, Idaho; and the Southeastern States. In several of these projects, Survey geologists were collaborating with Bureau of Mines engineers on exploration projects.

In Alaska during the summer of 1942, the Geological Survey investigated nickel-copper deposits at Spirit Mountain (Copper River region), at Mirror Harbor (Chichagof Island), and at Bohemia Basin (Yakobi Island); copper-molybdenum deposits at Orange Hill (Copper River region); iron-copper deposits of the Mount Andrew-Mamie area and the Poorman area (Prince of Wales Island); and copper-palladium deposits at the Salt Chuck mine. Reports on several earlier investigations in Alaska [1] were published during 1942.

In 1942 Survey geologists investigated copper deposits in Cuba and Haiti under the auspices of the Department of State and in Colombia and Central America under the auspices of the Board of Economic Warfare.

RECONSTRUCTION FINANCE CORPORATION LENDING POLICY

The lending policy of the Reconstruction Finance Corporation was liberalized in March to permit the owner or lessee of a mining property to borrow amounts not exceeding $20,000 to defray costs of developing small ore bodies containing strategic and critical metals. The loans were to be obtainable out of R. F. C. funds, repayable out of proceeds from operations; if the initial development showed favorable results, additional loans up to another $20,000 were to be had for further development.

BONUS PAYMENTS

Government action regarding the payment of bonuses to individual producers for production of copper over established quotas, whereby the payments were made by the Metals Reserve Co. and the quotas were assigned by the War Production Board and the Office of Price Administration, was discussed in the Copper chapter of Minerals

[1] Reed, J. C., and Dorr, J. V. N., II, Nickel Deposits of Bohemia Basin and Vicinity, Yakobi Island, Alaska: Geol. Survey Bull. 931-F, 1942, 34 pp.
Pecora, W. T., Nickel-Copper Deposits on the West Coast of Chichagof Island, Alaska: Geol. Survey Bull. 936-I, 1942, 23 pp.
Reed, J. C., and Gates, G. O., Nickel-Copper Deposit of Snipe Bay, Baranof Island, Alaska: Geol. Survey Bull. 936-M, 1942, 10 pp.
Reed, J. C., Nickel-Copper Deposit at Funter Bay, Admiralty Island, Alaska: Geol. Survey Bull. 936-O, 1942, 13 pp.

Yearbook, 1941. The quotas assigned were said to be so high that there was little chance that larger producers could produce enough copper to benefit. Small, high-cost, and new producers were the immediate beneficiaries. At the same time, the plan was sufficiently flexible so that at any time quotas could be lowered to give greater aid, without affecting the price of copper to consumers. Moreover, the quotas were established by mines or groups of mines rather than by companies, to avoid any possibility that expenditures for expansion of one property might be deterred by uncertainties as to future production from one mine or group of mines of the same company. Many quotas were revised downward during the year. An increasing number of copper quotas were lowered in the last month of the year and into 1943. This action was taken largely to permit copper companies to absorb the additional costs of mining caused by rather general wage increases late in the year. In recognition of the possibility of greater production gained by having an established, satisfactory price over an extended period, the Government in January 1943 extended the premium plan to July 31, 1945. The plan was amended May 1, 1943, to make possible additional premiums for mines that produced less than 2,000 tons of copper in 1942 and which required increased revenue to obtain maximum production. Individual mines were to be studied independently and special premiums to be paid for output over special quotas established. The Metals Reserve Co. announced that royalty payments on production entitled to premium payments would be paid on ceiling prices unless the lease specifically instructed otherwise, as it was not the intent of the order to have anyone other than the actual operator participate in the plan. Royalties paid by domestic mine operators for copper, lead, and zinc ores mined from leased properties were frozen by the Office of Price Administration on April 1, 1943, at rates in effect on December 31, 1942.

LABOR CONDITIONS

The labor situation at mines, mills, smelters, and refineries got progressively worse as the year advanced and reached a low point about August. At that time the War Labor Board was considering action in a large number of nonferrous mine cases which it had promised the miners to expedite. Local draft boards were requested to see that the mining program was not scotched by Army manpower requirements. The International Union of Mine, Mill and Smelter Workers reported that 3,000 men would be required to raise operations to full capacity. Later in the month the War Manpower Commission subjected migrations of lumber and copper workers in 12 Western States (termed a "critical labor area") to United States control. The States were Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming. In this area workers could not switch jobs (except under certain specified conditions) or employers release workers without first obtaining certificates of separation from the United States Employment Service. Gold mining was virtually stopped in the hope of inducing workers in those mines to accept employment in strategic metal mines, and the Government furloughed 4,000 men from the Army provided they

entered the strategic metal mines, particularly copper mines. The mines were benefited, at least temporarily, by a greater number of employees. Many of the recommended wage increases were accepted by the War Labor Board and subsequently approved by the Director of Economic Stabilization. The increases granted took up only part of the slack between wages in the mining industry and in others, such as airplane factories, shipyards, etc., and the urge to leave mining communities continued to be a deterrent factor in the labor situation.

CONSUMPTION AND DISTRIBUTION CONTROLS

Copper, copper-base alloys, and copper scrap were under complete priority control before the beginning of 1942. The War Production Board issued amendments and revisions to the control orders from time to time throughout 1942. These were directed mostly toward increasing the restrictions on uses. The supply situation became so tight by September that the Army and Navy and the Maritime Commission agreed to rigid restrictions that confined copper consumption to vital war uses. The Production Requirements Plan (PRP) was put into operation in the third quarter of 1942 (it was partly effective beginning the first quarter); its purpose was to provide stricter controls on the distribution of scarce materials. With few exceptions it applied to all concerns using metal valued at $5,000 during a calendar quarter. Manufacturers were asked to estimate their requirements for 3 months in advance. The plan was closely tied in with end-use allocation classification. An intricate system of numerical symbols was provided to identify the ultimate use to which the raw material was to be put. This plan, it was announced in November, was scheduled to give way to the Controlled Materials Plan (CMP) in part in the second quarter of 1943 for aluminum, copper, and carbon and alloy steel, "the three most basic and critical materials," and to be completely superseded by CMP for these products by July 1943. Under PRP each firm, large or small, prime contractor or subcontractor, submitted its own requirements to the War Production Board for approval and received an individual authorization to obtain materials. Under CMP, prime contractors were to prepare and submit a break-down of all materials required for the approved end-products on which they are working. The break-down was to comprise a "bill of materials" specifying not only what materials were required, but when they must be received to carry out the authorized program. The bills of materials were to include controlled materials required by the prime contractors and their subcontractors and their suppliers and also other scarce materials listed in the outline of the plan. The bills of materials from prime contractors were to be assembled by claimant agencies and presented to the War Production Board Requirements Committee and to the respective Controlled Materials Branches, which were to make the necessary adjustments to bring the whole program into balance with available supplies. The original claimant agencies included the Army, Navy, Maritime Commission, Aircraft Scheduling Unit, Office of Lend-Lease Administration, Board of Economic Warfare, and Office of Civilian Supply, but this list was promptly expanded.

PRICE ACTION

Ceiling prices of the Office of Price Administration for electrolytic and casting copper were discussed in the chapter on Copper in Minerals Yearbook, 1941. The principal price action on copper in 1942 (which, however, did not affect the price to consumers) was the establishment of bonus payments for overquota production, which already have been discussed under that heading. Ceilings for less than carlot shipments were revised in 1942; prices for copper alloy and scrap items not already covered were established by the General Maximum Price Regulation in May 1942 at the levels prevailing in March (many of which were changed by subsequent orders), and the prices to be paid by the Government for copper and copper-base alloy products in inventories frozen by various limitation and conservation orders were selected. Establishment of specifications and cents-per-pound prices for 16 new grades of copper scrap and copper-alloy scrap, effective March 22, 1943, brought under specific prices the entire field of such material when sold to consumers. Ceiling prices on scrap items are discussed in the chapter on Secondary Metals—Nonferrous.

DOMESTIC PRODUCTION

Statistics on copper production may be compiled upon a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better for showing the actual recovery of metal and 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 United States, 1930, part 1, discusses the differences among the three sets of figures.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1938–42, in short tons

Year	Mine	Smelter	Refinery
1938	557,763	562,328	552,574
1939	728,320	712,675	704,873
1940	878,086	909,084	927,239
1941	958,149	966,072	975,408
1942	1,080,062	1,087,991	1,064,792

PRIMARY COPPER

Smelter production.—The recovery of copper by United States smelters from ores of domestic origin totaled 1,087,991 short tons in 1942—a 13-percent increase over 1941. Domestic smelter output constituted 51 percent of the world production during 1925–29. The proportion dropped sharply in the succeeding years until 1934, when it was only 17 percent. It rose to 32 percent in 1936 and from then until 1939 never fell below 25 percent, fluctuating between the two figures. The proportion was believed to be between 31 and 35 percent in 1940 to 1942 and to be at the top of this range in the latest year.

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, 1938–42, by States

[Smelter output, in short tons fine]

State	1938	1939	1940	1941	1942
Alaska	16,746	152	64	95	33
Arizona	210,176	262,706	287,267	328,550	388,394
California	840	4,246	6,546	4,015	1,019
Colorado	15,282	12,774	13,186	6,483	1,249
Georgia	(1)		13		
Idaho	2,806	2,316	3,690	3,551	3,889
Michigan	37,641	44,701	45,743	46,752	47,470
Missouri	313	510	819	773	2,658
Montana	78,125	101,756	129,071	128,712	140,465
Nevada	46,828	64,422	78,621	80,518	83,434
New Mexico	21,956	37,042	70,484	73,848	79,598
North Carolina	(2)	(2)	(2)	(2)	(2)
Oregon	44	48	101	84	113
Pennsylvania	(2)	(2)	(2)	(2)	(2)
South Carolina	4	(1)			1
South Dakota			6		
Tennessee	(2)	(2)	(2)	(2)	(2)
Texas	18	33	33	7	104
Utah	114,938	163,059	248,732	270,647	317,717
Virginia	22	(1)			
Washington	6,247	8,378	10,511	8,667	8,525
Wyoming	(1)		2	4	1
Undistributed	10,342	10,532	14,195	13,366	13,321
	562,328	712,675	909,084	966,072	1,087,991

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

Copper produced (smelter output) in the United States, 1938–42, and total, 1845–1942

[Values rounded]

Year	Short tons	Value
1938	562,328	$110,216,000
1939	712,675	148,236,000
1940	909,084	205,453,000
1941	966,072	227,993,000
1942	1,087,991	[1] 256,766,000
Total, 1845–1942	29,552,541	8,736,779,000

[1] Excludes bonus payments of Metals Reserve Co.

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 output 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 1942 was 1,080,062 tons—an increase of 13 percent over that in 1941 and 22 percent above the average for 1925–29.

Production by States and districts.—The following tables show mine and smelter production by States for 1941 and 1942 and mine output by districts for 1938–42. In 1942 Arizona, Utah, and Montana led in production with 78 percent of the smelter total compared with 75 percent in 1941; adding the output of Nevada, New Mexico, and Michigan to the foregoing brings the proportions to 97 percent of the total for the country compared with 96 percent in 1941. Arizona supplied 36 percent compared with 29 percent for Utah and 13 percent for Montana. Montana's share of the total was unchanged from 1941, but the other two States showed gains. The three other most important copper-producing States (Nevada, New Mexico, and Michigan) represented smaller proportions of the country's total in 1942, although all produced more copper than in 1941. Among other States, there were sharp drops in output for Colorado and California. These declines were due to replacement of production of copper-iron-silver-gold ore in favor of zinc-lead ore at the Eagle mine of the New Jersey Zinc Co. in Colorado and closing of the Walker mine in Plumas County, Calif., which left that State without an important copper producer. Comparison of present production with that of the past century shows that Utah's share of the country's total is rising sharply, whereas Arizona's is becoming static at somewhat above the earlier period. Michigan and Montana are dropping markedly, while New Mexico and Nevada are advancing.

Copper produced in the United States, according to smelter and mine returns, by States, 1941–42 and 1845–1942, in short tons

State	1941		1942			1845–1942 smelter output	
	Smelter returns	Mine returns	Smelter returns		Mine returns	Total quantity	Percent of total
			Percent of total	Quantity			
Alaska	95	72	[1]	33	22	676,816	2.29
Arizona	328,550	326,317	35.70	388,394	393,387	9,802,882	33.17
California	4,015	3,943	.09	1,019	1,058	575,487	1.95
Colorado	6,483	6,748	.11	1,249	1,102	272,764	.92
Georgia						[2]	[2]
Idaho	3,551	3,621	.36	3,889	3,430	95,380	.32
Michigan	46,752	46,440	4.36	47,470	45,679	4,684,855	15.85
Missouri	773	1,400	.25	2,658	1,300	[2]	[2]
Montana	128,712	128,036	12.91	140,465	141,194	6,223,222	21.06
Nevada	80,518	78,911	7.67	83,434	83,663	1,536,911	5.20
New Mexico	73,848	73,478	7.32	79,598	80,100	1,089,901	3.69
North Carolina	[3]	[3]	[3]	[3]	[3]	[2]	[2]
Oregon	84	83	.01	113	103	11,648	.04
Pennsylvania	[3]	[3]	[3]	[3]	[3]	[2]	[2]
South Carolina		[4]	[1]	1	[4]	[2]	[2]
South Dakota					1	[2]	[2]
Tennessee	[3]	[3]	[3]	[3]	[3]	[5] 259,508	[5] .88
Texas	7	6	.01	104	99	[2]	[2]
Utah	270,647	266,838	29.20	317,717	306,691	3,985,455	13.49
Virginia					28	[2]	[2]
Washington	8,667	8,686	.78	8,525	8,030	56,801	.19
Wyoming	4	4	[1]	1		15,870	.05
Undistributed	13,366	13,566	1.23	13,321	14,175	[6] 265,041	[6] .90
	966,072	958,149	100.00	1,087,991	1,080,062	29,552,541	100.00

[1] Less than 0.01 percent. [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 1929–42 confidential and included under "Undistributed". [6] Includes Tennessee for 1929–42.

In 1942 the Bingham (Utah) district experienced no difficulty in maintaining its lead among the copper-producing districts of the country for the seventh consecutive year; its output was 117 percent higher than that of its nearest competitor, the Butte (Mont.) district. For 7 years the Butte district ranked second in production, and its total production from the beginning of operations is far above that of any other district in the country. Following the Globe-Miami district, Ariz., which has ranked third for a number of years, is a group of districts that frequently changes place in importance as copper producers.

Details of mine production, by districts and companies, in 1942 are available in the 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 of the United States,[1] 1938–42, in terms of recovered copper, in short tons

District or region	State	1938	1939	1940	1941	1942
Bingham	Utah	106,049	167,856	228,505	264,705	304,687
Summit Valley (Butte)	Montana	76,855	97,266	125,442	127,431	140,349
Globe-Miami	Arizona	44,528	62,400	70,406	82,419	94,265
Ely (Robinson)	Nevada	38,501	51,590	63,840	67,171	75,063
Central (including Santa Rita).	New Mexico	16,557	42,344	64,991	67,727	72,724
Ajo	Arizona	43,180	49,871	51,566	65,880	66,647
Copper Mountain (Morenci)	do	11,148	15,878	13,503	13,879	60,356
Bisbee (Warren)	do	47,518	54,617	55,254	56,592	53,278
Ray (Mineral Creek)	do	15,029	21,583	31,729	42,400	50,362
Lake Superior	Michigan	46,743	43,985	45,198	46,440	45,679
Yavapai County (mostly Jerome district).	Arizona	29,437	38,203	38,201	43,701	44,941
Pioneer	do	17,167	17,958	18,450	19,121	20,702
Chelan Lake	Washington	5,931	8,786	9,288	8,365	7,955
Cope	Nevada	6,563	14,065	13,542	10,756	7,074
Lordsburg	New Mexico	3,173	3,184	3,278	3,734	3,358
Coeur d'Alene region	Idaho	1,883	2,068	2,680	2,979	2,993
Tintic	Utah	1,177	1,413	1,295	1,042	853
San Juan Mountains	Colorado	1,819	981	1,209	705	539
Red Cliff (Battle Mountain)	do	12,013	11,921	10,552	5,609	323
Ophir	Utah	437	2,070	1,095	204	202
Bunker Hill	Arizona	1,626	246	8	11	24
Plumas County	California	602	4,029	5,293	3,644	3
San Pedro	New Mexico	44	336	1,394	719	
Copper River [2]	Alaska	[3] 14,549	[4]	[4]	[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 1938–42.
[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 mines in the United States in 1941; figures for 1942 are not yet available. Of the total copper produced from copper ores in the United States in 1941, 85 percent was obtained from ores concentrated before smelting and 10 percent from direct-smelting ores; in addition, copper was recovered from 3,785,654 tons of copper ore treated by straight leaching. The percentages for 1941 compare with 84 percent obtained from concentrated ore and 11 percent from direct-smelting ores in 1940. In 1940, 3,198,904 tons of copper ore were treated by straight leaching.

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 1941, 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	144	20,876	7.25	31	128	$8.17
Arizona	24,153,483	[1] 613,096,452	1.27	142,498	5,006,374	.35
California	292,232	7,418,100	1.27	12,038	179,744	1.88
Colorado	207,678	11,479,396	2.76	25,187	4,306,343	18.99
Idaho	7,979	687,128	4.31	696	43,851	6.96
Michigan	4,282,448	92,880,000	1.08		60,796	[2] .59
Montana	3,791,202	[1] 244,015,387	3.22	13,871	6,142,250	1.28
Nevada	6,850,444	156,649,800	1.14	65,510	259,686	.36
New Mexico	6,975,682	[1] 127,896,610	.92	8,908	242,834	.07
Oregon	629	48,000	3.82	10	2,220	3.07
Texas	58	3,000	2.59		22	.28
Utah	30,444,402	[1] 513,251,387	.84	243,953	2,285,377	.33
Washington	694,565	17,313,000	1.25	46,034	202,091	2.53
Wyoming	42	7,902	9.41	2	30	2.17
Eastern States	751,516	[3] 27,130,735		324	44,205	
	78,452,504	[3] 1,811,897,773	1.15	559,062	18,775,951	.42

[1] Excludes copper recovered from mine-water precipitates as follows: Arizona, 34,323,752; Montana, 5,503,585; New Mexico, 16,818,294; and Utah, 13,418,668 pounds.
[2] Calculated only on ore that yielded silver.
[3] Copper from magnetite-pyrite-chalcopyrite ore from Pennsylvania included with that from copper ore.

Copper ore, old tailings, etc., concentrated in the United States in 1941, 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)
Alaska	100	20	13,932	6.97
Arizona	[1] 18,607,089	938,095	[2] 374,509,382	1.01
California	291,468	14,934	7,298,500	1.25
Colorado	4,624	884	192,000	2.08
Idaho	3,906	476	178,814	2.29
Michigan	4,282,448	70,550	92,880,000	1.08
Montana	3,790,183	509,374	243,893,505	3.22
Nevada	6,825,565	267,234	147,030,600	1.08
New Mexico	6,901,193	222,411	125,266,413	.91
Oregon	500	72	24,000	2.40
Utah	30,432,336	789,335	512,546,305	.84
Washington	693,937	36,005	17,118,128	1.23
Eastern States	698,363	[3] 72,200	[4] 23,834,000	
	72,531,712	2,921,590	1,544,785,579	1.06

[1] In addition, 3,785,654 tons were treated by straight leaching.
[2] In addition, 84,127,150 pounds of copper were recovered by straight leaching.
[3] Includes concentrates from magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[4] Includes copper from magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Copper ore, old tailings, etc., smelted in the United States in 1941, with content in terms of recovered copper, and copper produced from all sources, in terms of recovered copper

State	Ore, old tailings, etc., smelted			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Short tons	Copper produced (pounds)	Percent of copper	
Alaska	44	6,944	7.89	144,000
Arizona	1,760,740	154,459,920	4.39	[1] 652,634,000
California	764	119,600	7.83	7,886,000
Colorado	203,054	11,287,396	2.78	13,496,000
Idaho	4,073	508,314	6.24	[2] 7,242,000
Michigan				92,880,000
Missouri				2,800,000
Montana	1,019	121,882	5.98	[1] 256,072,000
Nevada	24,879	9,619,200	19.33	157,822,000
New Mexico	74,489	2,630,197	1.77	[1] 146,956,000
Oregon	129	24,000	9.30	166,000
Texas	58	3,000	2.59	12,000
Utah	12,066	705,082	2.92	[1] 533,676,000
Washington	628	194,872	15.52	17,372,000
Wyoming	42	7,902	9.41	8,000
Eastern States	53,153	3,296,735	3.10	27,132,000
	2,135,138	182,985,044	4.29	1,916,298,000

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

Copper ores produced in the United States, 1937–41, and average yield in copper, gold, and silver

Year	Smelting ores [1]		Concentrating ores [1]		Total				
	Short tons	Yield in copper (percent)	Short tons	Yield in copper (percent)	Short tons [1]	Yield in copper (percent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1937	[2] 2,763,184	4.30	[2] 58,737,922	1.15	[2] 61,513,148	1.29	0.0081	0.327	$0.53
1938	[2] 2,028,000	4.49	[2] 34,374,026	1.17	[2] 37,794,938	1.34	.0090	.414	.58
1939	2,396,155	4.61	50,710,026	1.09	55,239,098	1.25	.0085	.333	.52
1940	2,179,060	4.33	63,900,512	1.10	69,278,476	1.20	.0078	.300	.48
1941	2,135,138	4.29	72,531,712	1.06	78,452,504	1.15	.0071	.239	.42

[1] Includes old tailings, etc.
[2] Exclusive of Alaska, figures for which Bureau of Mines not at liberty to publish.

REFINERY PRODUCTION

The refinery output of copper in the United States in 1942 was made by 11 plants; 8 of these employed the electrolytic method, 2 the furnace process on Lake Superior copper, and 1 the furnace process on western ores.

There are five large electrolytic refineries on the Atlantic seaboard, three Lake refineries on the Great Lakes, and three electrolytic refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; and one at El Paso, Tex. In 1942, fire-refined copper was produced for the first time at the Hurley plant of the Kennecott Copper Corporation. Of the above plants, the Lake refinery of the Quincy Mining Co. has been idle since 1933.

In addition to the foregoing plants, that at Inspiration, Ariz., is equipped to make electrolytically refined copper direct from the liquors obtained from leaching; this copper is shipped as cathodes to other refineries, where it is melted and cast into merchant shapes.

The 13 plants indicated constitute what commonly are termed "regular refineries." Of these plants, 9 employ the electrolytic process and 4 the furnace process. The Phelps Dodge Refining Corporation plant at El Paso used both methods in 1942. The electrolytic plants have a rated capacity of 1,547,000 tons of refined copper a year. As they produced 1,390,000 tons in 1942, this part of the industry was operated at 90 percent of capacity.

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

Primary and secondary copper produced by regular refining plants in the United States and imported, 1938–42, in short tons

	1938	1939	1940	1941	1942
Primary:					
Domestic: [1]					
Electrolytic [2]	516,488	662,409	883,610	929,711	963,177
Lake [2]	36,011	42,464	43,629	45,697	46,523
Casting	75				55,092
	552,574	704,873	927,239	975,408	1,064,792
Foreign: [1]					
Electrolytic	239,818	304,642	386,317	419,901	343,834
Casting and best select	24				5,935
Refinery production, new copper	792,416	1,009,515	1,313,556	1,395,309	1,414,561
Imports, refined copper [3]	1,801	16,264	68,337	346,994	395,039
Total new refined copper made available	794,217	1,025,779	1,381,893	1,742,303	1,809,600
Secondary:					
Electrolytic [4]	92,542	116,613	117,669	95,437	83,079
Casting				4,238	2,064
	92,542	116,613	117,669	99,675	85,143
Grand total	886,759	1,142,392	1,499,562	1,841,978	1,894,743

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

Copper cast in forms in the United States, 1941–42

Form	1941		1942	
	Short tons	Percent	Short tons	Percent
Wire bars	736,000	49.23	582,000	38.81
Cathodes	300,500	20.10	464,500	30.98
Cakes	191,500	12.81	119,500	7.97
Ingots	128,500	8.60	219,500	14.64
Other forms	138,500	9.26	114,000	7.60
	1,495,000	100.00	1,499,500	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 31,704 short tons having a copper content of 8,076 tons in 1942 compared with 27,417 tons having a copper content of 6,984 tons in 1941.

The output of copper sulfate by plants other than the regular primary refineries totaled 72,411 tons with a reported copper content of 18,390 tons in 1942 compared with 58,072 tons containing 14,684 tons of copper in 1941.

Copper chemicals, including copper sulfate, were placed under allocation control in an order effective October 1, 1942. The Office of Price Administration set the ceiling price for copper sulfate at $5 per 100 pounds, effective April 3, 1943, for sales by manufacturers and May 3 for sales by others. Previously the price had been $5.15 in the East and as high as $5.50 in the West. In May the order was amended to permit an increase to $5.15 for deliveries in the West. In an article on insecticide chemical requirements for war food supplies McBride [2] stated that over 200,000,000 pounds of copper chemicals, principally copper sulfate, are wanted for military use, for export, for other industries, and for insecticides. Availability of scrap, he said, would determine the size of production. In 1939 51,122,000 pounds of copper sulfate were used for agricultural purposes, and in the fiscal year ended September 30, 1942, 79,539,000 pounds were so used; 86,000,000 pounds were estimated as requirements for this purpose in 1943.

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 1938–42. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary copper produced in the United States, 1938–42, in short tons

	1938	1939	1940	1941	1942
Copper recovered as unalloyed copper	192,400	151,370	170,839	135,869	114,647
Copper recovered in alloys	167,400	[1] 348,330	[1] 361,207	[1] 590,527	[1] 813,108
Total secondary copper	359,800	499,700	532,046	726,396	927,755
From new scrap	92,500	212,800	198,156	313,697	500,633
From old scrap	267,300	286,900	333,890	412,699	427,122
Percent of domestic mine output	65	69	61	76	86

[1] Includes copper in chemicals as follows: 1939, 3,200 tons; 1940, 9,431 tons; 1941, 9,804 tons; 1942, 17,455 tons.

CONSUMPTION

Available data on consumption of copper indicate that new high record rates of use were established in 1941 and again in 1942. The calculations were made upon the basis of copper available for use, or apparent consumption. Also, in estimating apparent consumption it has been assumed that copper used in the manufacture of primary

[2] McBride, R. S., Insecticide Chemicals Needed For War Food Supply: Chem. and Met. Eng., vol. 50, No. 3, March 1943, pp. 101–103.

fabrications of copper is copper consumed. It is likely that statistics compiled upon a different basis (for example, by taking consumption as including only copper made into automobiles, electrical equipment, ships, etc.) would show very different results. Much copper leaves the country as primary fabrications and considerably more in manufactured products containing copper. Actual consumption data may be compiled at many points in the industrial process. The method of calculating the quantity of copper available for consumption is shown in the following table. It should be noted that exports and stocks include some refined secondary copper that cannot be determined separately and also that actual consumption of new copper would differ from the figures shown in the table by the changes in consumers' stocks.

New refined copper withdrawn from total year's supply on domestic account, 1938–42, in short tons

	1938	1939	1940	1941	1942
Total supply of new copper	794,217	1,025,779	1,381,893	1,742,303	1,809,600
Stock at beginning of year	179,000	181,000	95,500	91,500	77,500
Total available supply	973,217	1,206,779	1,477,393	1,833,803	1,887,100
Copper exported [1]	385,223	396,406	377,108	114,753	132,467
Stock at end of year	181,000	95,500	91,500	77,500	84,000
	566,223	491,906	468,608	192,253	216,467
Withdrawn on domestic account	406,994	714,873	1,008,785	1,641,550	1,670,633

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

The usual discussion of consumption of copper by uses cannot be given owing to inability of the American Bureau of Metal Statistics, the source of previous data on this subject, to obtain and release information because of the war.

STOCKS

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

Stocks of copper at primary smelting and refining plants in the United States at end of year, 1938–42, in short tons

Year	Refined copper	Blister and materials in process of refining [1]	Year	Refined copper	Blister and materials in process of refining [1]
1938	181,000	233,000	1941	77,500	240,000
1939	95,500	260,000	1942	84,000	235,500
1940	91,500	243,000			

[1] Includes copper in transit from smelters in the United States to refineries therein.

Total inventories of copper in the hands of smelters and primary refineries at the end of 1942 were virtually unchanged from those on hand at the beginning of the year, having gained less than 1 percent; refined stocks rose 8 percent and those of blister and unfinished materials at smelters, in transit to refineries, and at refineries fell 2 percent.

Figures compiled by the Copper Institute (published in the press before June) show that domestic stocks of refined, duty-free copper declined to 65,309 tons at the end of 1942 from 75,564 tons at the end of 1941 and 142,772 tons at the end of 1940. At the end of 1938 refined stocks were more than double those on hand at the end of 1940 and were more than four times those at the end of 1942. There are always differences between the stock data of the Bureau of Mines and those of the Copper Institute, due partly to a somewhat different coverage and partly to an arbitrary but permissible method used by the Copper Institute in designating the copper as domestic or foreign metal. This latter factor causes a time-lag difference between the two sets of figures.

According to fabricators' statistics (also published in the press before June), there were large variations in their inventories in recent years. Stocks of refined metal, in-process material, and primary fabricated shapes totaled 339,376 tons at the end of 1940, declined to 295,813 tons at the end of 1941, and rose to 414,668 tons at the end of 1942. Meanwhile unfilled purchases of refined copper in fabricators' hands fell from 326,269 tons at the end of 1940 to 241,335 tons at the end of 1941 and to 135,481 tons at the close of 1942. Fabricators' working stocks, which rise and fall according to plant activity, were 240,740, 291,515, and 340,547 tons, respectively. Unfilled sales by fabricators to customers rose from 414,892 to 547,468 to 613,005 tons. Even the staggering figure of 613,005 tons at the end of 1942 marked a decline from the historic total of 689,177 tons at the end of June. Copper classed as "available for sale" was 10,013 tons at the end of 1940, and —304,675 and —403,403 tons, respectively, at the close of 1941 and 1942.

The quantity of copper delivered thus far to the Metals Reserve Co. aggregates the equivalent of more than a good year's production from domestic mines. Monthly allocations are made against these stocks, and at the end of 1942 only 15 percent of the total metal delivered remained in the stock pile.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 1,086,000 tons of copper were delivered to domestic and foreign purchasers (excluding deliveries of foreign copper to the Metals Reserve Co.) in 1942 at an average price (f. o. b. refinery) of 11.8 cents a pound, unchanged from 1941 and 0.5 cent a pound higher than in 1940. The average price for 1942 is exclusive of bonuses paid for the overquota outputs of individual mines. Such bonuses are described later. Bonus payments added between 0.3 and 0.4 cent a pound to the average realization for copper in 1942, but only a relatively small proportion of total production benefited and that which did received 5 cents a pound above the ceiling price.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States, 1941–42, in cents per pound

Month	1941			1942		
	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]
January	11.87	11.819	10.257	11.87	11.775	11.508
February	11.87	11.794	10.414	11.87	11.775	11.700
March	11.87	11.814	10.592	11.87	11.775	11.700
April	11.87	11.820	10.952	11.87	11.775	11.700
May	11.87	11.815	10.950	11.87	11.775	11.700
June	11.87	11.810	10.950	11.87	11.775	11.700
July	11.87	11.812	10.950	11.87	11.775	11.700
August	11.87	11.778	10.950	11.87	11.775	11.700
September	11.87	11.775	11.027	11.87	11.775	11.700
October	11.87	11.775	11.367	11.87	11.775	11.700
November	11.87	11.775	11.200	11.87	11.775	11.700
December	11.87	11.775	11.200	11.87	11.775	11.700
Average for year	11.87	11.797	10.901	11.87	11.775	11.684

[1] As reported by American Metal Market Co.
[2] As reported by Engineering and Mining Journal.

Average yearly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States and for spot copper at London, 1933–42, in cents per pound

	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942
Domestic f. o. b. refinery [1]	7.15	8.53	8.76	9.58	13.27	10.10	11.07	11.40	11.87	11.87
Domestic f. o. b. refinery [2]	7.025	8.428	8.649	9.474	13.167	10.000	10.965	11.296	11.797	11.775
Export f. o. b. refinery [2]	6.713	7.271	7.538	9.230	13.018	9.695	10.727	10.770	10.901	11.684
London spot [2 3]	6.877	7.496	7.753	9.465	13.097	9.912	[4] 10.066	([5])	([5])	([5])

[1] As reported by American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Conversion of English quotations into American money based on average rates of exchange recorded by Federal Reserve Board of Treasury.
[4] Average for 8 months; thereafter, London Metal Exchange dealings suspended for duration of war.
[5] No quotations.

Ceiling prices were placed on electrolytic and casting copper in 1941 and were described in the chapter of Minerals Yearbook, 1941, on this subject. In January 1942 the Metals Reserve Co. was authorized to buy copper produced at domestic mines, and fulfilling certain requirements, at 5 cents above the ceiling price, or at 17 cents a pound. Payments were to be made on production from February 1, 1942, and were to extend over 2½ years. The payments were to be made only on production over quotas set by the War Production Board and the Office of Price Administration. The plan was inaugurated to stimulate production from either new or high-cost properties, or both. When individual quotas were established the mines falling into preferred classes were found largely to have zero quotas, which entitled the total amounts produced to bonuses. Well-established, large properties were assigned such high quotas that they were entitled to virtually no benefits. It was necessary during the year to revise a number of quotas to eliminate inequities. Late in the year and early in 1943 it became desirable to revise downward many more to take care of the generally increased costs of production. In January 1943 the plan was extended to July 31, 1945. On May 1, 1943, it was an-

nounced that a special additional premium would be made available to small copper mines that produced less than 2,000 tons of copper in 1942 and required increased revenue to obtain maximum production. Individual cases were to be considered separately, and a special premium was to be paid at a rate to be fixed for each mine on production in excess of a special quota. Premiums and quotas were subject to adjustments at any time or revocation on 30 days' notice.

The premiums for less-than-carlots sold by producers and refiners were revised in January 1942, effective February 1. The ceiling prices l. c. l. on electrolytic, Lake, and other fire-refined copper and casting copper were set at 12⅛ cents and 12 cents per pound f. o. b. shipping points, respectively. Premiums were no longer permitted on casting copper sold by persons other than a producer or refiner.

Copper and copper-alloy scrap prices are discussed in the chapter on Secondary Metals—Nonferrous.

The following official maximum prices, delivered to consumers' plants, have prevailed in the London market since December 18, 1939:

	Per long ton		
	£	s.	d.
Electrolytic, high conductivity	62	--	--
Fire-refined:			
High conductivity	62	--	--
High grade	61	10	--
Minimum, 99.7 percent	61	--	--
Minimum, 99.2 percent	60	10	--
Hot-rolled black wire rods	65	10	--

FOREIGN TRADE [3]

Under ordinary circumstances, excess copper smelting and refining capacities in the United States are utilized to reduce crude materials from abroad which later are shipped from the country as refined copper or fabricated shapes. This business has been done mainly without the payment of the duty, or if the duty was paid and the copper was subsequently exported virtually all of the expenditure has been refunded. The conditions once considered normal, however, have disappeared. First of all, war demands have, temporarily at least, removed all excess capacity, and all the copper that can be obtained at home or abroad is urgently needed. Copper in refined form (primarily that from Chile), which used to go directly to Europe and which was temporarily stranded without adequate outlet after war was declared, was later welcomed in the United States. Every effort was made to supply adequate shipping tonnage to obtain every available pound of refined metal—an "about face" from the pre-war situation. As a consequence, imports of refined metal reached new heights in 1941 and again in 1942. Since the war started, receipts of copper have been largely from countries that furnished the principal amounts of crude copper before, but, as already stated, the accent has shifted to obtaining higher grades. One important defection is noted in the absence of the usual copper from Yugoslavia. There has been an even greater disruption of export movements. The large shipments to most European countries and to Japan, previously the

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

principal destinations, have ceased. The United Kingdom is the one exception, as it now leads as a destination of copper from the United States and was one of the leading countries for many earlier years; the U. S. S. R. has taken large amounts, beginning in 1939. Copper is exported now only after careful scrutiny of the requests made and careful weighing of one need against another. Domestic requirements may go unfilled in favor of more urgent ones of our allies. Exports in 1941 and 1942 compared unfavorably with most other years in the twentieth century, and it was expedient that they did so. A noteworthy movement in 1942 was the shipment of over 32,000 tons of copper wire to the U. S. S. R., of nearly 13,000 tons to Egypt, and of nearly 8,000 tons to India. The export movement would be found to have been much larger than is evident from the records for refined and primary manufactures shown in this report, if data on the amounts of copper exported in such manufactured products as airplanes, tanks, and electrical apparatus were available separately.

IMPORTS

As regards imports, the outstanding development of the past 2 years has been the increased receipt of refined copper to record-breaking proportions. This class of imports had little significance from the time the 4-cent tariff on copper went into effect in 1932 to the beginning of the present war. Refined copper began to reach the country in increasing quantities again in 1940, and imports were larger than ever before in 1941 and again in 1942. Since 1932 Chile has furnished virtually all of the refined copper entered, and it has come from mines controlled by nationals of the United States. Canada was an important contributor before that time. In both 1941 and 1942 Chile supplied 99 percent of the total refined copper imported. Because of the absence of sufficient shipping accommodations to bring all desired commodities into the country, there were declines in the receipts of some of the lower grades of copper in 1942 as compared with 1941 and 1940, although most grades compared favorably with other recent years before World War II. Receipts of copper classed by the Department of Commerce as "unrefined black blister and converter copper in pigs or converter bars" were mainly from Chile, Mexico, Belgian Congo, Peru, Canada, and British Africa in 1941 and 1942. Chile supplied less of this grade of copper in 1941 than in 1940 and fell again in 1942. Peru followed the same pattern, and Canada sent only about a fourth as much in 1942 as in either 1941 or 1940. Mexico gained in 1941 and again in 1942, and Belgian Congo, whereas furnishing less in 1942 than in 1941, supplied considerably more in both years than in 1940. Belgian Congo also sent generous amounts of regulus or black copper, being the outstanding supplier of this grade. Imports from Belgian Congo in 1941 and 1942 were largely earmarked for reshipment to the United Kingdom after refining. Imports of the lower-grade classes of concentrates and ores came mainly from Canada, Cuba, Chile, and other Western Hemisphere sources in 1942, and Western Hemisphere sources predominated likewise in 1941. Canada was well ahead of all others in shipping copper concentrates; receipt from this source and from Mexico make no strain on ocean shipping facilities. A noteworthy quantity of copper in concentrates was shipped from the Philippine Islands in 1941. Unfortunately, the resources of these islands added to Japan's supplies in 1942.

Copper (unmanufactured) imported into the United States, 1941 and 1942, by countries, in short tons [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
1941						
Africa, British:						
Union of South		193	59			21
Other South		653		6,929		
Argentina	2	41	116			
Australia	1,150		1			
Belgian Congo		38	45,505	36,451		
Bolivia	191	6,265				
Burma			1,816			
Canada	117	34,533	413	22,420	3,912	1,887
Chile	1,199	1,612	2	114,430	343,082	45
Colombia	11	15				17
Cuba	124	7,943				
Curaçao (NWI)						54
Ecuador	162	3,375				
Honduras		136				
Mexico	1,150	7,122		46,136		51
Newfoundland and Labrador	5	5,811				5
Panama, Republic of						62
Peru	448	4,821	42	30,840		33
Philippine Islands	(2)	[2] 3,964				
Other countries	3	17	4			111
	4,562	76,539	47,958	257,206	346,994	2,286
1942						
Africa, British:						
Union of South		16	4,252	14,567		
Other South		321	24	4,224		
Argentina	2	55				
Australia	3,391	40		161		
Belgian Congo		(3)	62,542	29,068		
Bolivia	304	5,120				
Burma		355	1,249			
Canada	14	27,481	306	5,822	820	590
Chile	504	6,691	(3)	92,246	391,785	
Colombia		8				
Cuba		8,867			(3)	
Curaçao (NWI)						
Ecuador		1,482	270		500	
Honduras		(3)				
Mexico	735	4,986		51,846		
Newfoundland and Labrador		4,120				
Panama, Republic of						
Peru	516	5,501	357	22,300	1,934	
Philippine Islands	(2)	[2] 256				
Other countries	14	4	(3)	1,838		490
	5,480	65,303	69,000	222,072	395,039	1,080

[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."

[3] Less than 1 ton.

Copper (unmanufactured) imported [1] *into the United States, 1938–42*

Year	Short tons	Year	Short tons
1938	252,164	1941	735,545
1939	336,297	1942	757,974
1940	491,342		

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

EXPORTS

Total exports of copper in 1942, including those of the primary steps of manufacture, were over a third larger than the extremely low total for 1941. Of our principal pre-war customers—Japan, Germany, the United Kingdom, Italy, France, Belgium, and Sweden—only the United Kingdom remains. Three of these countries are our enemies in the present conflict, two are under enemy domination, and the sixth is an uneasy neutral surrounded by shipping and other complications. It is a sad commentary that Japan received nearly 22,000 tons of copper from the United States in 1941. The United Kingdom sharply increased its orders for copper in 1942 and took more of the refined class—the principal one—than it has since 1918. The U. S. S. R., a negligible buyer before the war, received the second-largest quantity of copper shipped from the United States in 1942. The recent sharp gains in shipments of insulated and other copper wire and cable to U. S. S. R., Egypt, and India (British) are worthy of note. In 1942 over 32,000 tons were shipped to the U. S. S. R., nearly 13,000 to Egypt, and nearly 8,000 to India.

The following table gives the destinations of exports of copper and primary manufactures in 1941 and 1942. The chapter on Copper from Minerals Yearbook, 1941, contains a table showing exports by countries for 1937 to 1940 and indicating the revolution in flow of copper from the United States since the outbreak of war in Europe.

Copper exported from the United States, 1941–42, by countries, in short tons

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
		Bars, ingots, or other forms	Rods						
1941									
Argentina		892	7		63	17	313	1,559	
Australia		3,364			2	228	51	806	
Brazil		6,718	483		80	125	218	297	
Burma		2,000			1		362	472	
Canada	4	284	314	26	578	679	175	1,268	
Chile		15	3		39	19	548	628	
China		6,461	326	112	70	108	1,197	374	
Colombia		45	(1)		31	117	175	710	
Cuba	1	1	3		123	31	135	995	
Egypt		56	6		4	3	371	3,363	
Hong Kong	2	14	1		2	10	6	288	(2)
India, British		2,437	6,889	56	166	1,160	817	368	
Japan		16,934	1,680	2,972				1	
Kwantung		251	1,344	36				145	
Mexico	3	3,043	4		93	39	67	824	
Netherlands		978	37		254	652	1,438	2,723	
Panama, Republic of		88	4		232	219	133	2,783	
Philippine Islands	2	176	4	1	52	22	279	1,308	
U. S. S. R.		5,768						2,773	
United Kingdom	(1)	53,734	9		1	5	163	1,786	
Other countries	(1)	343	37	55	341	348	944	4,105	
Total value	12	103,602	11,151	3,258	2,132	3,782	7,392	27,576	(2)
	$3,874	$23,351,231	$2,934,584	$722,943	$1,173,882	$1,574,750	$2,533,373	$13,901,638	$1,493,265

See footnotes at end of table.

Copper exported from the United States, 1941–42, by countries, in short tons—Continued

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
		Bars, ingots, or other forms	Rods						
1942									
Argentina		(1)	(1)		43	81	30	396	
Australia	(1)		2		2	50	128	1,267	
Brazil		1,131	(1)		20	19	63	284	
Burma					(1)		225	45	
Canada	2	208	91	1	650	143	32	991	
Chile		89	3		7	6	354	437	
China		3,002			(1)	6	342	117	
Colombia		(1)	(1)		7	1	33	145	
Cuba		(1)	(1)		74	17	63	335	
Egypt		2	6		1	(1)	4,015	8,826	
Hong Kong								(1)	(2)
India, British		251	1		9	170	2,544	5,278	
Japan									
Kwantung									
Mexico	(1)	3,376	6		85	20	200	1,157	
Netherlands									
Panama, Republic of					1	(1)	(1)	37	
Philippine Islands									
U. S. S. R.		15,238	172		3,629	1,078	415	31,898	
United Kingdom	3,422	108,683	34	1,130	30	131	169	2,140	
Other countries	(1)	161	11	1,103	220	188	1,877	7,077	
Total value	3,424 $796,062	132,141 $29,754,554	326 $134,686	2,234 $472,607	4,778 $5,757,806	1,910 $905,658	10,490 $3,773,341	60,430 $37,210,491	(2) $3,75 9,403

[1] Less than 1 ton.

[2] Figures for quantity not recorded.

Copper [1] exported from the United States, 1938–42

Year	Short tons		Total value	Year	Short tons		Total value
	Metallic [2]	Total			Metallic [2]	Total	
1938	421,012	422,014	$86,119,848	1941	158,893	158,905	$46,196,275
1939	427,517	427,579	96,321,365	1942	212,309	215,733	78,805,205
1940	427,650	427,944	108,534,217				

[1] Exclusive of "other copper manufactures" valued at $689,008 in 1938; $863,561 in 1939; $1,584,441 in 1940: $1,493,265 in 1941; and $3,759,403 in 1942.
[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.

Brass and bronze exported from the United States, 1941–42, by classes

Class	1941		1942	
	Short tons	Value	Short tons	Value
Ingots	124	$41,739	268	$85,342
Scrap and old	722	115,991	168	28,333
Bars and rods	8,603	3,139,014	10,689	3,719,266
Plates and sheets	30,770	11,377,672	63,172	24,056,349
Pipes and tubes	1,540	951,789	2,752	1,784,002
Pipe fittings and valves	1,527	2,101,318	1,694	1,862,328
Plumbers' brass goods	655	792,695	230	360,756
Wire of brass or bronze	3,769	1,897,069	3,517	1,496,365
Brass wood screws	(1)	149,650	(1)	64,610
Hinges and butts of brass or bronze	(1)	135,778	(1)	56,956
Other hardware of brass or bronze	(1)	547,753	(1)	341,215
Other brass and bronze manufactures	(1)	5,304,237	(1)	6,093,210
		26,554,705		39,948,732

[1] Weight not recorded.

Unmanufactured brass exported from the United States, 1938–42

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

Year	Short tons	Value	Year	Short tons	Value
1938	1,823	$677,809	1941	39,497	$14,558,425
1939	6,476	1,946,578	1942	74,129	27,860,957
1940	90,907	30,801,796			

Copper sulfate (blue vitriol) exported from the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	15,625	$1,229,317	1941	34,511	$2,950,714
1939	14,620	1,157,498	1942	35,280	3,443,922
1940	27,740	2,293,983			

WORLD ASPECTS OF COPPER INDUSTRY

Figures on production of copper—and for that matter on all other materials—have not been available for many countries since or immediately before the outbreak of World War II. Copper is one commodity of which the United Nations retain a preponderant share of the world total, however, and upon the basis of available information it is safe to assume that more copper was produced in the world in

1942 than in any previous year. The world's largest sources—the United States, Chile, Canada, Northern Rhodesia, and Belgian Congo—were producing at record or near-record levels, and copper from these countries (and from others as well) was all directed toward filling United Nations needs. Nevertheless, the United Nations had insufficient supplies to take care of their expanded war demands for military and essential civilian requirements. Certainly the Axis Powers, much less favored with reference to copper, at least, were hard-pressed to make ends meet. The overrunning of neighboring countries in Europe by the Germans and Italians added principally Yugoslav copper as new supplies. Much copper was also gained by seizing inventories of metal in the conquered territory and from intensive scrap drives therein. The yield in copper and copper products from conquered nations other than Yugoslavia is not of a nature to continue, however, and the situation as regards copper, therefore, must be rapidly worsening. Likewise Japan, despite great gains in raw material supplies, did not succeed in acquiring areas that can yield appreciable quantities of copper. The production of the Philippine Islands was the principal and doubtless only gain in this regard, and under 10,000 tons of copper probably will be obtained annually from that source. Unlike Germany, Japan did not conquer territory that would yield noteworthy quantities of copper, copper alloy, and scrap stocks.

World mine and smelter production of copper, 1939–42, in metric tons

[Compiled by B. B. Waldbauer]

Country	Mine				Smelter			
	1939	1940	1941	1942	1939	1940	1941	1942
North America:								
Canada	276,157	297,371	291,802	274,594	[1] 229,367	[1] 256,294	(2)	(2)
Cuba	9,964	9,559	9,838	(2)				
Mexico	44,390	37,602	48,716	51,379	39,045	31,252	40,914	(2)
Newfoundland	10,341	9,426	6,651	5,666				
United States	660,717	796,582	869,214	979,811	[3] 698,323	[3] 922,364	[3] 1,015,346	[3] 1,111,458
	1,001,569	1,150,540	1,226,221	(2)	966,735	1,209,910	(2)	(2)
South America:								
Bolivia	[4] 4,056	[4] 6,660	[4] 7,274	[4] 6,376				
Brazil	14	(2)	(2)	(2)				
Chile	339,173	352,010	465,467	(2)	324,591	336,861	453,594	477,733
Ecuador	2	1,133	2,894	(2)				(2)
Peru	35,616	43,965	36,822	37,000	34,115	33,678	28,289	29,473
	378,861	(2)	(2)	(2)	358,706	370,539	481,883	507,206
Europe:								
Belgium					[5] 65,850	(2)	(2)	(2)
Bulgaria	320	560	(2)	(2)				
Cyprus	24,384	(2)	(2)	(2)				
Finland	11,797	[6] 20,000	[6] 18,000	(2)	13,246	(2)	[6] 18,000	(2)
France	(7)	(2)	(2)	(2)	(7)	(2)	(2)	(2)
Germany [6 8] / Austria [6 8]	30,000	35,800	(2)	(2)	[9] 66,000	(2)	(2)	(2)
Hungary	(7)	(2)	(2)	(2)				
Italy	(7)	(2)	(2)	(2)	(7)	(2)	(2)	(2)
Norway	20,358	[8] 20,000	(2)	(2)	[8] 10,515	[6] 7,250	(2)	(2)
Portugal	(7)	(2)	(2)	(2)				
Rumania	(7)	(2)	(2)	(2)	(7)	(2)	(2)	(2)
Spain	(7)	(2)	(2)	(2)	10,445	9,422	(2)	[6] 17,070
Sweden	9,610	(2)	(2)	(2)	11,076	[6] 12,500	(2)	[6] 12,000
U. S. S. R.[10]	[11] 144,000	[11] 157,000	(2)	(2)	144,000	157,000	(2)	(2)
United Kingdom	(7)	(2)	(2)	(2)	[6] 4,000	[6] 4,500	(2)	(2)
Yugoslavia	64,200	(2)	(2)	(2)	41,658	[8] 42,951	(2)	(2)
	(7)	(2)	(2)	(2)	(7)	(2)	(2)	(2)

See footnotes at end of table.

World mine and smelter production of copper, 1939–42, in metric tons—Continued

[Compiled by B. B. Waldbauer]

Country	Mine				Smelter			
	1939	1940	1941	1942	1939	1940	1941	1942
Asia:								
Burma	[6] 3,365	(2)	(2)	(2)				
China [12]	1	([13])	[14] 163	(2)	1	([13])	[14] 163	(2)
India, British	([7])	(2)	(2)	(2)	6,640	[8] 6,900	(2)	(2)
Japan:								
Japan Proper	[6 11] 104,000	[6 11] 125,000	(2)	(2)	[6] 104,000	[6] 125,000	(2)	(2)
Taiwan	[6] 4,000	[6] 4,000	(2)	(2)				
Netherlands Indies	94	(2)	(2)	(2)				
Philippine Islands	7,496	9,259	[6] 9,900	(2)				
Turkey	[11] 5,917	[11] 8,731	[11] 10,500	(2)	5,917	8,731	10,500	(2)
U. S. S. R	([10])	([10])	([10])	([10])	([10])	([10])	([10])	([10])
	([7])	(2)	(2)	(2)	[10] 116,558	(2)	(2)	(2)
Africa:								
Algeria	([7])	(2)	(2)	(2)				
Belgian Congo	[11] 122,649	[11] 148,619	[6 11] 165,000	[6 11] 168,000	122,649	148,619	[6] 165,000	[6] 168,000
Rhodesia:								
Northern	([7])	(2)	245,622	254,654	215,065	[6] 231,330	(2)	(2)
Southern	([7])	(2)	(2)	(2)				
South-West Africa	3,530	1,485	(2)	(2)				
Union of South Africa	10,998	13,350	(2)	(2)	14,089	17,024	[15] 16,038	[15] 19,747
Oceania: Australia	([7])	(2)	(2)	(2)	351,803	([2])	(2)	(2)
	19,800	(2)	(2)	(2)	20,219	22,680	(2)	[6] 23,000
	2,251,000	(2)	(2)	(2)	[6] 2,182,000	(2)	(2)	(2)

[1] Copper content of blister produced.
[2] Data not available.
[3] Smelter output from domestic and foreign ores, exclusive of scrap. Production from domestic ores only, exclusive of scrap, was as follows: 1939, 646,524 tons; 1940, 824,703 tons; 1941, 876,401 tons; 1942, 987,004 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 Belgian Congo and would therefore duplicate output reported under the latter country.
[6] Approximate production.
[7] Estimate included in total.
[8] According to Yearbook of American Bureau of Metal Statistics.
[9] Exclusive of material from scrap.
[10] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.
[11] Smelter product.
[12] Exports of ingots and slabs.
[13] Less than 1 ton.
[14] January to August, inclusive.
[15] January to October, inclusive.

REVIEW BY COUNTRIES

Australia.—The efforts to augment production in Australia were extended in 1942. Figures showing results of these efforts are not available for the mines. As labor shortages were prevalent and difficulties were experienced in obtaining needed supplies and equipment, it may well follow that production did not gain as expected in 1942. The Government granted a further advance in price from £A86 10s. to £A105 a ton. The basic price to producers for their normal output was to be £A100, with a bonus of £A5 for each ton in excess.

In November it was reported that large-scale mining of copper ore had begun at the Mount Isa mine, Queensland. The stripping of overburden at the Mount Morgan mine was reaching a stage that should permit mining of a greater tonnage of ore. Here open-cut operations to the 700-foot level were in prospect. Ore from the Mount Chalmers mine is to be transported to Mount Morgan for reduction when production begins. In the year ended September 30, 1942, a larger tonnage of ore was treated at the Mount Lyell mine, Tasmania, than in the previous year, but the average grade was lower and only a small increase in the output of copper resulted. Ore reserves at Mount Lyell were given as 14,850,000 tons of ore, averaging 1.14 percent copper, 0.07 ounce silver, and 0.012 ounce gold. Preliminary surface inspection, for the Government, of South Australia mines, idle for many years, and examination of previous records for the district led to the conclusion that absence of sufficient ore in any one section to permit working from one shaft prevented the revival of mining. The report stated that unless geophysical surveying, in conjunction with diamond drilling, can locate new ore bodies worth developing, it is not feasible to work the ore remaining in the mines at Moonta and Kadina. A diamond-drilling program was suggested.

Belgian Congo.—Following a visit of several months in Belgian Congo, the Belgian Minister of Colonies stated that the colony was producing at the rate of about 160,000 tons of copper annually and could add 30,000 tons if new equipment were available. Late in 1942 a reliable authority estimated that 168,000 metric tons would be produced in 1942. The estimated production capacity is reported as 200,000 tons. In the first part of 1943 an extreme drought lasting several months threatened a 20,000-ton drop in the production rate, with a more serious drop in prospect if enough coal could not be obtained from Northern Rhodesia for the steam power plant. A booklet prepared by the Belgian Information Office stated that under purchase agreements with the United Kingdom a minimum of 124,000 English (126,000 metric) tons was to be purchased in 1941 and a minimum of 144,000 long (146,000 metric) tons in 1942. These figures were contrasted with the 3,766 long (3,826 metric) tons imported into the United Kingdom from Belgian Congo in 1914 and 13,178 long (13,390 metric) in 1916. Large amounts of Belgian Congo copper began to come to the United States again in 1940 following a lull of a number of years. In 1941 the United States received 41,300 metric tons of regulus, black or coarse copper, and cement copper and 33,100 tons of unrefined black blister and converter from Belgian Congo, compared with 56,700 tons and 26,400 tons, respectively, in 1942.

Bolivia.—Early in 1942 a contract was entered into with the Metals Reserve Co. for the sale of all copper produced to that organization, on the same basis as the one covering Chilean copper and other items. Exports in 1942 aggregated 6,376 metric tons compared with 7,274 tons in 1941.

Canada.—Contrary to expectations and to forecasts in the press, the production of copper in Canada did not establish new peak records in 1941 and 1942. Figures for 1940 recently made available indicate that the peak rate was established in that year, with a mine total of 327,797 short tons; the total for 1941 was 321,658 short tons, and for 1942, 302,690 tons. There is little doubt that successive record outputs would have been made as expected if it had not been for labor difficulties, such as those in the United States.

The Bureau of Mines, Ottawa, summarized the copper operations in Canada recently.[4] That organization stated that Canada's output of copper is obtained from the copper-nickel ores of Sudbury, Ontario; the copper-gold, copper-zinc, and copper-pyrites ores of western Quebec; the copper-zinc ores of northern Manitoba; and the copper ores of British Columbia.

The Britannia Mining & Smelting Co. operated its mine and concentrator at Britannia Beach, British Columbia, shipping the copper concentrate as previously to Tacoma, Wash. A reduction of approximately 50 percent in operations in 1942 was due to labor shortage. The production of Granby Consolidated Mining, Smelting & Power Co. approximated 86 percent of that in 1941. Ore reserves once more gained during the year. Anyox Metals, Ltd., is conducting a diamond-drilling campaign at the Hidden Creek and adjoining properties near Anyox.

Preparations were under way for operation of the Tyee zinc-lead-copper property near Chemainus, Vancouver Island, by Twin "J" Mines, Ltd., under supervision of Wartime Metals Corporation, Canadian counterpart of the Metals Reserve Co. of the United States. Production is expected early in the summer of 1943.

At Flin Flon, Manitoba, Hudson Bay Mining & Smelting Co., Ltd., operated its mine, concentrator, smelter, and zinc plant at increased capacity. A fifth copper roaster was installed and put in operation, and the reverberatory furnace was enlarged. This company is said to have proved an important copper-zinc ore body at Schist Lake by exploratory work. A subsidiary company is equipping the old Mandy mine with a 200-ton concentrating plant, ending many years of idleness at this property, and production is expected in the first half of 1943. Sherritt Gordon Mines, Ltd., has indicated a large tonnage of low-grade copper ore by diamond drilling in a section of its property north of the main ore body. The company mine and mill were operated at capacity.

The leading producer in Ontario, as usual, was the International Nickel Co. of Canada, Ltd., which operated its Frood, Frood Open Pit, Creighton, Levack, and Garson mines and started sinking operations at the Murray and Stobie mines. The concentrator at Copper Cliff was operated at capacity, and the capacity was increased to treat additional tonnages of ore from the Open Pit mining operations. Falconbridge Nickel Mines, Ltd., operated its mine and smelter at

[4] Canada Bureau of Mines, Canadian Copper Operations in 1942 Reviewed: Quoted in the Northern Miner, vol. 29, No. 7, May 6, 1943, p. 20.

capacity. The capacity of the smelting plant was increased. Kam-Kotia Porcupine Mines, Ltd., a project of Wartime Metals Corporation, is opening the Jamieson copper property in Robb Township, 20 miles northeast of Timmins.

Metals Controller Geo. C. Bateman of Canada stated that the United States was aiding mining in Canada, that 17 properties were being operated, and that production plans called for the recovery of 46,000 tons of copper.

Chile.—In an effort to supply a substantial part of the needs of the United States Government for copper to feed its war machine, Chile again pushed its copper-production rate into new high territory. Output totaled 477,733 metric tons compared with the previous record tonnage of 453,594 tons in 1941, and the country safely maintained its place as the second most important producer in the world. The Metals Reserve Co. contracted to purchase all of Chile's output. Despite efforts of various United States Government agencies to give all possible help toward increasing the output from Chilean mines, impediments to satisfactory operation were numerous. These involved inadequate supplies of machinery and fuel and scarcity of competent technical personnel. It probably affected small operations more seriously than large ones. The predominant copper-producing mines at Chuquicamata, Potrerillos, and Sewell maintained a high level of activity throughout the year. The Chile Exploration Co. produced 47.25 percent of the country's total, Andes 19.17 percent, and Braden 30.76 percent. Smaller producing mines in Central Chile (according to the Annual Review number of the Engineering and Mining Journal, February 1943) included the Tocopilla, with mills at Tocopilla (300 tons) and Ovalle (700 tons); Ojancos, at Copiapó; and Farellon Sanchez, Merceditas, Volcan, and Carlota, in the Maipo Valley near Santiago. The Chagres and Naltagua smelters operated at capacity; the former handled concentrates produced in the El Cobre and Caracoles mills and the latter received the production of the 500-ton Disputada mill. The Punitaqui mine near Ovalle treated auriferous copper ore in a 400-ton selective flotation plant. A new company was formed to exploit the Cerro Negro mine, 40 km. from Cabildo, Province of Aconcagua; the Compagnie Minière du M'Zaíta is ready to exploit the Cerrado mine; and the Carrizal Consolidated has combined the mining claims of Carrizal under one controlling interest. The Caja de Credito Minero was expected to blow in a matte furnace at Carrizal in March.

At the request of the United States Government the Chile Exploration Co. is expanding and enlarging the mining and treatment facilities for copper production at Chuquicamata to increase its output substantially. The project involves the expenditure of about $5,000,000, to be advanced by the Defense Plant Corporation; the advance is to be retired as the copper produced from the additional facilities is sold.

Of the copper exported, the United States received by far the largest amounts. Copper exported as electrolytic copper totaled 264,481 metric tons, of which the United States was the destination of 238,762 tons, Brazil 15,197, and Argentina 10,221. Standard copper exports were 233,763 tons, of which 229,401 were for the United States and 3,732 for Uruguay. The United States was scheduled to receive all of the 14,176 tons of concentrates and the 1,969 tons of ore shipped from the country.

Ecuador.—According to the Annual Report of Commerce and Industries for 1942, toward the latter part of the year copper was being exported from the country in the form of blister copper instead of as concentrates. Exports for the year were given as 417 metric tons of copper in bars and 7,407 tons of copper concentrates.

Finland.—The Metal Bulletin (London) of July 17, 1942, stated that the Outokumpu Copper Co., overwhelmingly the principal producer in the country, produced 18,000 metric tons of copper in 1941 and that Finland suffered a severe shortage in this metal despite the fact that normal consumption is only 7,000 tons annually. The shortage resulted from the retention of only 3,000 to 4,000 tons of the total for home consumption. Obviously, with domestic consumption needs unfilled, there must have been urgent reasons for shipment of such a large portion of the total out of the country. Germany is believed to have been the destination of the shipments.

Germany.—Speculation increases as to how Germany's inaccessibility to adequate copper supplies is being overcome as war progresses, and the time factor—from a copper viewpoint at the very least—moves to Hitler's disadvantage. Copper is one of the commodities of which the United Nations control by far the preponderant share, and even the United Nations promptly felt a pinch in regard to its supplies. The Metal Bulletin (London) of December 15, 1942, makes the following suggestions as to how Germany's problem has been managed thus far.

(*a*) She started off with large supplies of manufactured copper and brass components accumulated while the rest of the world was still blissfully anticipating peace, (*b*) she also held considerable stocks of raw copper at the outbreak of war previously sold to her by her future enemies, (*c*) she captured appreciable stocks of virgin copper when she successfully overran various neighboring countries, (*d*) she has stripped most of Europe of all kinds of copper articles, (*e*) she has to some extent offset her lack of copper by substituting aluminum, zinc, plastics, etc.

The partial solution under "(*d*)" is surely not an entirely satisfactory one. Increasing amounts of scrap materials are used ordinarily by both participants in the progress of a war. With Germany, however, the proportion of scrap used must necessarily be larger than in the United Nations. The increased consumption of scrap materials containing a wide variety of metals in widely varying proportions presents metallurgical problems that tend to reduce maximum efficiency and capacity output. No new statistical data can be added to those presented in earlier Minerals Yearbook chapters on Copper.

Mexico.—Mine output of copper in Mexico has gained in the past 2 years; 51,379 metric tons were produced in 1942 and 48,716 in 1941. Both years were above the records for previous years since 1931, though much below the annual average of 61,700 tons for 1923–31. No doubt the improved rate in 1942 is due in part to agreements between Mexico and the United States, signed in April, whereby the Metals Reserve Co. was to purchase, for the period of the agreement, copper and other metals at prices that were expected to stimulate increased production. Under this agreement the Mexican Government assures the mining industry of a stabilized tax policy, no increases in railroad rates on mineral products, and cooperation in other ways to facilitate increased production. The Mexican Government and the Mexican Mining Labor organizations also gave assurances of a cooperative and liberal attitude in applying labor laws and regulations applying to certain phases of mining operations.

At the request of the United States Government, The Cananea Consolidated Copper Co., South America, a subsidiary of Greene Cananea Copper Co., is developing an extensive body of low-grade copper ore adjacent to its present mine and plant at Cananea, Sonora. The company is constructing treatment facilities, involving an expenditure of approximately $12,000,000, designed to increase the production of copper substantially. The construction will be financed through the Metals Reserve Co.

The Moctezuma Copper Co. has entered a contract with the Metals Reserve Co. under which the Pilares mine is to be unwatered to the 2,100 level so that the lower levels can be reconditioned and production increased. Under the contract, Metals Reserve is paying the cost of that work, the cost of operating all the properties of the Moctezuma Copper Co., and a small operating profit and receives the copper produced.

Early in 1943 operations of the Boleo Copper Co. in Lower California were facing possible curtailment owing to difficulties in procuring operating supplies.

Northern Rhodesia.—The supposition that Northern Rhodesia was continuing to break production records, mentioned in Minerals Yearbook, 1941, was not borne out by confidential data made available early in 1943. These showed that the production of 245,622 metric (241,744 long) tons for 1941 was down somewhat from the record of 254,904 metric (250,879 long) tons in 1938 and that the output of 254,654 metric (250,634 long) tons in 1942 just about equaled that for 1938. The details, by mines, for 1941 and 1942 were as follows:

	1941	1942
	(Long tons)	
Mufulira	87,791	84,512
Nchanga	15,804	13,523
Nkana	66,741	82,801
Roan Antelope	71,408	69,798

In a report covering mineral resources of this area, the Mineral Resources Department of the Imperial Institute,[5] London, gives the following information on copper:

The Copperbelt of Northern Rhodesia is an area some 50 miles long and 25 miles wide along the upper reaches of the Kafue river, close to the Katanga border of the Belgian Congo. Several copper deposits are known outside this area, * * * but they are insignificant in size when compared with those of the Copperbelt and none of them is now worked. Natives and Arabs had worked copper at Luanshya and Bwana Mkubwa before the arrival of Europeans whose attentions were therefore soon attracted to these deposits. Development work commenced at Bwana Mkubwa in 1903 and ten years later copper concentrates were exported from the mine. The ores, however, were of relatively low grade compared with those mined profitably in the Katanga, and being oxidized proved difficult to treat, so that when thick deposits of clean sulfide ores averaging 4 per cent of copper were found at Luanshya in 1925 interest in the oxidized ores dwindled. The Luanshya discovery led to the opening up of the Roan Antelope mine, and intense prospecting and geological work followed by drilling soon proved the existence of several enormous sulfide ore bodies in other parts of the Copperbelt. Despite the set-back caused by the world economic depression, copper smelting began at Roan Antelope in 1931, at Nkana in 1932, and at Mufulira in 1937.

The ore deposits occur in synclinal areas in the lower beds of the Mine Series and are generally considered to be of epigenetic origin and related to the intrusion of the Younger Granites, although a syngenetic theory of origin has also been advanced. The ores consist of altered shales and felspathic sandstones containing finely disseminated sulfides, principally chalcocite, bornite, and chalcopyrite.

[5] Imperial Institute Bulletin, vol. 40, No. 4, October–December 1942, pp. 298–301.

Most of the deposits consist entirely of sulfides, but the Nchanga ore body contains mixed sulphide and oxidized ores and the Nchanga Extension is largely oxidized ore, malachite being the principal mineral. The ore bodies are sharply defined, gradation into the country rock being exceptional. In form the deposits are beds, usually steeply inclined, and frequently 25 or 30 feet in thickness, but in the Mufulira mine three beds up to 60 feet in thickness occur, and in places two coalesce to form a bed 100 feet thick. The proved reserves of the larger deposits in June 1939, were as follows, taken in order from south to north.

	Reserves (long tons)	*Percent of copper*
Roan Antelope	98, 595, 000	3. 43
Baluba	19, 000, 000	3. 47
Nkana and Mindola	101, 792, 000	3. 43
Chambishi	22, 000, 000	3. 46
Mufulira	96, 800, 000	4. 39
Nchanga	128, 375, 000	[1] 4. 66

[1] 2.53 percent present in oxide minerals and 2.13 present in sulfide minerals.

Further reserves exist which have not yet been proved, and according to the Commissioner of Mines it is probably safe to say that there are at least 750 million tons of high-grade copper ore in the Territory. The proved reserves are greater than those of any other country and the ores are richer than those of the major copper producers, but the annual output of copper is still exceeded by that of the United States, Chile, and Canada.

The producing mines are evenly spaced through the Copperbelt, the Roan Antelope mine at Luanshya in the south, the Nkana mine 21 miles to the northwest, the Mufulira mine 20 miles north of Nkana, and Nchanga, where a pilot mill commenced production in 1939, 29 miles northwest of Nkana. Shafts have also been sunk at the Chambishi mine between Nkana and Nchanga. The Bwana Mkubwa deposit at the southeast corner of the Copperbelt was found to have relatively small ore reserves. A special ammonia leaching process was necessary to treat the ore but, although more than 20,000 tons of copper were thus produced between 1926 and 1930, the process was abandoned and the plant has been dismantled. Each mine has its own smelter producing extremely pure blister copper, and at Nkana there is an electrolytic refinery. From the start of smelting in 1931 until the outbreak of the present war, however, copper production was restricted for economic reasons by agreements with other major copper producers of the world. Between 1936 and 1939 the copper production of the different mines was as follows:

	1936	1937	1938	1939
Nkana, electrolytic copper	28, 012	30, 740	31, 367	29, 654
Nkana, blister copper	28, 092	54, 475	49, 514	50, 126
Roan Antelope, blister copper	56, 448	78, 349	71, 930	68, 904
Mufulira, blister copper	29, 782	44, 614	60, 220	61, 669
Nchanga, blister copper				[1] 1, 315
Total	142, 334	208, 178	213, 031	211, 668

[1] Smelted at Nkana.

The quantities of ore treated during 1939 and the copper produced, together with their copper contents, are shown in the following table.

Mine	Ore treated		Copper recovered			
			Blister		Electrolytic	
	Tons	Percent copper	Tons	Percent copper	Tons	Percent copper
Nkana	2, 469, 196	3. 53	50, 126	99. 41	29, 654	99. 95
Roan Antelope	2, 551, 161	3. 15	68, 904	99. 48		
Mufulira	1, 640, 401	4. 59	61, 669	99. 44		
Nchanga	47, 460	4. 15	1, 315	99. 58		
Total	6, 708, 218	3. 65	182, 014	99. 45	29, 654	99. 95

The article also contains limited descriptions of other copper occurrences in Northern Rhodesia.

Peru.—Recovery of copper from ores produced in Peru showed little change in 1942 from the previous year; production aggregated 37,000 metric tons (preliminary figures) compared with 36,822 tons in 1941. There is little expectation that a noteworthy increase in production will take place in 1943, the continuation of the 1942 rate even being dependent on the maintenance of a reasonable flow of supplies and equipment from the United States. The best chance for enlarged production is said to be at the Yauricocha mine of the principal company, the Cerro de Pasco Copper Corporation, but such an increase would depend on the receipt of equipment additional to that mentioned previously. The output of the principal mines in 1941 and 1942 is shown in the following table.

Copper produced by the principal mines in Peru, 1941–42

Company	1941			1942[1]		
	Concentrates or ores (metric tons)	Copper		Concentrates or ores (metric tons)	Copper	
		Metric tons	Percent		Metric tons	Percent
Cerro de Pasco Copper Corporation:						
Casapalca concentrator	6,232	1,299	20.84	4,734	1,118	23.62
Mahr concentrator	2,644	546	20.65	3,364	635	18.88
Morococha concentrator	30,497	6,737	22.09	25,035	5,695	22.75
Cerro de Pasco mine	388,138	12,537	3.23	448,637	15,119	3.37
Cie. de Mines de Huaron	4,676	1,509	32.27	7,776	2,548	32.77
Soc. Min. Puquicocha	13,442	3,533	26.28	10,781	3,199	29.67
Northern Peru M. & S. Co	13,280	4,683	35.26	10,804	3,775	34.94
Do				[2] 560	324	57.86
Cia. Minera Rescate	5,771	1,595	27.64	1,768	481	27.21
		32,439			32,894	

[1] Preliminary. [2] Cement copper.

The above companies produce roughly 90 percent of the total.

Sweden.—According to reports, the Boliden Mining Co., outstanding producer in the country, is planning to increase its copper production to 18,000 metric tons annually, over double the 1938 rate. Iron pyrites, copper, and zinc have been found in the company mines at Langsele, but so far no mining has been started. Ores rich in iron pyrites and having a low copper content have been discovered and surveyed at Asen and Svansele, but no mining has been done. At Bjurfors the company is mining copper pyrites; the annual production is about 70,000 tons. The company also operates the Laver copper mine near Älvabyn in the Province of Norrbotten, from which copper concentrates are transported by truck and railway to the Rönnskär smelter. At Kristineberg, in the Skellefte district, about 430,000 tons of crude sulfide ore are mined annually, from which copper, zinc, and pyrite concentrates are obtained. Efforts to increase domestic production of copper from ores and scrap materials are believed to have left Swedish supplies notably below consumption requirements.

LEAD[1]

By T. H. Miller and A. L. Ransome

SUMMARY OUTLINE

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GENERAL SUMMARY

Record-breaking receipts of foreign lead in 1942 coupled with a fairly steady rate of domestic production, accomplished despite rising costs, eased the supply situation which was outstanding in comparison with other strategic materials and completely reversed the 1941 position relative to supply versus demand. The growing availability of lead under Government control measures permitted partial relaxation of these measures; this allowed increased use of the metal as a substitute for more critical materials, principally copper and zinc, that have a more direct military application than lead.

The production of refined primary lead from domestic and foreign ores decreased less than 1 percent in 1942, the over-all total from both sources being only 4,128 tons less than the 1941 output. Although consumption of refined soft lead was less in 1942, it exceeded domestic production but permitted most of the imports of metal to be retained in the Government stock pile which at the end of 1942 was 13 times as large as at the beginning. Year-end stocks at domestic refineries advanced and reversed a 7-year downward trend, but consumers' inventories were 22 percent lower owing to the nonrelease of enough foreign metal to balance the deficient supply from domestic refineries.

Total imports of lead in all forms during 1942 again broke all records largely because of a 35-percent increase in receipts of refined lead over 1941; more than half of the increase came from Mexico and the balance almost entirely from Australia, Canada, and Peru.

The established price of 5.85 cents a pound for lead at New York at the beginning of 1942 advanced to 6.50 cents on January 13, at which level it remained during the balance of the year; the average price for the year increased from 5.79 cents in 1941 to 6.48 cents in 1942.

[1] This report deals primarily with the smelting, refining, and consuming phases of the industry. For 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 1938–42, in short tons

	1925–29 (average)	1938	1939	1940	1941	1942
Production of refined primary lead:						
From domestic ores and base bullion	660,525	331,964	420,967	433,065	470,517	467,367
From foreign ores and base bullion	123,104	51,705	63,068	100,114	100,450	99,472
	783,629	383,669	484,035	533,179	570,967	566,839
Recovery of secondary lead	280,000	224,900	241,500	260,346	397,416	323,001
Imports: [1]						
Lead in pigs, bars, and old	4,592	3,235	7,139	151,568	274,395	369,254
Lead in base bullion	95,747	15,296	48,902	19,624	24,704	37,244
Lead in ores and matte	40,096	45,370	30,842	111,300	82,115	81,936
Exports of refined pig lead	98,048	45,866	74,392	[2] 49,079	14,359	[2] 5,814
Lead remaining in bonded warehouse at end of period	136,969	87,811	79,215	211,876	156,286	(4)
Refined primary lead available for consumption	690,916	339,708	415,031	633,989	830,797	927,522
Estimated consumption of primary and secondary lead	900,250	546,000	667,000	782,000	1,050,000	(4)
Prices:						
New York:						
Average for year, cents per pound	7.47	4.74	5.05	5.18	5.79	6.48
Quotation at end of year, do	6.25	4.85	5.50	5.50	5.85	6.50
London average, do	5.87	3.33	[5] 3.09	([6])	([6])	([6])
Mine production of recoverable lead	664,230	369,726	413,979	457,392	461,426	496,239
World smelter production of lead	1,850,000	1,874,000	1,911,000	(4)	(4)	(4)

[1] Data include lead imported for immediate consumption plus material entering the country under bond.
[2] Includes 25,324 tons of foreign refined lead re-exported, according to American Bureau of Metal Statistics; official figures not available.
[3] Includes 3,874 tons of foreign lead re-exported, according to records of the Department of Commerce.
[4] Data not available.
[5] Average for 8 months; London Metal Exchange dealings suspended for duration of war.
[6] Official maximum price fixed by British Ministry of Supply at £25 per long ton.

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

War agency regulations.—Throughout 1942 lead remained under full priority control according to General Preference Order M–38 originally announced in October 1941 and later extended beyond the March 1942 termination date. The order provided for a system of allocation that previously had been restricted to releases of foreign lead purchased and held by the Metals Reserve Co., and a "pooling" arrangement was set up whereby primary producers set aside 15 percent of current output each month for allocation to meet special needs. The subsequent easing of the lead situation eliminated the need for this plan later in 1942, and the emergency 15-percent "pool" was dropped after July until further notice, according to Supplementary Order M–38–j effective July 4.

Under Conservation Order M–38–c, issued January 10, 1942, uses of lead were divided into three classes: A prohibited list, an unlimited list, and all other uses limited to 90 percent of the 1941 consumption in each. In September 1942 when the shortage was less acute industry requested some modification of the conservation order, but not until November 11, 1942, and again on January 1, and again on February 2, 1943, were amendments to the order issued that somewhat liberalized the use of lead for construction purposes and as a substitute for more critical materials, such as tin, brass, and bronze. Likewise, Limitation Order L–180, affecting storage batteries, was amended January 5, 1943, to balance consumption with available production of antimonial lead. Despite the continued requests for freer use of lead, further liberalization of the conservation program is limited by the orders and conservation measures that affect other more critical metals.

In an effort to stimulate domestic mine production the Office of Production Management, jointly with the Office of Price Administration, on January 13, 1942, announced the details of a premium-price plan whereby producers (miners) of lead (copper and zinc were also included in the plan) received, through the Metals Reserve Co., 9.25 cents a pound for lead produced in excess of quotas based on 1941 output as against the ceiling price of 6.50 cents a pound, New York, established on the same date. This plan, effective February 1, 1942, covered a period of 2½ years. In the Tri-State district a premium of $39.60 (later adjusted to $41.80) per ton for 80-percent lead sulfide

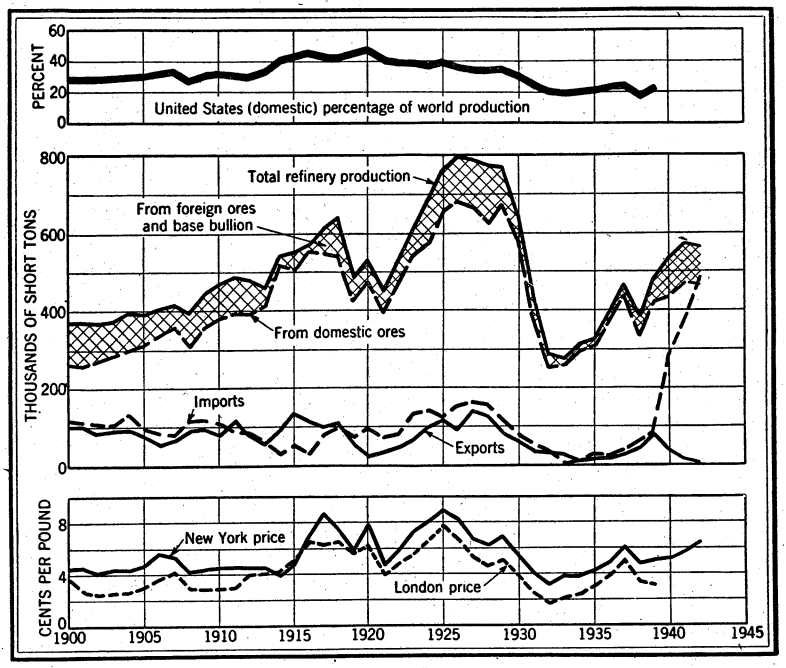

FIGURE 1.—Trends in the lead industry in the United States, 1900–1942. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of draw-back.

concentrates was established for overquota production; this was equivalent to 2.75 cents per pound premium. The premium-price plan was continued without further change throughout 1942. On February 18, 1943, the scope of the Metals Reserve Co. plan was broadened to include an additional premium of 2.75 cents a pound, and the effective time limit was extended to July 31, 1945. Under the revised plan the highest possible payment for excess production amounted to 12 cents a pound, New York basis, depending upon the quotas assigned to the particular mine.

DOMESTIC PRODUCTION

Pig lead is produced at primary plants that treat ore and a small amount of scrap 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 is essentially antimonial-lead alloys. Figures for production of refined lead at secondary plants are given in the section on Secondary Lead.

The following table shows production of refined lead and antimonial lead at primary refineries from 1938 through 1942.

Refined lead and antimonial lead produced at primary refineries in the United States, 1938–42, in short tons

Year	Refined lead				Antimonial lead
	From domestic ores and base bullion	From foreign ores and base bullion	From scrap	Total	
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
1941	470,517	100,450	13,454	584,421	40,237
1942	467,367	99,472	12,856	579,695	51,762

PRIMARY LEAD

Refinery production.—Production of refined primary lead decreased less than 1 percent in 1942.

Refined primary lead produced in the United States, 1938–42, by classes and sources

Year	Production (short tons) by—						Total production [1]		
	Class			Source			Short tons	Value	
	Desilverized lead [1] [2]	Soft lead [3]		From domestic ores and base bullion	From foreign ores	From foreign base bullion		Average sales price per pound	Total calculated value
		Desilverized	Undesilverized						
1938	243,891	31,986	107,792	331,964	32,862	18,843	383,669	$0.046	$35,298,000
1939	280,356	65,349	138,330	420,967	24,652	38,416	484,035	.047	45,499,000
1940	336,456	43,400	153,323	433,065	83,563	16,551	533,179	.050	53,318,000
1941	366,385	39,872	164,710	470,517	74,166	26,284	570,967	.057	65,090,000
1942	343,971	42,094	180,774	467,367	81,485	17,987	566,839	.063	71,422,000

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

Sources of primary lead.—Of the total refined primary lead produced in 1942, 82 percent was derived from domestic ores and base bullion and 18 percent from foreign, the same ratio as in 1941. Production from foreign ores increased 10 percent to within 2 percent of the record established in 1940, but lead refined from foreign base bullion was 32 percent less. The marked drop in output of lead from Mexican base bullion is due to larger quantities of bullion being refined in Mexico and does not indicate a corresponding decrease in total Mexican output of lead. This loss was offset in part by a marked increase in base bullion from Australia. 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, 1938–42, by sources, in short tons

Source	1938	1939	1940	1941	1942
Domestic ore and base bullion	331,964	420,967	433,065	470,517	467,367
Foreign ore:					
Australia	7,320	7,580	14,856	19,561	19,638
Canada	3,562	4,763	9,009	5,708	5,980
Europe	14	188	3,650	123	14
Mexico	9,745	227	1,303	390	2,403
South America	9,887	8,869	34,744	27,173	23,127
Other foreign	2,334	3,025	20,001	21,211	30,323
	32,862	24,652	83,563	74,166	81,485
Foreign base bullion:					
Australia				831	16,902
Mexico	18,268	37,463	16,161	25,358	111
South America		9		47	216
Other foreign	575	944	390	48	758
	18,843	38,416	16,551	26,284	17,987
Total foreign	51,705	63,068	100,114	100,450	99,472
Grand total	383,669	484,035	533,179	570,967	566,839

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

Production data from lead-smelting plants that handle scrap materials exclusively 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 such plants is shown in the following table. Since 1939 production has increased steadily, but in general the percentage of antimony contained has declined correspondingly.

Antimonial lead produced at primary lead refineries in the United States, 1938–42

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
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
1941	40,237	3,510	8.7	14,852	8,013	13,862	36,727
1942	51,762	3,524	6.8	24,512	12,165	11,561	48,238

SECONDARY LEAD

Although some scrap lead is treated at primary plants, the major portion 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 1941 and 1942 is shown in the following table. Secondary lead recovered in 1942 was 19 percent less than in 1941 and was equivalent to 69 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, 1941–42, in short tons

	1941	1942
As refined metal:		
At primary plants	13,454	12,856
At other plants	61,810	55,746
	75,264	68,602
In antimonial lead:		
At primary plants	13,862	11,561
At other plants	192,660	158,998
	206,522	170,559
In other alloys[1]	115,630	83,840
Grand total:		
Short tons	397,416	323,001
Value	$45,305,400	$40,698,100

[1] Includes some lead in chemical compounds.

LEAD PIGMENTS

Lead pigments manufactured in 1942 contained 223,338 tons of lead—an 18-percent decrease from 1941. Of the 206,680 tons of lead in pigments derived from refined pig lead, litharge contained 42 percent, white lead 36 percent, red lead 22 percent, and sublimed lead, leaded zinc oxide, and orange mineral less than 1 percent. Leaded zinc oxide and sublimed lead are the principal pigments of which the lead content is derived from ores. Details of production and consumption of lead pigments are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

Lead in pigments produced in the United States, 1938–42, by sources, in short tons [1]

Year	Lead in pigments from—				Year	Lead in pigments from—			
	Ore		Metal	Total		Ore		Metal	Total
	Domestic	Foreign				Domestic	Foreign		
1938	12,025	----------	163,815	175,840	1941	23,951	290	248,674	[2] 273,315
1939	15,171	----------	200,390	215,561	1942	15,949	707	206,680	[3] 223,338
1940	16,869	----------	196,235	213,104					

[1] Includes also lead recovered in leaded zinc oxide.
[2] Includes 400 tons from scrap.
[3] Includes 2 tons from scrap.

MINE PRODUCTION

Mine production of lead (including that made into lead pigments) in the United States and Alaska increased 8 percent in 1942, the advance being credited to an over-all gain of 4 percent in the Western States and Alaska and 12 percent in the Central States, which more than compensated for a decline of 19 percent in the Eastern States. Production of lead from southeastern Missouri increased 33,090 tons to a total of 197,432 tons, or about 40 percent of the entire United

States production. The output from the Tri-State region amounted to 34,341 tons, a drop of 6,739 tons and a reversal of the trend of 1941. A gain in southwestern Missouri was too small to balance losses in the greater productive States of Oklahoma and Kansas. Idaho continued to be the leading producer of the Western States with a 9-percent increase, followed by Utah and Montana with a 3-percent rise and 6-percent loss, respectively. The decrease in Montana's total production of recoverable lead was due largely to the closing in May of nearly all the zinc-lead mines of the Anaconda Copper Mining Co. at Butte in favor of maintaining copper production in the face of labor shortages. Arizona produced 866 tons less than during the record year of 1941, largely because of the decline in output of zinc-lead ore from the Tennessee-Schuylkill mine at Chloride and the suspension in January of the milling of zinc-lead ore from the Hillside mine. In Colorado and Washington the recoverable mine production of lead continued to gain, but the output from Nevada, largely from the Pioche district, and from New Mexico declined. Additional details of production by mines, districts, and States may be found in the State chapters.

Mine production of recoverable lead in the United States, 1925–29 (average) and 1938–42, by States, in short tons

State	1925–29 (average)	1938	1939	1940	1941	1942
Western States and Alaska:						
Alaska	982	994	937	779	662	415
Arizona	9,743	10,571	10,771	13,266	15,638	14,772
California	2,070	495	526	1,772	3,464	5,151
Colorado	30,112	9,455	8,222	11,476	12,574	15,181
Idaho	141,610	92,177	90,981	104,834	104,914	113,909
Montana	18,871	9,327	16,555	23,036	21,259	20,050
Nevada	9,807	4,679	4,236	7,499	9,623	5,376
New Mexico	6,730	4,949	5,392	3,822	4,668	4,608
Oregon	6	23	15	35	59	23
South Dakota	21			7		85
Texas	213	342	227	205	186	181
Utah	149,509	65,657	67,634	75,688	69,601	71,930
Washington	1,323	4,284	3,718	2,555	3,903	4,851
Wyoming						3
	370,997	202,953	209,214	244,974	246,551	256,535
Central States:						
Arkansas	38	7		55	11	2
Illinois	552	175	308	1,508	2,376	2,344
Kansas	26,121	15,239	13,697	11,927	14,538	9,419
Kentucky	135	101	87	360	282	335
Missouri	202,240	122,027	156,281	172,052	165,909	199,548
Oklahoma	58,306	21,004	27,720	21,240	25,021	22,906
Wisconsin	1,745	320	388	445	1,225	775
	289,137	158,873	198,481	207,587	209,362	235,229
Eastern States:						
New York		2,005	2,387	1,973	2,100	2,434
Tennessee	250	553	517	573	23	238
Virginia	3,846	5,338	3,380	2,285	3,390	1,803
North Carolina		4				
	4,096	7,900	6,284	4,831	5,513	4,475
	664,230	369,726	413,979	457,392	461,426	496,239

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year from 1938 to 1942, in short tons

District	State	1938	1939	1940	1941	1942
Southeastern Missouri region	Missouri	118,870	153,522	169,893	164,342	197,291
Coeur d'Alene region	Idaho	82,274	81,699	95,609	95,529	106,474
Bingham	Utah	41,334	36,842	37,857	34,512	39,996
Joplin region	Kansas, Southwestern Missouri, Oklahoma.	39,400	44,176	35,311	41,080	34,341
Park City region	Utah	7,258	11,631	19,749	19,094	15,278
Tintic	do	9,605	8,618	6,536	9,424	10,176
Butte	Montana	204	4,708	8,859	8,630	7,206
Harshaw	Arizona	149	2,287	4,581	5,541	6,132
Metaline	Washington	4,009	3,509	2,495	3,819	4,553
Resting Springs	California			870	2,581	4,044
Rush Valley	Utah	4,619	3,422	4,760	4,168	3,988
Warm Springs	Idaho	7,370	5,565	5,050	5,334	3,783
Leadville	Colorado	1,222	1,088	794	1,112	3,348
Central	New Mexico	340	2,941	3,245	3,902	3,206
Pioche	Nevada	3,214	2,964	5,520	6,822	2,764
St. Lawrence County	New York	2,005	2,387	1,973	2,100	2,434
Heddleston	Montana		7	50	967	2,290
Pioneer (Rico)	Colorado	29	752	1,928	2,525	2,282
Red Cliff	do	933	1,137	1,412	1,710	2,240
Animas	do	996	958	2,471	3,045	2,124
Eagle	Montana	4,301	3,252	4,108	3,294	1,999
Smelter	do	710	1,256	1,363	1,527	1,988
Old Hat	Arizona	1,919	1,861	1,908	2,172	1,801
Upper San Miguel	Colorado	885	1,489	1,278	1,408	1,716
Barker	Montana	283	780	131	22	1,704
Austinville	Virginia	5,338	3,380	[1] 2,285	3,390	1,661
Wallapai	Arizona	4,004	703	2,304	2,408	1,656
Bayhorse	Idaho	915	999	935	1,378	1,644
Ophir	Utah	2,013	6,050	5,354	1,437	1,623
Port Hill	Idaho	291	1,111	1,837	1,537	1,044
Montana	Montana	212	293	955	1,601	1,025
Upper Mississippi Valley	Iowa, Northern Illinois, and Wisconsin.	320	388	453	1,345	908
Hog Heaven	Montana	1,214	2,767	3,588	2,824	614
Cataract	do	1,326	1,672	1,904	355	26
Oro Blanco	Arizona	4,150	3,568		1	6
Willow Creek	New Mexico	4,277	1,800			

[1] Total for Virginia but almost entirely from Austinville district.

STOCKS

Producers' stocks.—Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by most refiners of secondary material who produce common soft 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, 1938–42, in short tons

	1938	1939	1940	1941	1942
Refined pig lead	102,489	52,783	32,458	15,973	28,815
Antimonial lead	13,413	5,994	8,468	4,212	6,122
	115,902	58,777	40,926	20,185	34,937
Lead in base bullion—					
At smelters and refineries	18,693	10,337	9,166	8,594	7,359
In transit to refineries	2,339	3,521	3,457	2,215	1,706
In process at refineries	16,690	15,958	18,141	17,709	13,925
	37,722	29,816	30,764	28,518	22,990
Lead in ore and matte and in process at smelters	56,332	59,486	71,722	51,446	59,247
	209,956	148,079	143,412	100,149	117,174

In contrast with 1941 the excess of production over shipments in 1942 resulted in an over-all gain in inventories for the year. Stocks of refined and antimonial lead at refineries, which totaled approximately 20,200 tons at the end of 1941, steadily increased to 31,400 tons by the end of April, followed by a general decline to 25,900 tons by the end of August. During the next 3 months increasing output more than balanced nearly constant shipments, and stocks advanced to 35,600 tons by the end of November—the high point for the year. A slight decrease in output in December coupled with a gain in shipments reduced inventories to about 35,000 tons at the end of 1942, a net gain of 73 percent over the total on hand at the end of 1941. Stocks of lead in ore and matte and in process at smelters, in base bullion at smelters and refineries, and in transit to and in process at refineries were 3 percent higher at the end than at the beginning of 1942.

Consumers' stocks.—The data on consumers' stocks by grades at the beginning and end of 1942 are shown in the following table. These results, as obtained from a consumer survey of 500 respondents, are estimated to represent 85 to 90 percent of the consuming industry on the basis of lead consumed, but the same relative percentage does not necessarily hold as regards inventories. Stocks of all grades of domestic lead decreased slightly, but the decided drop in foreign lead caused an over-all decline of 22 percent by the end of 1942.

Consumers' stocks of refined soft lead at beginning and end of 1942, by grades, in short tons [1]

	Domestic			Foreign (all grades)	Total
	Corroding	Chemical	Common		
Dec. 31, 1941 [2]	29,900	17,456	32,363	21,245	100,964
Dec. 31, 1942	25,532	16,587	31,360	5,587	79,066

[1] Based upon a survey of 500 respondents.
[2] Revised figures.

DOMESTIC CONSUMPTION

New supply.—The calculated supply of refined primary lead available for consumption in 1942 was 12 percent above that for 1941 and 34 percent above the 1925–29 average (690,916 tons). The figures in the following table do not include variations in producers' stocks and do not indicate the true trend in actual consumption. Moreover, the greater part of the large tonnage of imported lead which swelled the supply in 1942 is still held in Government stock piles.

Refined primary pig lead available for consumption in the United States, 1938–42, in short tons

	1938	1939	1940	1941	1942
Supply:					
Imports	1,905	5,388	149,889	274,189	366,497
Production	383,669	484,035	533,179	570,967	566,839
	385,574	489,423	683,068	845,156	933,336
Withdrawn: Exports	[1] 45,866	74,392	[2] 49,079	14,359	[3] 5,814
Supply available for consumption	339,708	415,031	633,989	830,797	927,522

[1] Includes small quantity of "sheets and pipes"; figures not separable.
[2] Includes 25,324 tons of foreign refined lead re-exported, according to American Bureau of Metal Statistics; official figures not available.
[3] Includes 3,874 tons of foreign refined lead re-exported, according to records of the Department of Commerce.

Consumption.—Although figures showing the total consumption of lead, primary and secondary (including antimonial lead), are not available for 1942 the total probably was somewhat less than the record 1,050,000 tons consumed in 1941 as reported by the American Bureau of Metal Statistics. 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. The supply of new lead was greater in 1942, but the actual tonnage released to consumers was considerably less because of use restrictions, and the proportion of secondary and scrap lead to primary material was probably even higher than normal.

Consumption of refined soft lead in the United States, 1941–42, by grades and uses, in short tons [1]

	1941	1942		1941	1942
By grades:			By uses—Continued.		
Domestic:			Collapsible tubes	3,726	9,966
Corroding	289,679	227,207	Foil	51,516	9,375
Chemical	150,206	142,213	Pipes, traps, and bends	32,946	21,395
Common	257,113	134,101	Sheet lead	35,480	31,774
Foreign: All grades	115,649	92,568	Solder	35,630	34,764
			Storage batteries	73,982	41,135
Total consumed	812,647	596,089	Terneplate	2,069	2,337
			Type metals	2,975	943
By uses:			White lead	83,230	58,372
Ammunition	32,959	48,025	Red lead and litharge	143,496	98,667
Bearing metals	10,160	12,648	Chemicals and insecticides	8,861	6,298
Cable covering	141,161	113,374	Other uses [2]	112,833	94,904
Calking lead	32,380	9,038			
Casting metals	9,243	3,074	Total consumed	812,647	596,089

[1] Based upon survey of 500 respondents; 1941 figures are revised, but 1942 figures are preliminary and subject to revision.
[2] Includes consumption of lead in manufacture of tetraethyl lead, lead used for ships' ballast, annealing, galvanizing, brass and bronze, and other miscellaneous uses.

A consumer survey conducted by the Bureau of Mines for the second consecutive year disclosed that the consumption of refined soft lead at 500 plants decreased 27 percent in 1942. Judging from available data as regards supply, shipments, and producers' stocks, receipts of 607,431 tons of refined soft lead by those consumers canvassed indicate that the 1942 coverage was probably 85 to 90 percent. Antimonial lead, unrefined scrap lead, and lead in alloys are not included. The accompanying table presents a 2-year comparison by grades and by uses of soft lead. Consumption of all three grades of domestically refined lead and foreign lead declined, common lead showing the greatest drop (48 percent). Of the total amount used in 1942 (comparative 1941 percentages in parentheses), corroding accounted for 38 (36) percent, chemical 24 (18) percent, common 23 (32) percent, and all grades of foreign 15 (14) percent. Consumption of lead by uses decreased during 1942 except that consumed in making ammunition, bearing metals, collapsible tubes, and terneplate. Use in solder remained virtually unchanged. Cable covering was the largest of the principal uses of soft lead in 1942, followed in order by red lead, litharge, white lead, ammunition, and storage batteries. The effect of conservation measures, use restrictions, and the general industrial change-over from peacetime to wartime economy is particularly apparent with respect to some of the principal uses of lead. The cessation of automobile manufacturing largely was respon-

sible for the drop in the consumption of lead for storage batteries and, to some extent, the decline in lead used for red lead and litharge which also enters into the manufacture of batteries and pigments. White lead, the most widely used lead paint pigment, showed a considerable decline, and foil dropped markedly, largely owing to the restrictions placed on the consumption of lead in making foil for packaging.

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 normally based upon quotations in these markets. Since suspension of the London Metal Exchange dealings in September 1939 for the duration of the war the London market has had no actual influence on New York quotations, and the differential between St. Louis and New York prices has remained at 0.15 cent a pound, an amount approximating the freight charges between the two points.

At the beginning of the year prices for pig lead were 5.70 cents at St. Louis and 5.85 cents at New York, both prices having prevailed since March 26, 1941. Effective January 13, 1942, the Office of Price Administration established the ceiling price for lead at 6.35 cents, St. Louis, and 6.50 cents, New York, at which point it remained for the remainder of 1942.

The official London maximum price of £25 per long ton, duty paid, for Empire and foreign lead, as fixed by the British Ministry of Supply in December 1939, remained unchanged during 1942.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1938–42, in cents per pound [1]

Month	1940			1941			1942		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	5.32	5.47		5.35	5.50		6.12	6.27	
February	4.93	5.08		5.45	5.60		6.35	6.50	
March	5.04	5.19		5.61	5.77		6.35	6.50	
April	4.92	5.07		5.70	5.85		6.35	6.50	
May	4.87	5.02		5.70	5.85		6.35	6.50	
June	4.85	5.00	(2)	5.70	5.85	(2)	6.35	6.50	(2)
July	4.85	5.00		5.70	5.85		6.35	6.50	
August	4.70	4.85		5.70	5.85		6.35	6.50	
September	4.78	4.93		5.70	5.85		6.35	6.50	
October	5.16	5.31		5.70	5.85		6.35	6.50	
November	5.58	5.73		5.70	5.85		6.35	6.50	
December	5.35	5.50		5.70	5.85		6.35	6.50	
Average	5.03	5.18	(2)	5.64	5.79	(2)	6.33	6.48	(2)

[1] St. Louis: Metal Statistics, 1943, p. 465. New York: Metal Statistics, 1943, p. 457.
[2] London Metal Exchange dealings suspended for duration of war. Official maximum price fixed by British Ministry of Supply at £25 in December 1939.

FOREIGN TRADE [2]

The continued upward trend in imports of lead was most significant in 1942. The total receipts of foreign material, principally as refined metal but also as lead in ore, matte, and base bullion, were sufficient not only to supplement the domestic refinery production but also to allow reserve stock piling of a large tonnage of pig lead. The result

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

of this increased supply, coupled with Government control, was to place lead in the position of a substitute metal.

Imports.—Total imports of lead in 1942 again broke all records largely on account of a 35-percent increase in receipts of foreign refined lead over 1941. In this category Mexico furnished 52 percent, Australia nearly 23 percent, Canada 19 percent, and Peru 6 percent as compared with 36, 16, 33, and 15 percent, respectively, in 1941. Nearly all imports of base bullion (97 percent) in 1942 came from Australia, which heretofore has furnished little or no material of this class. Since the war, however, lead bullion in excess of that which could be refined in Australia has been shipped to the United States rather than to other metallurgical centers barred by wartime restrictions. Lead in ores and matte came from many countries but principally from Newfoundland, Australia, Peru, and Canada, which together supplied 81 percent of the total imports of this material.

Total lead imported into the United States, 1938–42, by forms in which imported, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, and old	Total lead content
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
1941	82,115	24,704	274,395	381,214
1942	81,936	37,244	369,254	488,434

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

Total lead imported into the United States, in ore, base bullion, and refined, 1938–42, by countries, in short tons [1]

Year	Canada	Mexico	Newfoundland	South America [2]	Europe	Other countries	Total
1938	3,174	38,467	----------	13,426	680	8,154	63,901
1939	5,641	52,059	1	16,527	1,971	10,684	86,883
1940	8,721	149,493	27,563	63,120	3,891	29,704	282,492
1941	95,686	129,446	17,569	69,826	175	68,512	381,214
1942	77,677	194,820	26,549	42,263	52	147,073	488,434

[1] Data include lead imported for immediate consumption plus material entering country under bond.
[2] Includes imports from Argentina as follows—1938: 4 tons; 1939: 3,362 tons; 1940: 16,469 tons; 1941: 13,374 tons; and 1942: 4,582 tons.

Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and old, 1938–42, by countries, in short tons [1]

Country	1938	1939	1940	1941	1942
In ore and matte:					
Africa	----------	7	7,586	575	3,871
Argentina	4	3,362	16,469	13,374	4,582
Australia	6,434	7,612	17,472	22,634	20,997
Bolivia	----------	7	2,707	7,314	1,383
Canada	3,173	5,624	8,666	5,725	7,468
Chile	2,107	1,844	6,271	1,384	3,166
Mexico	24,023	3,846	1,804	5,770	2,358
Newfoundland	----------	----------	27,563	17,569	26,549
Peru	9,317	7,174	18,383	6,665	11,168
United Kingdom	2	1,058	3,498	175	2
Other countries	310	308	881	930	392
	45,370	30,842	111,300	82,115	81,936

See footnote at end of table.

Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and old, 1938–42, by countries, in short tons [1]—Continued

Country	1938	1939	1940	1941	1942
In base bullion:					
Australia				835	36,289
Mexico	14,444	47,915	19,009	23,726	56
Peru	198	84	179	58	16
Other countries	654	903	436	85	883
	15,296	48,902	19,624	24,704	37,244
In pigs, bars, and old:					
Australia	1,475	2,727	4,266	43,631	84,749
Canada	1	17	55	89,887	70,089
Mexico		298	128,680	99,950	192,406
Peru	1,736	4,051	18,452	40,868	21,948
Other countries	23	46	115	59	62
	3,235	7,139	151,568	274,395	369,254
	63,901	86,883	282,492	381,214	488,434

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

Lead [1] *imported for consumption in the United States, 1938–42, by forms in which imported*

Year	Lead in ores, flue dust, and mattes, n. s. p. f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
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
1941	82,345	5,343,577	17,579	1,743,350	325,999	23,403,260	47	15,812	19,389	30,582,741
1942	90,633	5,685,692	41,977	3,603,026	388,533	33,091,425	20	7,009	4,690	42,529,235

[1] In addition to quantities shown (values included in total values), "reclaimed, scrap, etc.," imported as follows—1938: 189 tons, valued at $20,374; 1939: 36 tons, $3,387; 1940: 24 tons, $3,917; 1941: 1,331 tons, $57,353; and 1942: 1,305 tons, $137,393. Figures for 1942 include foreign lead received by the Government and held in stock piles.

Miscellaneous products, containing lead, imported for consumption in the United States, 1938–42

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
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
1941	702	241	711,388	1,657	1,454	112,120
1942	972	274	66,096	245	210	19,631

Exports.—Total exports (excluding re-exports of foreign refined lead) of lead in 1942 were much less than in 1941. The marked drop from the high level of 1939 resulted from the restrictions imposed under the Export Control Act of 1940.

Lead exported from the United States, 1938–42

Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1938	[1] 45,866	[1] $3,354,616	9,061	1941	14,359	$1,159,148	21,953
1939	74,392	4,547,219	10,379	1942	1,940	285,354	26,248
1940	23,755	1,794,590	15,604				

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

Pig lead exported from the United States, 1938–42, by destinations, in short tons

Destination	1938 [1]	1939	1940 [2]	1941	1942 [3]
Countries:					
Belgium	28	588	644		
Brazil	111	647	1,559	764	51
Canada	101	5	34	12	1
Chile	8	323	492	822	18
China		224	517	2,335	
Denmark		1,569			
Finland	560	616	112		
France	[4]	540	1,120		
Germany	1,092	8,333			
Hungary		560	437		
Japan	30,203	34,790	11,958	8,154	
Kwantung	314	99	336		
Mexico	11,403	2,922	15	14	7
Netherlands		2,101	2,352		
Norway		1,091			
Panama	87	238	538	379	74
Philippine Islands	1,037	974	450	628	
Sweden	23	7,340	301	112	224
United Kingdom	78	9,411	2		1,379
Uruguay			350	407	
Other countries	821	2,021	2,538	732	186
	45,866	74,392	23,755	14,359	1,940
Continents:					
North America	12,002	3,345	865	574	134
South America	303	1,317	3,078	2,334	192
Europe	1,950	33,152	6,400	228	1,608
Asia	31,606	36,122	13,384	11,132	4
Africa and Oceania	5	456	28	91	2

[1] Includes sheets and pipes; figures not separable.
[2] In addition, 25,324 tons of foreign lead were re-exported, according to American Bureau of Metal Statistics; official figures not available.
[3] In addition, 3,874 tons of foreign lead were re-exported, according to records of the Department of Commerce.
[4] Less than 1 ton.

WORLD ASPECTS OF THE LEAD INDUSTRY

Since 1939 the lack of production data from many of the important lead-producing countries has precluded any official statement of world output. According to estimates published by the Metal Bulletin, London, world smelter production of lead in 1941 reached 1,770,000 metric tons, a slight gain over the 1940 estimate of 1,700,000 tons from the same source. Although no figures are available for 1942, it is doubtful if total smelter production has increased appreciably, if at all. The Bureau of Mines estimated that in 1942 the world mine production of lead (recoverable lead content) amounted to roughly 1,635,000 metric tons, an indication that production did not increase. Based on estimates by countries, about 80 percent of the world's supply of lead ore by the end of 1942 was controlled by, or available to, the United Nations.

World production of lead, 1937–42, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942
Argentina	9,900	10,200	14,000	12,864	(2)	(2)
Australia	232,198	226,155	269,590	[3] 275,000	(2)	(2)
Belgium	93,310	94,170	82,000	[3] 55,000	[3] 20,000	(2)
Burma	77,728	80,166	77,220	[3] 83,000	(2)	(2)
Canada	181,162	181,783	172,880	199,662	201,976	221,170
China	[3] 1,500	(4)	(4)	(2)	(2)	(2)
Chosen	5,850	(4)	(4)	(2)	(2)	(2)
Czechoslovakia	4,300	(4)	(4)	(2)	(2)	(2)
France	37,168	41,753	42,000	[3] 20,000	[3] 10,000	(2)
Germany [5]	162,400	171,700	181,440	[3] 200,000	[3] 225,000	(2)
Austria	10,836	9,280				
Greece	5,890	6,050	4,925	(2)	(2)	(2)
Hungary	147	(4)	(4)	(2)	(2)	(2)
Indochina	8	10	5	(2)	(2)	(2)
Italy	38,938	43,287	38,102	[3] 35,000	(2)	(2)
Japan	10,200	[3] 12,000	[3] 12,000	[3] 15,000	[3] 17,000	(2)
Mexico	[6] 214,653	[6] 273,529	213,675	191,980	151,167	[6] 197,019
Northern Rhodesia	568	277	163	(2)	(2)	(2)
Norway	236	323	321	(2)	(2)	(2)
Peru	19,053	28,478	24,310	31,131	34,375	42,246
Poland	17,587	19,973	(4)	[3] 23,000	[3] 25,000	(2)
Rumania	6,725	5,655	5,100	(2)	(2)	(2)
South-West Africa	1,355	3,214	4,283	690		(2)
Spain	31,973	31,809	25,991	45,991	(2)	(2)
Tunisia	24,758	23,916	23,421	(2)	(2)	(2)
Union of South Africa		19	11	(2)	(2)	(2)
U. S. S. R.	[3] 55,000	(4)	(4)	[3] 75,000	(2)	(2)
United Kingdom	10,313	10,000	(4)	(2)	(2)	(2)
United States (refined) [7]	423,232	330,963	404,257	468,675	494,126	497,908
Yugoslavia	4,038	8,646	10,652	(2)	(2)	(2)
	1,681,000	1,700,000	1,734,000	(2)	(2)	(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] Includes small tonnage of lead contained in exported ore and concentrates. Separate figures not available.
[7] Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.

REVIEW BY COUNTRIES

Argentina.—Production from the lead-zinc properties in the province of Jujuy came principally from the Aguilar mine of the Compania Minera Aguilar S. A., subsidiary of the St. Joseph Lead Co. The output in 1942 was curtailed owing to a shortage of fuel oil. The monthly production rate in January 1943 was estimated at 3,000 metric tons of lead concentrates. Total exports of lead concentrates (containing 74 percent lead, 6 percent zinc, and 50 ounces of silver) during January 1942 aggregated 1,950 metric tons; for the remainder of the year no further shipments were recorded. Stocks at the Aguilar mine and the port of Santa Fé on January 1, 1943, totaled 14,047 metric tons.

Australia.—Mining activities in Australia in 1942 were confronted with many adversities such as higher taxation, drafting of labor into the armed services, and flow of miners into higher paying munitions industries. The Minerals Production Committee was authorized by the Federal Government to expedite the mining and treatment of strategic minerals by furnishing financial aid, providing equipment, and helping to alleviate manpower shortages; it also engaged in mining on its own account.

Production of lead concentrates was maintained at Mount Isa Mines, Ltd. The Zinc Corporation, Ltd., reported lead lode ore reserves of 3,800,000 tons at the beginning of 1942.

Bolivia.—Mine production of lead in Bolivia, largely from small mines in the La Quiaca region, decreased from 15,653 metric tons (lead content in ore) in 1941 to 12,360 tons in 1942. All ore and concentrates are exported. No further information has been received regarding the erection of a lead smelter in the province of Sud Chichos. It was reported that such a plant would be built through the use of funds allotted by the Bolivian Banco Minero.

Brazil.—The Furnas mine in the Iporanga district continued to be the principal lead producer in 1942. Four additional deposits on the Iporanga River, operated by another company, are reported to have estimated reserves of 20,000 metric tons of galena. The State of São Paulo is having the mineral resources of this entire zone explored. The small lead smelter at Apiai, São Paulo, produced 10 tons of lead during the year, all of which was consumed in Brazil.

Burma.—The Bawdwin lead-zinc mines of the Burma Corporation were seized by the Japanese near the end of April 1942. Assuming that the Japanese successfully repair the reported damage to mines, mill, and smelter, the potential peacetime annual output of about 80,000 tons of lead would become available to them.

Canada.—Production of lead in Canada increased from 230,084 short tons in 1941 to 255,751 short tons in 1942. These figures include smelter production plus lead contained in exported ore. Well over 95 percent of the lead is mined in British Columbia almost entirely from the Sullivan mine of the Consolidated Mining & Smelting Co. Sales of primary lead in Canada were placed under a system of control in 1942 whereby no producer could sell or supply primary or secondary lead or lead-base alloys in pig or ingot form without written approval of the Metals Controller of Canada; lead-base type metal, babbitt, and solder were excepted. Extensive exploratory drilling for new deposits was done in an effort to replace the heavy drain on existing reserves. Gulf Lead Mines, Ltd., was organized to continue the development of lead-zinc deposits on the east coast of Hudson Bay. Ore supplies are being supplemented by numerous efforts to recover lead from residues. The slag dumps at the gold mines of the Kirkland Lake and Larder Lake areas of Ontario yielded considerable lead, and the Western Exploration mill produced lead concentrates from tailings dredged from Slocan Lake. The New Calumet was expected to have its new 300-ton zinc-lead concentrator in operation before the end of 1942.

Mexico.—Mine production of lead in Mexico increased 27 percent from 155,259 metric tons (lead content of ore) in 1941 to 197,019 tons during 1942. The most important event in 1942 was the Bateman-Juarez-Tellez agreement between the Metals Reserve Co., the State Department, and the Mexican Government, under which the Metals Reserve Co. contracted to buy 250,000 tons of lead at 5.40 cents a pound each year for the duration of the war; the contract could be extended by mutual agreement after the war. Mexico agreed to stabilize taxes on lead, freeze freight rates, and hold in abeyance certain clauses in the labor laws. In spite of the agreement labor difficulties arose, and at the end of the year the miners were threatening to strike for a 25-percent wage increase. On December 23 a reciprocal trade pact with the United States reduced the duty on lead and lead in ore to 50 percent of the amount set by the United States Tariff Act of 1930. It will remain at this level until 30 days after

the termination of the national emergency, at which time it will be established at 20 percent below the rate set in the Tariff Act of 1930.

In 1942 the Avalos lead smelter of the American Smelting & Refining Co. at Chihuahua treated 466,549 metric tons of ore containing 118,401 tons of lead, compared with 362,211 tons of ore containing 94,947 tons of lead in 1941. Production from the five principal mines in the Chihuahua district increased in 1942, despite the fact that the Potosí Mining Co. exhausted its main ore body after nearly 100 years of operation. Nearly all the cooperative mining companies reverted to private ownership and operation in 1942. The Eagle Picher Lead Co. and the American Smelting & Refining Co. reopened old lead-zinc mines in the Taxco district. The El Bote mine, owned by the Sociedad Cooperativa Minera "El Bote", S. C. L., produced 30 tons of lead a day (content in concentrates).

Newfoundland.—The mine production of lead in terms of lead content of all concentrates produced amounted to 28,007 short tons in 1942 as compared with 33,166 tons in 1941.

North Africa.—The North African military campaign, starting in November 1942 and successfully concluded by the Allies in May 1943, aroused interest in raw materials thus made available to the United Nations. The largest lead producer in Morocco is the Aouli mine, 15 miles northeast of Midelt. Reserves at this property have been estimated at 60,000 tons on the basis of 75 percent lead concentrates. The concentrating plant has a capacity of 20 tons an hour.

The lead-mining industry in Tunisia is active; production comes from scattered deposits in the northern half of the country from ore (concentrates?) reportedly averaging 60 to 70 percent lead. In normal times about 90 percent of the Tunisian lead ores are treated at the smelter owned by the Peñarroya Co. at Mégrine, near Tunis, which has a capacity of about 25,000 metric tons of lead annually. On May 1, 1942, 3,700 tons of lead were in stock at the smelter. For the period January 1 to May 1, 1942, production of lead concentrates in Morocco, Algeria, and Tunisia totaled 7,839 tons.

Peru.—The lead content of concentrates produced in Peru during 1942 was estimated to be about 55,830 metric tons, compared with 54,822 tons in 1941. This estimate is based upon the reports of companies producing 80 percent of the total lead output of Peru. Exports for 1942 included 3,117 metric tons of ore, 7,616 tons of concentrates, and 36,979 metric tons of refined lead compared with an estimated 8,000, 12,000, and 38,000 tons, respectively, in 1941. The largest lead producer is the Huaron mine; reserves are estimated to be 180,000 tons of positive ore and 500,000 tons of probable ore averaging 6.89 percent lead, 8.73 percent zinc, and 319 grams of silver per ton. The Oroya lead smelter, with a capacity to produce 4,000 tons of refined lead a month, recovered 42,246 metric tons of lead in 1942 (34,375 tons in 1941).

Spain.—According to the official figures of the General Mining Board of Spain, the 1942 output was 51,118 metric tons of lead concentrates compared with 43,728 tons in 1941. The most important deposits are in the Sierra Morena and the southeastern coast section. There are five lead smelters that reportedly can produce 32,000 to 35,000 tons of lead annually. Domestic consumption is about 23,000 tons, leaving a surplus of about 12,000 tons available for export.

Sweden.—The suspension of virtually all imports of lead in addi-

tion to other metals into Sweden due to the conditions of war has forced the Boliden Mining Co. to further intensify its efforts to produce the metal from Swedish deposits. Reportedly by the summer of 1943, the company will start commercial-scale production from the mine at Laisvall. Lead concentrates produced at this property have a lead content of 80 percent and are shipped to the Rönnskär smelter at Skelleftead.

ZINC [1]

By A. L. RANSOME AND J. H. SCHAUM

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GENERAL SUMMARY

In 1942, a year of broken records resulting from the "all-out" industrial mobilization of a nation at war, the zinc industry was outstanding in its ability to more than maintain the delicate balance between supply and demand. With the assistance of increasing Government regulatory measures, an expanded smelting industry increased its output 7 percent above the 1941 record to establish once more an all-time high level of production and to show a marked gain in stocks. Conservation measures restricting the use of zinc to essential needs resulted in an over-all 12-percent drop in domestic consumption, but consumers' stocks advanced 6 percent. The general decrease in domestic shipments of zinc by smelters was largely balanced by a gain in exports, principally for Lend-Lease accounts. The particular emphasis placed on the use of High-Grade zinc resulted in a 27-percent rise in production of high-purity metal, of which increasing amounts were made by redistillation of the lower grades of zinc. Partly as a result of this and also because of use restrictions, the lower grades of zinc decreased 8 percent. At the close of 1942, smelters were operating at usable capacity, with additional facilities under construction expected to bring an already enlarged output to a peak by the middle of 1943.

Domestic mine output showed only a slight gain in 1942 despite the incentive of premium prices, and to fulfill requirements and operate at capacity smelters continued to use foreign ore in greater amounts than ever before. Total imports in 1942 exceeded all previous records, as did domestic output of zinc from foreign ores, which amounted to 29 percent of the total production.

The established ceiling price of 8.25 cents a pound at St. Louis for Prime Western zinc was unchanged during 1942 and compares with the average of 7.48 cents in 1941 and 6.34 cents in 1940.

[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 1938–42

	1925–29 (average)	1938	1939	1940	1941	1942
Production of primary slab zinc:						
By sources:						
From domestic ores.....short tons	589,648	436,007	491,058	589,988	652,599	629,957
From foreign ores.....do	12,734	10,334	16,178	85,287	169,421	261,915
	602,382	446,341	507,236	675,275	822,020	891,872
By methods:						
Electrolytic.....percent of total	21	21	25	28	27	28
Distilled.....do	79	79	75	72	73	72
Production of redistilled secondary slab zinc.....short tons	43,756	31,613	50,428	48,917	59,503	53,195
Stocks on hand at primary smelters Dec. 31 short tons	45,575	157,511	83,728	19,212	24,212	82,632
Primary zinc available for consumption short tons	548,472	375,004	607,464	677,168	762,265	735,865
Price:						
Prime Western at St. Louis:						
Average for year.....cents per pound	6.76	4.61	5.12	6.34	7.48	8.25
Highest quotation.....do	8.90	5.05	6.50	7.25	8.25	8.25
Lowest quotation.....do	5.40	4.00	4.50	5.50	7.25	8.25
Yearly average at London.....do	6.46	3.05	[1] 2.89	[2]	[2]	[2]
Mine production of recoverable zinc short tons	724,720	516,703	583,807	665,068	749,125	768,025
Tri-State district (Joplin) percent of total	49	38	38	35	35	31
Western States.....do	30	28	29	36	38	40
Other.....do	21	34	33	29	27	29
World smelter production of zinc short tons	1,435,000	1,728,000	1,800,000	1,810,000	[2]	[2]

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

WAR-AGENCY REGULATIONS

Despite the excellent cooperation between the zinc industry and the Government during 1940 and 1941, the increasingly critical status of the over-all zinc supply problem necessitated more definite control measures. Under General Preference Order M–11, in effect at the beginning of 1942, the War Production Board controlled the supply of slab zinc. However, this right was exercised over only a part of the total zinc output, as the percentage requirements for the "pool" increased from 31 in January to 75 of High Grade and 50 of lower grades in May, the balance of output being distributed by the industry. On May 1 Order M–11 was amended placing slab zinc under complete allocation effective June 1. A subsequent amendment on February 9, 1943, tightened the control on zinc by placing remelt zinc as well as refined metal under allocation. Because of the shortage of zinc dust for war purposes that developed at the end of 1942, this material, under the "pool" arrangement since June 1, was placed under complete allocation on December 22, 1942, according to General Preference Order M–11–l. Conservation Order M–11–b, issued July 24, restricted the use of zinc in a large number of manufactured products and prohibited others, the exceptions being principally for United States Government and Lend-Lease accounts. An amendment to this order prohibited the use of zinc after October 10 for making closures for glass containers, one of the largest peacetime uses of rolled zinc. A later amendment dated November 26 added to the list of prohibited items. Other restrictions were subsequently imposed by General Limitation Order L–71 as amended October 2, 1942, and amendment 1 to General Conservation Order M–99, which referred to production of dry-cell batteries and engravers' plates, respectively.

In an effort to increase domestic mine production, the Office of Production Management, jointly with the Office of Price Adminis-

tration, on January 13, 1942, announced the details of a premium-price plan whereby producers (miners) of zinc (copper and lead were also included in the plan) received, through the Metals Reserve Co., 11 cents a pound for zinc produced in excess of quotas based upon 1941 output as against the regular established ceiling price of 8.25 cents at East St. Louis. This plan became effective February 1, 1942, for 2½ years. In the Tri-State district the miner was paid an extra $28.05 a ton for 60-percent concentrates, this being declared the equivalent of the 2.75 cents a pound premium. Later in the year the figure was adjusted to $29.70. This plan was continued without further change in 1942, and although the expected increase in the rate of production did not materialize, the maintenance of past production was in itself an accomplishment. On February 18, 1943, Jesse Jones, Secretary of Commerce, announced that the scope of the Metals Reserve Co. premium-price plan had been broadened to include additional premiums and that the effective time limit had been extended to July 31, 1945. Under the revised plan two additional premiums for zinc were added, bringing the highest possible payment for excess production to a total of 16.50 cents a pound, East St. Louis basis, depending on the quotas assigned to the particular zinc mine.

Figure 1 shows trends in the zinc industry since 1900.

SMELTING CAPACITY

Under the pressure of war requirements a record output of 945,067 short tons of slab zinc was produced from ore and secondary materials in 1942. This total is somewhat short of early estimates largely owing to delays in completing construction of additional smelting capacity caused by priority and manpower problems. The peak production scheduled for the latter part of 1942 will not be reached until well into 1943. By use of this additional capacity under construction it has been estimated that the 1943 production will reach 1,036,000 tons.[2]

An important development regarding zinc production in 1942 was the expansion of facilities for redistillation of the lower grades of zinc into High-Grade metal to supplement the already expanded existing plants that produce High-Grade zinc. This type of operation is already being increased for 1943.

In all probability the scheduled total zinc productive capacity has reached the peak beyond which it will be impractical to go, the principal limiting factor being available supplies of zinc concentrates.

SUPPLY OF ZINC CONCENTRATES

In 1942 the domestic mine production of recoverable zinc increased 2.5 percent over 1941—a notable achievement in view of the decline in quality of ore available for mining. Premium prices for overquota production stimulated the mining of high-cost ores, and although definite figures are not available it is safe to say that, to effect the small gain in output of recoverable zinc in 1942, a much larger gross weight of ore had to be mined than in 1941 because of the lower zinc content of the material milled.

In addition to production from mined ore, zinc was recovered from ever-increasing amounts of old tailings. The remilling of this low-grade material, in many instances for the second and third time, was

[2] As reported by American Zinc Institute, upon the basis of estimates by producer members that together represent approximately 98 percent of total United States production, including primary and secondary.

made possible by advances in milling technology plus the allowed premium payments for the zinc produced. Plants at Helena, Mont., and Tooele, Utah, added to the over-all supply in 1942 by treating lead blast-furnace slag for the recovery of zinc, and a third plant of this type, under construction in Idaho at the end of 1942, will be ready for operation in 1943.

An indicated decrease in production from domestic sources, to a large extent determined by a declining output from the Central States,

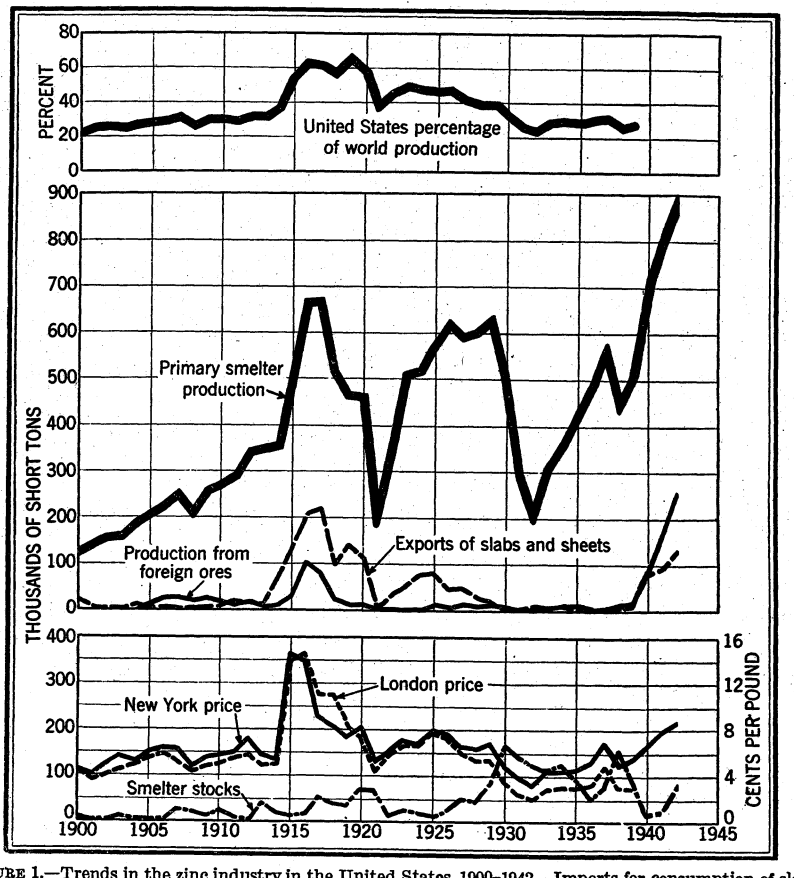

FIGURE 1.—Trends in the zinc industry in the United States, 1900–1942. Imports for consumption of slab and sheet zinc are not shown. Before 1936 they seldom exceeded 500 tons annually, but in recent years they have increased, amounting to 7,456 tons in 1938, 31,138 tons in 1939, 10,164 tons in 1940, 40,559 tons in 1941, and 36,445 tons in 1942.

makes the dependency on imports of foreign ores and concentrates greater than ever before. To keep smelters operating at their expanded capacity in 1942, it was necessary to import foreign material totaling an amount equal to 10 times that in 1939, and estimates of increasing imports for 1943 and 1944 indicate that zinc produced from foreign raw material will exceed the total metal output from domestic mines. The foreign supply, principally from the Western Hemisphere, comes largely from Mexico and Canada. Imports from these two countries, which supplied nearly two-thirds of the minimum import requirements in 1942, fortunately move by all-rail routes to

the United States and may be counted on for future supplies, with nearly equal assurance as domestic production.

The United States has encouraged further development of foreign ore deposits by lending both technical and financial assistance to many mines in other countries through the auspices of the Board of Economic Warfare and the Metals Reserve Co. Definite contracts made by the latter agency for production and delivery of specific amounts have already resulted in gains in foreign output; assuming that necessary increases in water-borne imports can be relied upon, the minimum requirements for 1943 are assured.

DOMESTIC PRODUCTION

PRODUCTION OF PRIMARY AND REDISTILLED SECONDARY SLAB ZINC

The production of 891,872 short tons of primary slab zinc from domestic and foreign ores in 1942 was the highest ever made and exceeded the previous record of 1941 by 8 percent. This increase was made possible by a 55-percent larger output from foreign ore, which more than balanced the 3-percent decline in production from domestic ore.

Heavy demands on a dwindling supply of zinc scrap reduced the output of redistilled slab zinc in 1942 by 11 percent. To prevent inadvertent duplication, figures for the output of remelted secondary slab zinc are not included with those for redistilled metal. In 1942, 8,637 tons were recovered by remelting purchased scrap. Zinc rolling mills and other consumers recover considerably more than this from their own plant scrap, but such metal normally does not enter the market as scrap and is therefore not measured statistically.

Primary and redistilled secondary slab zinc produced in the United States, 1938–42, in short tons

Year	Primary			Redistilled secondary	Total (excludes zinc recovered by remelting)
	Domestic	Foreign [1]	Total		
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
1941	652,599	169,421	822,020	59,503	881,523
1942	629,957	261,915	891,872	53,195	945,067

[1] Most of the foreign ores smelted in the United States in 1938 originated in Peru; in 1939, in Mexico, Peru, and Argentina; in 1940–41, principally in Mexico, Canada, Newfoundland, and Peru; and in 1942, in Mexico, Canada, Argentina, Newfoundland, Australia, and Peru.

DISTILLED AND ELECTROLYTIC ZINC

Of the primary zinc produced in 1942, 72 percent was distilled and 28 percent electrolytic compared with 73 and 27 percent in 1941.

The tremendous increase in the demand for wrought-brass products for military uses emphasized more than ever the importance of High-Grade slab zinc. In fact, it was found necessary to greatly enlarge the existing capacity to produce High-Grade zinc by redistilling Selected and Prime Western grades, the supply of which was not so critical. As a result the production of Special High Grade gained 14 percent and Regular High Grade 41 percent in contrast with Prime Western production, which was 21 percent lower. To avoid duplication the lower grades of zinc consumed in this operation

do not appear in the production figures shown in the following table, but the High-Grade slab zinc produced is included. Of the total 1942 production, 29 percent was Prime Western, 27 percent Regular High Grade, 24 percent Special High Grade, 9 percent Brass Special, 8 percent Intermediate, and 3 percent Selected.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1938–42, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled primary	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
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
1941	224,313	597,707	27,904	31,599	881,523
1942	252,987	638,885	20,978	32,217	945,067

APPORTIONED ACCORDING TO GRADE

Year	Grade A		Grade B (Intermediate)	Grades C and D		Grade E (Prime Western)	Total
	Special High Grade (99.99% Zn)	Ordinary		Brass Special	Selected		
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
1941	203,030	177,451	74,797	73,968	5,152	347,125	881,523
1942	231,422	250,501	77,527	86,176	26,800	272,641	945,067

[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 held without interruption since 1934. Montana ranked next followed closely by Illinois. Of the States for which production figures may be released, Oklahoma, Arkansas, and Idaho occupied the next three positions in order of decreasing importance. Arkansas and Oklahoma had less production than in 1941. Illinois was conspicuous with a 44-percent increase in 1942 output. Montana and Idaho, as usual, produced electrolytic zinc only. Illinois and Texas made both electrolytic and distilled metal, and all other producing States confined their operations to distillation alone.

Primary slab zinc produced in the United States, by States where smelted, 1938–42, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Other States [1]	Total	
								Short tons	Value
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	85,085,000
1941	44,045	39,285	121,921	176,406	105,885	222,486	111,992	822,020	123,303,000
1942	41,649	39,916	175,455	193,486	102,422	231,362	107,582	891,872	155,186,000

[1] Texas and West Virginia.

SECONDARY ZINC

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

BYPRODUCT SULFURIC ACID

Sulfuric acid made from the sulfur dioxide gases produced in roasting zinc blende (sphalerite) is an important byproduct of zinc smelting. To utilize a larger proportion of their acid-producing capacity, some plants also consume large quantities of sulfur. The production of sulfuric acid at zinc-blende roasting plants increased 3 percent during 1942.

Sulfuric acid (60° B. basis) made at zinc-blende roasting plants in the United States, 1938–42

Year	Made from zinc blende [1]		Made from sulfur		Total [1]		
	Short tons	Value [2]	Short tons	Value [2]	Short tons	Value [2]	
						Total	Average per ton
1938	466,879	$4,253,268	30,996	$282,373	497,875	$4,535,641	$9.11
1939	528,872	4,765,137	102,663	924,993	631,535	5,690,130	9.01
1940	586,912	5,364,376	134,250	1,227,045	721,162	6,591,421	9.14
1941	672,177	5,706,783	148,257	1,258,702	820,434	6,965,485	8.49
1942	695,242	6,570,037	147,513	1,393,998	842,755	7,964,035	9.45

[1] Includes acid from foreign blende.

[2] At average of sales of 60° acid.

ZINC DUST

Production of zinc dust in 1942 was 7 percent below the record output in 1941. The zinc content of the dust ranged from 95 to 99.5 percent and averaged 97.2 percent. Of the total zinc dust shipped in 1942, 11 percent went to foreign countries. This percentage, based on data submitted to the Bureau of Mines, is probably low because sales to the Treasury Department are listed as domestic shipments, although the material eventually was shipped abroad to our Allies. Government restrictions curbing gold and silver mining resulted in a sharp decline in the use of zinc dust for precipitating these metals. Direct war uses, such as the use of dust in smoke screens and chemical-warfare reagents, continued to increase. The largest single use for zinc dust was in the production of sodium hydrosulfite. Production and shipments during 1942 about balanced, so stocks at the end of the year were approximately the same as at the beginning. The average price of zinc dust shipped to domestic consumers in 1942 was 10.4 cents per pound as compared with an average of 9.3 cents in 1941. The raw materials used to manufacture dust are reviewed in the chapter on Secondary Metals—Nonferrous, since approximately 80 percent of it is produced from scrap items, principally galvanizers' dross. The balance is made from zinc ore, slab zinc, and as a byproduct of zinc refining.

Zinc dust [1] produced in the United States, 1938–42

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1938	11,609	$1,542,511	$0.066	1941	24,429	$4,641,580	$0.095
1939	16,835	2,367,861	.070	1942	22,805	4,789,050	.105
1940	20,731	3,404,970	.082				

[1] All produced by distillation.

ZINC PIGMENTS AND SALTS

The principal zinc pigments are zinc oxide and lithopone, and the principal salts are the chloride and sulfate. These products are manufactured from various zinciferous materials including ore, metal, scrap, and residues. 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 of zinc in the United States increased only 2.5 percent during 1942 to a total of 768,025 short tons of recoverable zinc. The Western States advanced 28,226 tons or 10 percent, the Central States declined 17,825 tons or 6 percent, and the Eastern States increased 8,499 tons or 4 percent. Oklahoma continued to be the principal producer in the country by a wide margin, contributing more than half of the yield from the Central States, which supplied 34 percent of the total mine production in 1942. The rapid depletion of ore reserves in the Central States lowered production in all but Wisconsin, Illinois, and Missouri. The Tri-State (Joplin) region supplied 31 percent of the total domestic production compared with 35 percent in 1941.

All Western States except Montana and Nevada gained in production during 1942 and together contributed 40 percent of the domestic total. Idaho continued to be the largest producer in this region, with a 10-percent increase over the previous record level of 1941. In spite of a drop in production, Montana ranked second, followed closely by New Mexico and Utah. The output of Colorado was more than double that of 1941. The 8-percent gain in Utah's output was due almost entirely to the additional production of the Tooele slag-fuming plant.

Among the Eastern States, New Jersey continued to be the leading producer and maintained its rank as second in importance in the country by mining 94,040 tons of recoverable zinc. The output from New York and Tennessee continued to be higher than in the past. Virginia mine production was somewhat smaller than in 1941.

Additional data on mine production of zinc are given in the separate chapters covering each State.

Mine production of recoverable zinc in the United States, 1925–29 (average) and 1938–42, by States, in short tons

State	1925–29 (average)	1938	1939	1940	1941	1942
Western States:						
Arizona	2,628	5,814	6,711	15,456	16,493	18,522
California	3,999		6	79	440	613
Colorado	32,868	4,553	1,830	5,060	15,722	32,215
Idaho	29,128	44,030	47,549	70,601	79,084	87,256
Montana	72,519	8,844	34,799	52,587	60,710	54,715
Nevada	5,570	8,944	6,228	11,833	15,129	10,197
New Mexico	23,351	28,236	29,356	30,313	37,862	46,461
South Dakota						115
Utah	44,385	33,658	34,526	43,788	42,049	45,543
Washington	575	11,402	10,131	11,560	14,320	14,398
	215,023	145,481	171,136	241,277	281,809[a]	310,035
Central States:						
Arkansas	71	152	123	440	206	181
Illinois	1,174		334	4,818	9,198	9,389
Kansas	114,323	73,024	68,971	57,032	71,403	55,874
Kentucky	644	322	909	1,278	427	407
Missouri	16,708	10,226	15,096	12,703	21,932	36,394
Oklahoma	226,969	112,924	140,379	162,935	166,602	146,510
Wisconsin	23,055	2,073	5,904	5,770	6,238	9,426
	382,944	198,721	231,716	244,976	276,006	258,181
Eastern States:						
New Jersey	93,839	85,839	88,716	91,406	93,781	94,040
New York	7,091	29,896	36,014	35,686	38,446	45,807
Tennessee	14,631	29,810	32,375	34,796	36,170	43,971
Virginia	11,192	26,956	23,850	16,927	22,913	15,991
	126,753	172,501	180,955	178,815	191,310	199,809
	724,720	516,703	583,807	665,068	749,125	768,025

Mine production of recoverable zinc in the United States, by districts that produced 1,000 tons or more during any year, 1938–42, in short tons

District	State	1938	1939	1940	1941	1942
Joplin region	Kansas, Southwestern Missouri, Oklahoma.	196,174	224,446	232,437	258,837	237,936
New Jersey	New Jersey	85,839	88,716	91,406	93,781	94,040
Coeur d'Alene region	Idaho	31,937	40,065	62,948	68,321	78,313
St. Lawrence County	New York	29,896	36,014	35,686	38,446	45,807
Eastern Tennessee	Tennessee	29,810	32,375	34,796	36,170	[1] 43,971
Central	New Mexico	16,695	23,677	29,573	34,649	42,374
Summit Valley (Butte)	Montana	942	20,016	35,899	38,070	29,313
Red Cliff	Colorado				10,880	22,880
Bingham	Utah	23,096	20,861	21,812	20,496	22,634
Smelter	Montana	6,063	12,639	14,462	18,751	20,190
Austinville	Virginia	26,956	23,850	[1] 16,927	[1] 22,913	15,793
Metaline	Washington	11,402	10,130	11,560	14,201	13,620
Park City region	Utah	5,678	9,054	17,598	16,177	13,026
Upper Mississippi Valley	Iowa, Northern Illinois, Wisconsin.	2,073	5,904	5,776	7,956	11,126
Pioche	Nevada	8,414	5,737	10,773	14,391	8,957
Kentucky-Southern Illinois	Kentucky-Southern Illinois	322	1,243	6,090	7,907	8,096
Rush Valley	Utah	1,955	2,370	2,971	3,726	7,625
Warm Springs	Idaho	12,070	7,463	7,104	8,534	6,260
Harshaw	Arizona		1,075	2,714	3,531	4,825
Pioneer	do	825	2,000	3,175	4,139	3,884
Leadville	Colorado	97	172	172	48	3,344
Magdalena	New Mexico	218	317	206	2,580	3,185
Pioneer (Rico)	Colorado	30	867	2,607	3,008	2,764
Big Bug	Arizona		110	1,740	1,804	2,650
Wallapai	do	1,660	770	4,295	2,346	2,244
Patagonia	do			990	1,788	1,913
Tintic	Utah	921	851	225	797	1,708
South Mountain	Idaho			540	2,201	1,485
Warren	Arizona		7	1,812	2,095	1,449
Heddleston	Montana				548	1,266
Montana	do		5	713	1,474	489
Animas	Colorado	132	574	1,394	832	379
Eagle	Montana	550	394	418	1,048	348
Ophir	Utah	1,893	1,268	603	173	189
Cataract	Montana	605	1,070	773	93	
Oro Blanco	Arizona	3,265	2,377	484		
Willow Creek	New Mexico	11,291	4,925			

[1] Includes very small quantity produced elsewhere in State.

STOCKS

PRODUCERS' STOCKS

Inventories at primary reduction plants at the end of 1942 were more than triple the amount on hand at the beginning, and the 241-percent increase raised the total to the highest point since 1939. Stocks held at secondary distilling plants, although comparatively small, advanced similarly from 890 to 1,790 tons to bring the over-all gain to 236 percent above 1941. Of the total stocks on hand at the end of the year, 18,058 tons were High Grade and Intermediate, and the remaining 66,364 tons were the lower grades, compared with 18,491 tons and 6,611 tons, respectively, at the end of 1941. Nearly the entire inventory gain can be accounted for by the accumulation of Prime Western grade.

This steadily increasing stock pile has been the outgrowth of the program of conservation, particularly with regard to nonessential uses, coupled with the necessity of building up reserves to a safe working level. Nearly half of the total stock on hand at the end of the year was credited to the account of the Metals Reserve Company. Although subject to allocation, a large proportion of the balance of Prime Western grade zinc probably will be refined into the higher-grade metal at some future date to help fulfill the demand for this critical material.

According to the American Zinc Institute, stocks of slab zinc followed a general downward trend until the end of May and then advanced rapidly during the remaining months of the year.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1938–42, in short tons

	1938	1939	1940	1941	1942
At primary reduction plants	157,511	83,728	19,212	24,212	82,632
At secondary distilling plants	1,915	2,555	761	890	1,790
	159,426	86,283	19,973	25,102	84,422

Stocks of zinc ore (60 percent concentrates) in the Tri-State district (as reported by the Tri-State Zinc and Lead Ore Producers' Association) on January 3, 1942, were only 1,500 tons but quickly attained the level of 4,970 tons by January 24. Production continued to exceed shipments until the middle of February, when stocks were 5,805 tons. This rise was followed by a slow drop to 3,331 tons on hand at the end of the first quarter. The premium-price plan covering overquota mine production subsequently disturbed normal stock trends by encouraging the practice of making heavy shipments at the end of the month, with a resultant sharp drop in stocks. Throughout April, May, June, and July inventories remained fairly steady near 3,800 tons. August saw an accumulation up to 4,600 tons, but during September, October, and November stocks returned to the general level of 3,800 tons. By the middle of December the total reached 5,116 tons,but heavy shipments resulted in a January 2 inventory of only 957 tons.

According to an American Zinc Institute survey, stocks of ore and concentrates at primary zinc reduction plants on December 31, 1942,

totaled 540,339 tons averaging 55 percent zinc compared with 413,427 tons containing 55 percent zinc at the end of 1941. Smaller stocks of ore were also held at plants producing zinc oxide and zinc dust.

Data on stocks of metallic zinc outside the United States continue to be unavailable, owing to the disruption of international trade in zinc ore and strict censorship imposed by the Nations at war.

CONSUMERS' STOCKS

Consumers of slab zinc improved their inventory position in 1942, total stocks on December 31 being 6 percent above the amount on hand on the corresponding date at the end of 1941. Stocks increased steadily from the beginning of the year until August 31, when the maximum of 84,900 tons was attained. This was followed by a drop to 64,800 tons on November 30, the low point for the year. Galvanizers decreased their inventories by 23 percent during the year, but stocks at brass mills rose 57 percent. Because of variance in coverage and certain changes in industrial classification all stock figures for December 31, 1941, which appeared in the 1941 chapter were revised. At the average monthly rate of consumption in 1942 stocks on hand at the end of 1942 were sufficient to supply consumers' requirements for slightly more than 1 month.

In addition to physical stocks on hand at consumers' plants at the end of 1942, a total of nearly 21,000 tons of zinc was in transit to consumers, held for redistillation, and in dealers' hands. Exclusive of an indeterminate amount in bonded warehouses the approximate total slab zinc in stock (including inventories at producers' plants) on December 31, 1942, amounted to 176,000 tons. The comparative figure at the end of 1941 was 106,000 tons.

Consumers' stocks of slab zinc at plants at the beginning and end of 1942, by industries, in short tons

	Galvanizers	Die casters [1]	Brass mills [2]	Zinc rolling mills	Oxide plants	Others	Total
Dec. 31, 1941 [3]	33,437	8,295	20,225	3,373	317	1,207	66,854
Dec. 31, 1942	25,729	9,086	31,713	3,063	532	1,074	71,197

[1] Includes producers of zinc-base die castings, zinc-alloy dies, and zinc-alloy rods.
[2] Includes brass mills, brass ingot makers, and brass foundries.
[3] Revised figures.

DOMESTIC CONSUMPTION

NEW SUPPLY

The following table shows the 5-year trend of primary slab zinc available for consumption in the United States. This calculated quantity, in effect, is equivalent to the slab zinc apparently made available each year for shipment to domestic consumers during the year.

In addition to primary zinc, 52,295 tons of redistilled secondary metal were made available to consumers in 1942 after allowance for increased stocks at secondary smelters.

Primary slab zinc available for consumption in the United States, 1938–42, in short tons

	1938	1939	1940	1941	1942
Supply:					
Stock at smelters Jan. 1	79,144	157,511	83,728	19,212	24,212
Production	446,341	507,236	675,275	822,020	891,872
Imports for consumption	7,230	30,960	[1] 16,468	[1] 34,554	[1] 36,394
Total available	532,715	695,707	775,471	875,786	952,478
Withdrawn:					
Exports	[2] 200	4,515	79,091	89,309	133,981
Stock at smelters Dec. 31	157,511	83,728	19,212	24,212	82,632
Total withdrawn	157,711	88,243	98,303	113,521	216,613
Available for consumption	375,004	607,464	677,168	762,265	735,865

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

CONSUMPTION

Approximately 600 companies, representing better than 95 percent of the consuming industry in the United States, used 728,169 tons of slab zinc in 1942—a 12-percent drop from the 1941 total of 827,435 tons. Receipts reported for this same period were 732,512 tons. The apparent discrepancy between this figure and the calculated 788,160 tons of primary and secondary slab zinc apparently shipped to domestic consumers in 1942 may be attributed largely to variances in metal in transit, unaccounted-for metal stored in bonded warehouses, and incomplete coverage of the survey.

Industrial mobilization for total war made startling changes in 1942 in the various phases of the zinc-consuming industry under close Government control. In comparison with 1941, zinc consumed in galvanizing dropped 29 percent and in brass products gained 40 percent. The manufacture of zinc-base alloy was cut more than half, as was the use of slab zinc in zinc oxide, and rolled zinc decreased 8 percent. Details are shown in the following table.

Consumption of slab zinc in the United States, 1941–42, by industries, in short tons [1]

	1941	1942		1941	1942
Galvanizing: [2]			Zinc oxide	16,128	7,977
Sheets	129,028	76,106			
Tubes and pipe	69,749	47,085	Zinc-base alloy:		
Wire	41,408	35,216	Die castings	[3]	58,918
Wire cloth	11,307	7,320	Alloy dies and rod	[3]	21,227
Shapes [4]	99,362	81,764		150,853	80,145
	350,854	247,491	Other uses:		
Brass products:			Slush castings	751	552
Sheets, tubes, etc	195,714	292,820	Wet batteries	1,767	1,667
Ingots, castings, etc	32,324	27,126	Desilverizing lead	1,431	1,251
	228,038	319,946	Miscellaneous [5]	5,564	3,095
				9,513	6,565
Rolled zinc	72,049	66,045	Total: All uses	827,435	728,169

[1] Based upon canvass of approximately 600 companies.
[2] Includes zinc used in electrogalvanizing but excludes sherardizing.
[3] Separate figures for 1941 not available.
[4] Includes pole-line hardware, hollow ware, chains, and miscellaneous articles not elsewhere mentioned.
[5] Includes zinc used in manufacture of zinc dust, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.

The consumption of zinc in sheet galvanizing fell off 41 percent, and the amount used for this purpose was 31 percent of the total consumed in all galvanizing compared with 37 percent in 1941. In contrast, zinc used in coating shapes (largely items for military and naval use), although 18 percent under the 1941 figure, comprised 33 percent of the total as against 28 percent in the previous year. The balance of the zinc used in galvanizing went into tubes and pipe, wire, and wire cloth, all totals being less than in 1941.

Of the total slab zinc consumed in 1942, brass mills, foundries, and ingot makers absorbed 44 percent compared with 28 percent in 1941. The marked gain in zinc used for sheets and tubes, amounting to 50 percent, shows the urgent need for brass in cartridges and shell cases. The successful use of steel for certain of these items did not lessen the need for brass; rather it augmented a supply that otherwise would have been limited by the availability of zinc and copper.

The vastly increased use of High-Grade slab zinc by the brass mills left a much smaller proportion available to the producers of zinc-base alloys. Moreover, rigid military specifications prohibited the use of zinc-base die castings in much of the war equipment. As a direct result of the aircraft expansion program, greater quantities of zinc-base alloys were needed for making stamping and forming dies used in fabricating certain airplane parts. Despite the marked gain of this specific type of use, over-all consumption of slab zinc in zinc-base alloy decreased 47 percent.

Zinc rolling mills showed only an 8-percent drop in slab-zinc consumption. In addition to slab zinc, the rolling mills remelt and reroll the metallic scrap originating during their fabricating operations. The scrap thus treated in 1942 amounted to 15,641 tons—a 7-percent gain over 1941. In addition, 2,023 tons of purchased zinc scrap in the form of zinc clippings, old zinc scrap, and engravers' plates were melted and rolled in 1942. No comparative data for 1941 are available. The zinc lost in such waste products as skimmings and ashes totaled 1,639 tons in 1942, an amount equivalent to about 2.4 percent of the net production of rolled zinc.

Production of rolled zinc from these raw materials amounted to 66,439 tons—a 6-percent decrease from 1941. The average value advanced 6 percent from $0.115 in 1941 to $0.122 in 1942. Inventories of rolled zinc were 1,619 tons on December 31, 1942, as compared with 1,300 tons for the same date in 1941—an increase of 25 percent. In addition to actual shipments of rolled zinc in 1942 amounting to 43,647 tons, the rolling mills consumed 38,104 tons of rolled zinc in the manufacture of 22,463 tons of fabricated products, such as battery cans.

Rolled zinc produced and quantity available for consumption in the United States, 1941–42

	1941			1942		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	18,823	$4,933,000	$0.131	14,554	$4,191,000	$0.144
Boiler plate and sheets over 0.1 inch thick	3,610	775,000	.107	3,542	790,000	.112
Strip and ribbon zinc [1]	47,046	10,125,000	.108	46,930	10,610,000	.113
Foil, rod, and wire [2]	1,084	391,000	.180	1,413	564,000	.200
Total rolled zinc	[3] 70,563	[3] 16,224,000	[3] .115	66,439	16,155,000	.122
Imports	271	54,500	.100	50	10,100	.101
Exports	4,670	1,141,800	.122	3,880	1,013,500	.131
Available for consumption	66,164			[4] 62,280		
Value of slab zinc (all grades)			.075			.087
Value added by rolling			[3] .040			.035

[1] Figures represent net production. In addition, 14,586 tons of strip and ribbon zinc in 1941 and 15,641 tons in 1942 were rerolled from scrap originating in fabricating plants operated in connection with zinc rolling mills.
[2] Data on foil, rod, and wire shown for the first time. Statistics for prior years excluded to prevent revealing individual company figures.
[3] Total figures for 1941 are higher than previously published owing to the addition of foil, rod, and wire.
[4] Allowances made for change in producers' stocks of rolled zinc; stock data obtained for first time in 1942.

The use of slab zinc for zinc oxide was cut to practically half that of 1941. Slab zinc is used to make French process oxide which represented approximately 16 percent of the total oxide made in 1942. Of the total French process oxide produced, about 58 percent was made from slab zinc and the remainder from scrap.

Zinc slab differs from most metals in that it is refined into six grades of purity, ranging from Special High Grade containing 99.99 percent zinc to Prime Western grades containing less than 98.75 percent zinc. The following table shows the grades of zinc consumed by the various industries in 1942. Of the 700,731 tons of domestic slab zinc consumed, 33 percent was Prime Western, 28 percent Special High Grade, and 25 percent Regular High Grade. Nearly 83 percent of the total slab zinc used by galvanizers was Prime Western Grade in 1942; the high grades of zinc, principally in the form of anodes, were used for the most part by the electrogalvanizers. As die castings require the highest-purity metal, consumption by their producers is limited almost entirely to High-Grade slab zinc. War demands for lead-free wrought brass products, such as cartridge cases, were responsible for 84 percent of the slab zinc used by the brass-mill group being of the three highest grades. Zinc rolling mills consume very little slab zinc below the grade of Brass Special.

Consumption of slab zinc in the United States, 1941–42, by grades according to industry, in short tons

	Special High Grade	Regular High Grade	Intermediate	Brass Special	Selected	Prime Western	Foreign	Total
1941:								
Galvanizers	16,375	8,406	20,147	1,746	177	296,992	7,011	350,854
Die casters	145,744	3,324	618	2	1	270	894	150,853
Brass mills	42,829	85,974	34,822	13,678	5,094	19,801	25,840	228,038
Zinc rolling mills	1,550	22,597	13,151	20,676	8,325	2,607	3,143	72,049
Zinc oxide	1,169	14,359					600	16,128
Other	4,261	2,031	512	51	6	1,728	924	9,513
Total	211,928	136,691	69,250	36,153	13,603	321,398	38,412	827,435
1942:								
Galvanizers	7,272	9,189	11,599	4,452	831	204,622	9,526	247,491
Die casters [1]	78,227	1,913	5					80,145
Brass mills [2]	103,003	134,465	30,152	10,523	5,334	21,312	15,157	319,946
Zinc rolling mills	2,197	19,708	11,108	27,477	35	3,173	2,347	66,045
Zinc oxide	1,579	6,117				281		7,977
Other	1,405	1,897	889	138	51	1,777	408	6,565
Total	193,683	173,289	53,753	42,590	6,251	231,165	27,438	728,169

[1] Includes producers of zinc-base die castings, zinc-alloy dies, and zinc-alloy rods.
[2] Includes brass mills, brass ingot makers, and brass foundries.

PRICES

The informal base price ceiling of 8.25 cents a pound for Prime Western at St. Louis, established by the Office of Price Administration on October 9, 1941, was replaced by Price Schedule 81, effective January 29, 1942. As a result, control became stricter, but the quotations remained unchanged. The following formal ceilings were established per pound f. o. b. East St. Louis: Prime Western grade, 8.25 cents; Selected, 8.35 cents; Brass Special, 8.50 cents; and Intermediate, 8.75 cents. Regular High-Grade and Special High-Grade price ceilings were set at 9.25 cents delivered. The base price of 60-percent zinc concentrates in the Joplin region remained stationary at $55.28 per ton. In comparison with 1942 prices, which remained unchanged throughout the year, the average price for Prime Western zinc in 1941 was 7.48 cents a pound and 60-percent concentrates at Joplin, $49.80 a ton. The premium price plan is briefly outlined in this chapter under the heading, War-Agency Regulations.

The official British price of £25 15s. for foreign zinc delivered consumers, duty paid, and £26 10s. for domestic metal remained unchanged throughout 1942.

Price of zinc and zinc concentrates, 1938–42

	1938	1939	1940	1941	1942
Average price of common zinc at—					
St. Louis (spot)—cents per pound	4.61	5.12	6.34	7.48	8.25
New York—do	4.99	5.51	6.73	7.87	8.66
London—do	3.05	[1] 2.89	[2]	[2]	[3]
Excess New York over London—do	1.94	[3] 2.03	[4]	[4]	[4]
Joplin 60-percent zinc concentrates:					
Price per short ton—dollars	27.83	34.15	41.87	49.80	55.28
Price of zinc content—cents per pound	2.32	2.85	3.49	4.15	4.61
Smelter margin—do	2.29	2.27	2.85	3.33	3.64
Price indexes (1925–29 average=100):					
Zinc (New York)	70	77	95	111	122
Lead (New York)	63	68	69	78	87
Copper (New York)	70	75	77	80	80
Nonferrous metals [5]	74	79	82	85	87
All commodities [5]	80	79	80	89	101

[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 1941–42 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, 1941–42 [1]

Month	1941			1942		
	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	$48.20	7.25		$55.28	8.25	
February	48.22	7.25		55.28	8.25	
March	48.19	7.25		55.28	8.25	
April	48.20	7.25		55.28	8.25	
May	48.20	7.25		55.28	8.25	
June	48.21	7.25		55.28	8.25	
July	48.21	7.25	(2)	55.28	8.25	(2)
August	48.22	7.25		55.28	8.25	
September	48.39	7.25		55.28	8.25	
October	52.88	7.99		55.28	8.25	
November	55.28	8.25		55.28	8.25	
December	55.28	8.25		55.28	8.25	
Average for year	49.80	7.48	(2)	55.28	8.25	(2)

[1] 1941 quotations from Metal Statistics, 1942; 1942 quotations from E&MJ Metal and Mineral Markets, 1942.

[2] Official maximum price fixed by British Ministry of Supply at £25 15s., equivalent to 4.64 cents a pound at the official 1941–42 rate of exchange.

Average price received by producers for zinc, 1938–42, by grades, in cents per pound

	1938	1939	1940	1941	1942 [2]
Grade A: [1]					
Special High Grade	5.03	5.34	6.59	8.04	9.00
Regular High Grade				7.74	9.10
Grade B: Intermediate				7.52	8.64
Grades C and D: [1]					
Brass Special	4.73	5.00	6.04	7.37	8.32
Selected				6.64	8.18
Grade E: Prime Western	4.71	5.08	6.14	7.16	8.23
All grades	4.8	5.2	6.3	7.5	8.7
Prime Western; spot quotation at St. Louis	4.6	5.1	6.3	7.5	8.25

[1] American Metal Market quotes average prices of High Grade and Brass Special as follows: High Grade (f. o. b. New York)—1938, 5.74 cents; 1939, 6.16 cents; 1940, 7.38 cents; 1941, 8.48 cents; 1942, 9.25 cents. Brass Special (f. o. b. East St. Louis)—1938, 4.71 cents; 1939, 5.22 cents; 1940, 6.44 cents; 1941, 7.68 cents; 1942, 8.50 cents.

[2] Does not include overquota premium payments made by Metals Reserve Co.

ZINC-REDUCTION PLANTS

ZINC SMELTERS

No change took place during 1942 in the number of zinc smelters. As in 1941, there were 17 active plants, of which 13 continued to operate with horizontal retorts exclusively, one with both horizontal and vertical retorts, two with large vertical retorts, and one with electrothermic furnaces. The total number of retorts reported at the horizontal-retort primary plants was 67,816, 2 percent less than the 69,552 (revised figure) at these plants on December 31, 1941. Of the total retorts reported, 65,508 were in use at the end of 1942—a minor decrease from the 65,969 in operation at the close of 1941. The increased output in 1942 from a numerically smaller number of retorts was accomplished by the use of larger retorts and increased efficiency of operation. Although only 97 percent of the available retorts was in operation at the end of the year, smelting operations

were at usable capacity throughout 1942; the remainder, for the most part, comprised a decreasing amount of obsolete equipment that has been idle for some time and is being replaced or reconditioned, and a certain percentage that must necessarily be closed down for repairs and replacement. At the end of 1942, 4,896 new retorts were under construction. Of the 66 vertical retorts in this country, 63 were in operation at the year's end.

Twelve of the primary smelters mix scrap and residues such as skimmings and dross with the ore before distillation. Small quantities of clean metallic scrap are occasionally added to the (condensed or molten) primary zinc without affecting the quality. Supplementing these 17 primary producers, 15 plants made redistilled secondary slab zinc by treating scrap in 2,560 clay retorts, 112 graphite crucibles, and a few special furnaces. One plant at Philadelphia plans to add 3 graphite crucibles in 1943. A part of this available production capacity at secondary smelters is used to produce zinc dust and zinc oxide in addition to slab zinc.

ELECTROLYTIC PLANTS

Five electrolytic plants were in operation by the end of 1942 compared with four in 1941. The American Smelting & Refining Co. started producing slab zinc in its new plant at Corpus Christi, Tex., during October and by December was operating at about 94 percent of capacity. Lack of raw materials delayed completion of additional new cells at the East St. Louis electrolytic refinery. By the end of 1942, 2,814 cells out of a total of 3,038 were in use compared with 2,502 out of 2,526 cells in 1941. The seemingly large number of unused cells is probably due to the fact that some were not completed. At the end of 1942, 156 cells were under construction in the country.

FOREIGN TRADE [3]

IMPORTS

The following tables give total zinc imports (general) in ore and blocks, pigs, or slabs into the United States, 1940–42, and imports for consumption. Of the 368,355 tons of zinc imported in ore, 44 percent came from Mexico, 21 percent from Canada, and 9 percent from Australia. Receipts from Canada were 58 percent higher and from Australia almost four times larger than in 1941. Imports from Belgian Congo dropped considerably, but all other countries supplied more ore than in 1941. Imports of slab zinc from Mexico increased 33 percent, whereas receipts of slab zinc from Canada declined 67 percent.

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

Zinc imported into the United States in ore, blocks, pigs, or slabs, 1940–42, by countries, in short tons [1]

Country	1940	1941	1942
Ore (zinc content):			
Argentina	6,723	20,579	23,395
Australia	1,749	8,933	32,212
Belgian Congo		12,563	2,873
Bolivia	2,530	2,687	5,893
Canada	33,993	49,764	78,744
Chile	611	2,157	6,872
Mexico	93,789	148,201	160,713
Newfoundland and Labrador	23,640	7,267	30,103
Peru	17,285	28,833	27,506
Spain		8,227	
Other countries		2	44
	180,320	289,213	368,355
Blocks, pigs, or slabs:			
Belgium	336		
Canada	6,938	7,236	2,392
Indochina, French		1,653	
Mexico	8,948	25,621	34,002
Other countries	246	44	
	16,468	34,554	36,394

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

Zinc imported for consumption in the United States, 1938–42, by classes

Year	Ores (zinc content)		Blocks, pigs, or slabs		Sheets		Old, dross, and skimmings [1]		Zinc dust		Total value [2]
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1938	4,860	$392,591	7,230	$480,169	226	$25,989	96	$8,944	64	$5,074	$912,767
1939	33,503	1,304,433	30,960	1,890,236	178	21,166	203	14,067	41	3,388	3,233,290
1940	44,637	1,108,361	10,146	801,331	18	2,796	520	36,689			1,949,177
1941	154,520	4,596,480	40,288	3,661,549	271	54,464	456	31,695	140	21,495	8,365,683
1942	268,470	10,400,541	36,395	2,927,079	50	10,086	3,342	156,288	702	43,464	13,537,458

[1] Includes dross and skimmings as follows—1939: 30 tons, valued at $1,918; 1940: 356 tons, $21,815; 1941: 353 tons, $23,028; and 1942: 3,199 tons, $148,272. None reported in 1938.
[2] In addition, manufactures of zinc imported as follows—1938: $463; 1939: $1,545; 1940: $32; 1941: $1,099; 1942: $16.

EXPORTS

The value of exports of zinc ore and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) amounted to $24,551,255 in 1942 compared with $14,717,513 in 1941. Slabs, plates, or blocks continued to be the largest export group, and the total shipped to foreign countries increased 50 percent—from 89,309 tons in 1941 to 133,981 tons in 1942. In addition to the items shown in the accompanying tables, considerable zinc is exported each year in brass, pigments, chemicals, and galvanized iron and steel. Export data on zinc pigments and chemicals are given in this volume in the chapter on Lead and Zinc Pigments and Zinc Salts. Much of the zinc used in the manufacture of such products is of foreign origin, and when they are exported a draw-back of 99 percent of the import duty is paid on the basis of zinc contained in the finished product. For 1942, draw-back was paid on 23,047 tons of zinc, of which 8,677 tons had been imported as slabs and 13,580 tons as ore. Totals for preceding years were: 1941, 34,478 tons; 1940, 19,306 tons; 1939, 16,213 tons; 1938, 11,550 tons; and 1937, 9,253 tons.

Slab and sheet zinc exported from the United States, 1939–42, by destinations, in short tons

Destination	Slabs, plates, and blocks				Sheets, strips, or other forms, n. e. s.			
	1939	1940	1941	1942	1939	1940	1941	1942
Country:								
Argentina	56	890	862		404	579	504	
Australia					1,052	246	464	
Brazil	526	1,391	1,004		50	96	125	
Canada	5	(2)			2,902	2,813	1,247	
Chile	298	428	196		20	130	144	
China	201	4,115	1,947		148	40	102	
France		8,681		(1)				(1)
India and Dependencies		9,634	11,553		122	1,422	672	
Japan	3,252	13,958	175		5	259		
Mexico			400				311	
U. S. S. R.			480					
United Kingdom		36,718	71,325		841	585	209	
Other countries	177	3,276	1,367		1,164	1,320	1,468	
Total	4,515	79,091	89,309	133,981	6,708	7,490	5,246	4,767
Continent:								
North America	31	258	433		3,167	3,127	1,721	
South America	996	2,760	2,416		555	997	976	
Europe		45,982	71,805	(1)	952	783	320	(1)
Asia	3,488	29,431	14,394		741	1,657	1,431	
Africa		640	1		159	653	239	
Oceania		20	260		1,134	273	559	

[1] Data not available at time of publication.
[2] Less than 1 ton.

Zinc ore and manufactures of zinc exported from the United States, 1938–42

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
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	2,384	468,516
1940	448	42,207	79,091	9,103,030	[2] 7,490	[2] 1,564,720	3,044	592,271
1941			89,309	12,712,121	[2] 5,246	[2] 1,328,516	2,901	676,876
1942	(3)	18	133,981	22,843,391	[2] 4,767	[2] 1,289,889	1,772	417,957

[1] Pigs and slabs not shown separately; included with sheets, strips, or other forms, n. e. s.
[2] Includes "Other forms, n. e. s. (including scrap)," as follows—1939: 259 tons, valued at $64,434; 1940: 435 tons, $143,652; 1941: 576 tons, $186,731; and 1942: 887 tons, $276,370.
[3] Less than 1 ton.

WORLD ASPECTS OF ZINC INDUSTRY

The war continued to necessitate strict censorship regarding base-metal statistics from many countries. Although official zinc production figures were not, for the most part, available, some general information did filter through. The Bureau of Mines estimated that in 1942 the world mine production of zinc totaled about 2,044,000 short tons (recoverable zinc content) and that zinc smelter capacity amounted to approximately 2,950,000 tons. About 75 percent of the world supply of zinc ore and 54 percent of the total zinc smelting capacity is in the hands of, controlled by, or available to the United Nations. The inability of domestic supplies to pace a greatly expanded smelter capacity has aroused keen interest in all foreign deposits, of which the principal ones are discussed in the following pages.

World smelter production of zinc, 1937–42, by countries where smelted, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942
Australia	70,869	70,941	72,363	[2] 85,000	[3]	83,316
Belgium [4]	225,580	210,400	185,700	[2] 65,000	[3]	[3]
Canada	143,826	156,008	159,338	168,486	193,784	195,769
Czechoslovakia	7,336	8,876	[5]	[5]	[3]	[3]
France	60,427	60,560	60,262	[2] 35,000	[3]	[3]
Germany [6]	163,814	194,370	[7] 212,285	[7 8]	[3]	[3]
Indochina	4,204	4,470	5,439	[2] 6,700	[3]	[9] 4,647
Italy	37,982	33,637	33,566	[2] 40,000	[3]	[3]
Japan	45,500	[8]	[8]	[2] 55,000	[2] 65,000	[3]
Mexico	36,587	35,881	35,369	33,388	31,543	[3]
Netherlands	24,645	25,300	20,500	[2] 6,000	[3]	[3]
Northern Rhodesia	14,256	10,379	12,899	15,000	[3]	[3]
Norway	41,276	46,523	45,917	[2] 20,000	[3]	[3]
Poland	107,174	108,071	117,936	[2] 120,000	[3]	[3]
Spain	1,843	7,672	13,396	12,322	11,589	[10] 3,514
Union of Soviet Socialist Republics	[2] 65,000	[8]	[8]	[8]	[3]	[3]
United Kingdom [6]	63,138	56,190	50,440	[2] 60,000	[3]	[3]
United States	505,212	404,912	460,154	612,596	745,720	809,088
Yugoslavia	4,259	3,956	4,182	6,025	[3]	[3]
	1,623,000	1,568,000	1,635,000	1,643,000	[3]	[3]

[1] Statistical data derived in part from American Bureau of Metal Statistics, Yearbook.
[2] Estimated.
[3] Data not available.
[4] Includes the following tonnages of electrolytic zinc: 1937, 7,830 tons; 1938, 8,670 tons. Data not available for later years. Production of electrolytic zinc began in August 1935.
[5] Included with Germany.
[6] Some secondary metal included.
[7] Includes Czechoslovakia.
[8] Estimate included in total.
[9] January to June, inclusive.
[10] January to March, inclusive.

REVIEW BY COUNTRIES

Argentina.—Practically all the zinc mined in Argentina is from the Aguilar mine of the St. Joseph Lead Co. in the Province of Jujuy, near the Bolivian border. Although no final data for 1942 are available, the reported monthly rate of production from this property alone, amounting to 6,000 to 6,500 metric tons of 54-percent concentrates, indicates that total Argentine output was above the 66,010 tons (36,300 tons zinc content) produced in 1941. Concentrates are transported to Santa Fé for shipment. Exports of this material in 1942 totaled 56,430 tons, all of which went to the United States. Inventories reported on hand at the mine in April totaled 115,000 tons; but by November 30, this stock, available for export, had been reduced to about 93,000 tons. An estimated 1,200 tons of concentrates a month, mostly from other smaller mines, is treated at the Puerto Vilelas smelter.

Australia.—The total production of zinc concentrates in Australia in 1942 was reported to be 387,000 long dry tons averaging about 53 percent zinc. No comparative data are available for 1941. In January 1943 the milling rate was 166,000 long tons of ore a month. The war has hindered increased mining operations by necessitating higher taxation and the transfer of miners to the army and munition industries. Several expansion efforts have been delayed when construction lagged. Diamond drilling has been continued at New Broken Hill and has led to the location of a body of lead ore containing about 16 percent zinc. Production of zinc concentrates was maintained at the Mount Isa Mines, Ltd.

Operation of the smelter of the Electrolytic Zinc Co. at Risdon, Tasmania, was hindered by a labor shortage, and production failed to reach full capacity for a short time when an adequate supply of important operating reagent was not available. The Risdon plant produced about 82,000 tons of metal in 1942, but none was available to the United States.

Bolivia.—The mine production of zinc (content in ore) amounted to 10,909 metric tons in 1942 compared with 6,065 metric tons in 1941. All production is exported.

The Huanchaca mine produces most Bolivian zinc by the cut-and-fill method. Output has continued to be small, and no apparent reserves are in sight.

Brazil.—The main deposits of zinc ore (blende) are in the Iporanga region of the State of São Paulo and the Morro do Bule and Januaria regions of the State of Minas Gerais. Reserves have been estimated at about 30,000 metric tons containing 31 to 36 percent zinc, but no large deposits have been found.

Burma.—The fall of Lashio to the Japanese early in March 1942 precluded continued operation by the Burma Corporation of the mines at Bawdwin, and the properties were evacuated by April 25. Reportedly some damage was done to the mines, smelter, and equipment before evacuation, but the extent of destruction and its effect upon subsequent operations by the Japanese is not known. These mines had an annual production of about 45,000 long tons of zinc. The last available information on reserves at this mine (June 30, 1941) gives an estimate of 3,130,200 tons of ore assaying 15.1 ounces of silver, 19.5 percent lead, and 12.1 percent zinc.

Canada.—The war has brought considerable pressure on the Canadian mining industry to expand its output. As a result the 1942 mine output totaled 294,101 short tons (metallic content), an 11-percent gain over the 1941 production of 265,191 short tons. Because Canada has only two refineries—one at Trail and the other at Flin Flon—its ore production exceeds its refinery capacity. There has been considerable interest in building a zinc refinery in Quebec instead of sending the concentrates to the United States. As most of the excess concentrates are shipped to the United States, where the supply of raw material is critical, it is not surprising that the United States has been a guarantor for expansion of mills and other facilities to increase the output of zinc. Plans for a $1,000,000 smelter to be built by the Reeves MacDonald mines south of Trail, British Columbia, and financed by United States funds have been under discussion, but nothing definite has yet materialized.

Of the total zinc mined in Canada, approximately 71 percent is produced in British Columbia (mostly from the Sullivan mine), 20 percent from Flin Flon, and 7 percent from the Noranda district. A large number of small, idle mines were reopened, and extensive diamond-drill prospecting was conducted. An important zinc deposit was found near the Labrador border.

The Sherritt Gordon Mines, Ltd., located a new sulfide-ore deposit containing 1 percent copper and the same amount of zinc. A new zinc-concentrate plant is about completed, and the product will be purchased by the Metals Reserve Company with whom it has contracted to sell 50,000 tons of 50-percent zinc concentrates within a

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2-year period. Development work in the zinc deposit at Calumet Island was speeded up, owing to the demand for concentrates for smelters in the United States. The New Calumet expected to "tune up" its new 300-ton zinc-lead concentrator before the end of December. The Golden Manitou mine is constructing a 600-ton-a-day zinc concentrator. By October the Hudson Bay Mining & Smelting Co. had enlarged its plant to 6,200 tons daily capacity. A new shaft allows a higher metallic content ore to be drawn below the 2,250 level in the southern section. Zinc is recovered from a 300,000-ton residue pile averaging 23 percent zinc. Residues are treated with sodium chloride, and the zinc is roasted to yield zinc oxide. The company is selling its excess zinc to the United Kingdom at pre-war prices, with adjustments for increased costs. This same company has proved an important copper-zinc ore body at Schist Lake. Emergency Metals, Ltd., is equipping the Mandy mine with a 200-ton concentrating plant to treat an estimated 180,000 tons of ore averaging 20 to 38 percent zinc, 5 to 8 percent copper, and $5 in gold and silver per ton.

As of June 13, 1942, all imported zinc spelter and zinc in blocks, pigs, bars, or rods has been exempted from customs duty. According to the Department of Munitions and Supply, approximately 95 percent of Canada's entire supply of zinc is devoted to essential and war uses, compared with 75 percent in 1941 and 36 percent in 1940.

Japan.—There are no known zinc deposits of commercial importance in Japan proper, but extensive ore bodies are reported in Chosen. Japan's estimated smelter output in 1941 was 65,000 metric tons. In April 1943 Japan captured the Bawdwin lead-zinc mines of the Burma Corporation, which are capable of supplying 45,000 (long) tons of zinc a year. During 1942 a trade agreement was made with French Indo-China in which Japan will help develop the zinc deposits in that country.

Mexico.—Mine output of zinc in Mexico increased 22 percent from 154,996 metric tons (metal content) in 1941 to 189,278 metric tons in 1942. The most important event in 1942 was the Bateman-Juarez-Tellez agreement among the Metals Reserve Company, the State Department, and the Mexican Government, whereby the Metals Reserve Company contracted to buy 200,000 tons of zinc at 8.25 cents per pound each year for the duration of the war and extendible by mutual agreement after the war. Mexico agreed to stabilize taxes on zinc, freeze freight rates, and hold in abeyance certain clauses in the labor laws. In spite of this agreement labor difficulties appeared, and at the end of the year the miners were threatening to strike for a 25-percent wage increase. On December 23 a reciprocal trade pact between Mexico and the United States reduced the duty on slab zinc and zinc in ore to 50 percent of the amount set by the United States Tariff Act of 1930. The new rate places the tariff on slab zinc at $0.875 cents a pound and zinc in ore and concentrates at $0.750 cents.

The American Smelting & Refining Co. expanded its mining operations at Xichu, Tecolote, Taxco, and San Carlos. Old zinc mines in the Taxco district are being reopened by American Smelting & Refining Co. and Eagle Picher Lead Co. The Sociedad Cooperativa Minera "El Bote," S. C. L., at El Bote is treating 400 tons of lead-zinc ore a day. Crude-ore production of five principal mines in the Chihuahua district increased in 1942 despite the fact that Potosí Mining Co. exhausted its main ore body after nearly 100 years operation. Nearly

all the cooperative mining companies reverted to private ownership and operation in 1942. It is reported that a large zinc deposit has been discovered in the Nacozari-Pilars district. The Moctezuma Copper Co. will treat the ore.

Inadequate transportation facilities have continually handicapped the movement of materials and are a limiting factor in further mine expansion.

The Federal Power Commission granted permission to export Texas natural gas to the Rosita smelter of the American Smelting & Refining Co. It is expected that this move will boost zinc production at the only zinc smelter in Mexico an additional 2,400 to 4,800 tons per year.

North Africa.—The principal zinc deposits in North Africa are in the Province of Constantine, Algeria, where the ores—calamine, sphalerite, and galena—occur chiefly as replacement deposits in limestone.

Deposits of ore are known in Tunisia north of Béja and Tunis, and south of Tunis is the Zaghouan concession containing calamine and lead ore. In this same vicinity at the Djebel Ressas concession zinc is mined in conjunction with lead. In the West lies the Sakiet-Sidi Youssef concession, south of Ghardimaou. It is reported that an electrolytic zinc plant was built in 1931 near Touireuf, but there is no record of its ever having operated. The output in Tunisia has fallen off considerably in recent years, largely owing to the depletion of known reserves.

The following table from Mineral Industries of North Africa, Special Supplement to Confidential Series 7, Mineral Trade Notes, lists the production, shipments, and stocks of zinc concentrates, in metric tons, from January 1 to May 1, 1942.

	Production	Shipments	Stocks
Tunisia	840	368	1,972
Algeria	459	4,300	13,091
Morocco	403	800	5,511

Production of concentrates, available to the United Nations since the successful conclusion of the North African military campaign late in 1942 and the first months of 1943, is reportedly being shipped to the United Kingdom for treatment.

Newfoundland.—In spite of a labor shortage that prevented capacity operations, 94,114 short tons of zinc concentrates averaging 53-percent zinc were produced in 1942. In addition 6,564 tons of zinc were recovered in lead and copper concentrates. The comparative figures for 1941 were 116,836 tons of 52-percent zinc concentrates and 8,745 tons of zinc recovered in lead and copper concentrates.

Norway.—Owing to the difficulty of obtaining raw materials, only 3,250 tons of zinc metal were produced from January to September 1942, as against 46,000 tons in the whole year of 1939. In addition to Norwegian ore some Finnish and Swedish ore was used.

Northern Rhodesia.—At Broken Hill, Rhodesia, the Rhodesian Broken Hill Development Co., Ltd., operates the most important zinc mine in Africa. The ore contains 30 to 55 percent zinc plus lead and is associated with vanadium-bearing material.

Peru.—In 1942 the mines in this country produced 51,263 metric tons of 58-percent zinc concentrates, a substantial increase over the 1941 total of 40,800 tons containing 23,700 tons of extractable zinc. Zinc mining continued to be largely controlled by the Cerro de Pasco Copper Corporation which owns a zinc deposit in central Peru containing ore reserves estimated at 10,000,000 tons containing 17 percent zinc, 6 percent lead, and 6 ounces of silver per ton. The output from the Cerro de Pasco Casapalca mine, which decreased from 15,877 tons of concentrates in 1940 to 13,550 tons in 1941, probably was smaller in 1942. This mine has a flotation plant with a daily capacity of 800 tons. The Huaron mine of the Cie de Mines de Huaron is now producing at the rate of nearly 1,270 tons of 60-percent concentrates a month. In 1943 Cerro de Pasco should finish a new 800-ton daily capacity concentrator, under construction. The smelter at Oroya produces about 800 tons of refined zinc annually which is consumed in South America. Peruvian exports in 1942 were 247 metric tons of zinc in ore, 25,220 tons in concentrates, and 942 tons of refined zinc.

Spain.—Three mines and one smelter were reported operating in 1941. Output of zinc concentrates in 1941 was estimated at 73,000 metric tons. The monthly production rate of zinc concentrates early in 1943 was between 5,500 and 6,000 tons, and the stocks on hand available for export were about 15,000 tons containing 58 percent zinc and 7,000 tons containing 52 percent zinc. The Cie Royale Asturienne des Mines enlarged its plant and installed a special furnace to produce high-grade zinc.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

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

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GENERAL SUMMARY

Activity in the pigments industry as a whole was sharply curtailed in 1942 from the rate that prevailed in 1941. This recession was due not to failure of demand but rather to restrictions in supplies of metal, scrap, and ores early in the year; to curtailment in the use of shipping drums, cans and other containers, brushes, drying oils, and other materials, as the year advanced; and also to conditions that revolutionized whole industries, such as the automobile industry—one of the principal users of pigments. Another deterring factor was the regulation of the Office of Defense Transportation requiring that all shipments by rail be in full carlots or at least up to the full marked capacity of freight cars.

Supplies of zinc and lead metal were restricted throughout the year, but as increasing amounts of lead became available from a record rate of importation, limitations regarding its use were eased in November. Large-scale production of ilmenite began in New York in August, greatly changing the outlook concerning supplies of crude materials for the competitive titanium-pigment group. As a result, restrictions on titanium pigments were lifted in December. The restrictions, nonetheless, had been responsible for what was probably the only noteworthy set-back thus far to the steady advance of this group of pigments.

Consumption of the lead oxides for storage-battery manufacture in 1942 was considerably below the record quantities used in 1941, but except for that year it was higher than ever before. The amounts of zinc oxide and lithopone used in the manufacture of rubber dropped sharply. The outlook for future needs for this purpose is clouded by inability to gage requirements for the manufacture of synthetic rubber. The use of pigments in paints also fell sharply in 1942, except for red lead, which established a new high record. Zinc sulfate for paints and varnish processing was also consumed at a new high rate. Curtailment in the use of pigments by the ceramics industry was marked. On the other hand, agricultural use of zinc sulfate established a new high record in 1942.

According to the F. W. Dodge Corporation, new building construction in 1942 attained a new high record rate, exceeding the previous

record by 25 percent. The Lumber and Lumber Products Division of the War Production Board anticipates a noteworthy reduction in the number of board feet required by the Nation in 1943 as compared with 1942, or 31,100,000,000 compared with 40,300,000,000. The peak of war construction at army cantonments, drydocks, airports, and shipyards obviously has passed. In 1942 paint materials were largely used to fill Government needs. In its January 11, 1943, issue the Oil, Paint and Drug Reporter estimated that by fall of 1942 the Government was taking approximately 60 percent of total paint materials compared with 25 percent in 1941 and 5 percent in 1940. The large proportion of steel-construction paint requirements is indicated in part by the new high-record use of red lead in paint in 1942. This pigment is the only one in the group covered by this report that showed increased use for paint manufacture; it is well-known for its use in steel-construction paints.

During and after World War I the chemical industry in the United States made great progress. Dr. J. S. Long [1] says that the American paint industry will emerge from World War II independent of the importation of basic commodities from foreign countries. Many of the new products and processes developed since the start of the war have advantages over those used before that time.

The flexibility of the paint-mixing industry will be tested further by the recent (April 1943) amendment to War Production Board Order M–71 of the Fats and Oils Section of the Department of Agriculture, which reduced this trade's quota of linseed oil and of all other drying oils not required immediately for direct war effort and not already embraced in the edible and potential food categories from 60 to 50 percent of the average 1940–41 usage for the second quarter of 1943. Original Order M–71 (effective October 1942) cut chemical and vegetable oils to 70 percent. In a mimeographed release on conservation in the use of linseed oil in paint, Hickson [2] pointed out that linseed oil is the most widely used drying oil in the paint industry and that about 79 million gallons were consumed in 1940 and about 109 million in 1941, of which 75 to 80 percent was used in the paint and varnish industry. Consumption in 1942 was considered to have been higher than in 1940. Hickson said:

> Nearly all the linseed oil used in the United States is manufactured there, but in 1940 more than one-third of the 31 million bushels of flaxseed required was imported, mainly from Argentina. Under present conditions practically no flaxseed is imported from South America. At the same time there have been new demands for the oil, in part to meet the needs of our Allies, and in part to replace other imported oils such as tung (China wood oil) and perilla oils that were used previously.

Adding to the list of paint components whose need as food material is considered greater than their desirability for paint and other industrial uses, the War Production Board has placed processed industrial casein under allocation control under Order M–307.

In connection with the container problems that developed during the year, an article by Lahey [3] probably will be of interest. Several papers on packaging problems were read at the 14th Annual Pack-

[1] Long, J. S., War Jogs Us Out of Our Complacency: Paint Industry Magazine, vol. 58, No. 4, April 1943, p. 138.

[2] Hickson, Eugene F., Conservation of Linseed Oil in Paint: Department of Commerce, Nat. Bureau of Standards Letter Circ. LC–717, February 10, 1943, 8 pp.

[3] Lahey, Richard W., Chemical Containers for the Duration: Chem. Ind., vol. 52, No. 3, March 1943, pp. 351–352.

aging Conference in New York early in April and were reviewed briefly in the April 1943 issue of Chemical Industries (p. 482).

The increasing use of fiber drums, wood barrels, glass bottles, and wood boxes, as well as the exercise of great care in handling steel drums already in use in the industry, have tended to offset container difficulties.

Recently released data on the pigments industry in Canada in 1941 show that in that year the industry was at record levels there, as well as in the United States. The following statistics on the short tons used in manufacturing in 1941 (1940 in parentheses) should be of interest: White lead (dry) 2,164 (1,642), white lead in oil 714 (648), basic sulfate white lead 111 (64), litharge 729 (492), red lead 648 (597), zinc oxide (pure) 1,589 (1,680), zinc oxide (leaded) and zinc leads 2,255 (2,087), and lithopone 10,538 (8,194).

Through the Reciprocal Trade Agreement with Mexico, signed in December, the rate of duty on zinc oxide and on leaded zinc oxide containing not more than 25 percent of lead was reduced to 1/10 cents a pound for oxide in dry form and 1½ cents a pound for that mixed with oil or water. The duty on zinc sulfate was cut to ½ cent a pound.

Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 (average) and 1938–42

	1925–29 (average)	1938	1939	1940	1941	1942
Production (sales) of principal pigments:						
White lead (dry and in oil)—short tons	154,483	100,213	98,429	80,562	113,000	83,639
Litharge—do	84,845	68,711	89,518	89,841	122,280	91,513
Red lead—do	41,362	30,183	39,976	42,200	53,838	48,369
Zinc oxide—do	154,208	79,129	114,552	113,213	148,833	99,677
Leaded zinc oxide—do	26,609	38,216	42,684	45,362	68,920	48,128
Lithopone—do	177,745	125,746	142,759	151,802	176,642	137,320
Value of products:						
All lead pigments	$60,092,000	$28,351,000	$35,485,000	$32,628,000	$46,572,000	$39,393,000
All zinc pigments	41,314,000	23,301,000	28,794,000	28,747,000	39,210,000	30,785,000
Total	101,406,000	51,652,000	64,279,000	61,375,000	85,782,000	70,178,000
Value per ton received by producers:						
White lead (dry)	178	123	138	137	147	160
Litharge	176	122	123	126	134	150
Red lead	193	137	140	141	161	171
Zinc oxide	133	117	117	118	125	138
Leaded zinc oxide	124	107	114	114	118	129
Lithopone	98	79	73	67	71	79
Foreign trade:						
Lead pigments:						
Value of exports	1,346,000	510,000	715,000	594,000	1,228,000	957,000
Value of imports	30,000	10,000	10,000	14,000	12,000	4,000
Zinc pigments:						
Value of exports	2,150,000	339,000	925,000	1,585,000	3,525,000	2,740,000
Value of imports	931,000	285,000	280,000	46,000	22,000	8,000
Export balance	2,535,000	554,000	1,350,000	2,119,000	4,719,000	3,685,000

PRODUCTION

In this report, sales are used as presenting a more accurate picture of the industry than production, partly owing to the lack of statistics covering inventories at the beginning and end of the year. One factor is that at times materials classified as one item for production have been sold later under another description. Thus, sales figures afford a more accurate measure of pigments as they go into consumption

channels. Moreover, pigments produced under one classification at a plant are sometimes employed at the plant of another company for blending into another product covered by the lead and zinc pigments canvass. To prevent duplication, the Bureau of Mines attempts to count the product only in the form in which it enters actual use. Basic lead sulfate used in the manufacture of leaded zinc oxide presents the principal problem in this connection. It is included in the statistics in this report at the leaded zinc oxide stage, at which point it enters use in paints. Some other blending is done; but it does not affect large amounts, and—insofar as possible—the duplication involved is eliminated. Production figures are employed in this report in calculating the metal content of pigments and salts in the section 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 considered here as sales.

The total value of sales of lead and zinc pigments in 1942 was 18 percent below 1941, falling from $85,782,000 to $70,178,000. It was, however, higher than in the 11 years before 1941. The higher average prices generally received for the commodities covered by this report were responsible for the smaller drop in total value as compared with that in the total quantity of the products.

Lead pigments.—In 1941 litharge, red lead, and white lead (dry) had reached new all-time peaks. The declines in these pigments, as well as in others in the lead group, in 1942 may be ascribed, in part at least, to artificial factors—those other than the actual demand. Under the influence of the heavy Government construction program red lead made the best showing of any pigment covered by this report; total sales fell only 10 percent compared with a 34-percent decline for dry white lead, the other extreme in activity among the important pigments. Sales of both red lead and litharge in 1942 exceeded those in all other years except 1941 and were 17 and 8 percent over the averages for 1925–29. White lead in oil decreased 18 percent from 1941, making a better showing than other lead pigments except red lead, but it continued below all others in its relation to other earlier years. Average values received by producers for all lead pigments showed gains in 1942 that ranged, except for the small-tonnage orange mineral, from $9 a ton for white lead in oil to $32 for blue lead sulfate. The lead-pigment group decreased 23 percent in total quantity and 15 percent in total value from 1941.

Lead pigments sold by domestic manufacturers in the United States, 1941–42

Pigment	1941			1942		
	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	8,739	$1,122,622	$128	7,229	$1,107,157	$153
Blue	1,631	211,816	130	1,181	191,811	162
Red lead	53,838	8,687,469	161	48,369	8,254,230	171
Orange mineral	246	57,516	234	128	30,643	239
Litharge	122,280	16,416,507	134	91,513	13,756,868	150
White lead:						
Dry	54,689	8,013,421	147	35,865	5,743,747	160
In oil [1]	58,311	12,062,375	207	47,774	10,308,863	216

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

Lead pigments sold by domestic manufacturers in the United States, 1938–42, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
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
1941	54,689	58,311	8,739	1,631	53,838	246	122,280
1942	35,865	47,774	7,229	1,181	48,369	128	91,513

Zinc pigments and salts.—In the zinc-pigment group leaded zinc oxide established a new high record in 1941. It dropped 30 percent in 1942 but remained above all previous years except 1941. This pigment has been increasingly popular in recent years, and another factor that permitted a better than average record in 1942 was that it was made almost entirely from ores, supplies of which were not as short as of either metal or scrap (other sources of zinc in pigments). Zinc oxide (lead-free) sales were down 33 percent from 1941. Stringent supplies of zinc metal and scrap have had a marked effect on the production of this pigment. Sales of lithopone also were lower than in 1941, having fallen 22 percent. Altogether zinc pigments decreased 28 percent in total quantity in 1942, but they dropped only 21 percent in total value because producers of all types received higher per-ton average prices.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1941–42

Pigment or salt	1941			1942		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	148,833	$18,558,474	$125	99,677	$13,746,599	$138
Leaded zinc oxide [1]	68,920	8,101,782	118	48,128	6,209,558	129
Lithopone	176,642	12,550,193	71	137,320	10,828,924	79
Zinc chloride, 50° B	(2)	(2)	(2)	52,374	2,789,430	53
Zinc sulfate	19,201	1,424,456	74	14,331	1,179,281	82

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

Zinc pigments and salts sold by domestic manufacturers in the United States, 1938–42, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
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
1941	148,833	68,920	176,642	(1)	19,201
1942	99,677	48,128	137,320	52,374	14,331

[1] Data not available.

Sales of zinc chloride totaled 52,374 tons (50° B.) in 1942. Comparable data for a number of earlier years are not available. The figures for 1942 include the equivalent zinc chloride content of chromated zinc chloride and zinc ammonium chloride sold.

Except for the high record quantity for 1941, sales of zinc sulfate were at peak levels in 1942. The total for 1942 lagged 25 percent behind 1941 which, however, was 61 percent above the previous record, attained in 1940.

CONSUMPTION BY INDUSTRIES

White lead.—Sales of dry white lead declined 34 percent from 1941, and the "in oil" variety fell 18 percent; the total was 26 percent below 1941 and 46 percent less than the 1925–29 average. The predominant use of both classes of product is in the manufacture of paints, and 92 percent was so used in 1942.

Distribution of white lead (dry and in oil) sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Paint	95,018	92,380	73,137	100,665	76,837
Ceramics	1,918	1,767	3,029	3,704	1,812
Other	3,277	4,282	4,396	8,631	4,990
	100,213	98,429	80,562	113,000	83,639

Basic lead sulfate.—Basic lead sulfate also goes mainly into paints, either directly or as a component of leaded zinc oxide. The statistics for basic lead sulfate do not include the quantity used for blending into leaded zinc oxide, the amount so used being accounted for under the latter pigment. In 1941 the use of basic sulfate in the manufacture of leaded zinc oxide reached a peak total of 12,000 tons; in 1942 it amounted to 6,000 tons.

Distribution of basic lead sulfate sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Paints	5,024	5,170	5,593	9,285	7,733
Rubber	91	140	128	200	89
Storage batteries	3	4	4	8	
Other	683	224	475	877	588
	5,801	5,538	6,200	10,370	8,410

Red lead.—This pigment receded from its peak performance in 1941 but maintained a high rate of activity in the face of more serious declines all along the line. Sales in 1942 were 10 percent below 1941 but, except for that year, were the highest ever recorded, surpassing even the heavy construction period in the prosperous twenties. An important reason for the favorable record is the performance of this pigment in construction paints. Red lead is used principally in the manufacture of storage batteries. Its use for this purpose was below the amounts so consumed in 1939, 1940, and 1941, whereas sales for paint manufacture were at new high record levels in 1942. In 1939–40 paint manufacture took 28 percent of the total red lead sold, whereas in 1941 and 1942 it took 37 and 43 percent.

Distribution of red lead sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Storage batteries	19,057	24,709	26,718	27,405	23,545
Paints	8,698	11,421	11,949	20,130	21,017
Ceramics	655	1,123	1,117	1,593	939
Other	1,773	2,723	2,416	4,710	2,868
	30,183	39,976	42,200	53,838	48,369

Orange mineral.—This pigment is produced in very small quantities. The manufacture of ink has been its principal application in recent years. Restrictions were placed on its use for this purpose by the War Production Board, limiting consumption in the second quarter of 1942 to 70 percent of that used in one quarter in 1941. The above order was withdrawn in August.

Distribution of orange mineral sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Ink manufacture	20	64	51	98	93
Color pigments	94	40	18	26	7
Other	13	27	68	122	28
	127	131	137	246	128

Litharge.—Although sales of litharge in 1942 were 25 percent less than in 1941, they were the largest on record, except for that year. Over a period of years the use of litharge in storage batteries has shown an up-trend. Its use for this purpose in 1942 was less than in 1941 but above all earlier years. Consumption of litharge in insecticides was 24 percent less than in 1941, and except for 1938 it had been exceeded in every year from 1937 to 1941, inclusive. The use in ceramics dropped 48 percent in 1942, but the quantity consumed in that year probably had not been exceeded before 1940. Chrome pigments fell 47, oil refining 29, and rubber 13 percent. Consumption of litharge in oil refining was only 4,771 tons in 1942, compared with 13,615 tons in 1929. In addition to the litharge used in the manufacture of batteries, the storage-battery manufacturers themselves make a black or suboxide of lead which they use as a substitute for litharge. Whereas the quantity so manufactured in 1942 (55,000 tons) was below the peak quantity (61,000 tons) in 1941, it equaled the former record level established in 1940. Black oxide figures are not included in the Bureau of Mines totals for litharge.

Distribution of litharge sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Storage batteries	32,514	39,754	38,303	49,847	43,630
Insecticides	11,736	16,435	16,041	19,403	14,830
Ceramics	5,889	8,679	12,072	18,285	9,525
Chrome pigments	5,590	9,415	8,456	13,927	7,344
Oil refining	6,411	7,619	6,876	6,749	4,771
Rubber	880	1,404	1,590	3,968	3,460
Varnish	2,449	2,428	3,003	3,165	3,423
Linoleum	231	226	418	647	343
Other	3,011	3,558	3,082	6,289	4,187
	68,711	89,518	89,841	122,280	91,513

Zinc oxide.—Zinc oxide production was affected adversely by the scarcity of zinc metal and scrap. Metal and scrap supplies have been restricted for several years; as a result, the proportion of zinc oxide made from ores has advanced sharply. Zinc oxide produced by the American process (from ore) accounted for 58 percent in 1936; it was 64 percent in 1940, 76 in 1941, and 84 in 1942. French process (from metal and scrap) meanwhile accounted for 42, 36, 24, and 16 percent, respectively, in those years. The proportion of French-process oxide made from scrap has also been on the up-trend. It amounted to 22 percent in 1936 and 45 in 1940 and 1941 but dropped back to 40 in 1942.

Total zinc oxide sales declined 33 percent in 1942, the amounts sold for use in rubber and ceramics showing the most severe drops. The paint class performed better than all others.

Supplementary Order M–11–a was amended in May 1942 (effective June 1) to read that each producer of zinc oxide shall set aside from his production each month quantities to be determined from time to time by the Director of Industry Operations, the remainder to be distributed so that each customer would receive an equal percentage of the producer's commitments to him. For some time no zinc oxide has been set aside because of an excess already in the pool.

Distribution of zinc oxide sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Rubber	46,266	70,187	70,979	90,429	52,717
Paints	20,884	25,334	23,268	30,304	25,122
Floor coverings and textiles	3,030	5,641	4,752	6,991	5,224
Ceramics	4,908	6,572	6,352	8,596	2,934
Other	4,041	6,818	7,862	12,513	13,680
	79,129	114,552	113,213	148,833	99,677

Leaded zinc oxide.—Sales of leaded zinc oxide declined 30 percent in 1942, which was almost as severe as the drop in sales of zinc oxide (lead-free). On the basis of long-time trends, however, it has fared far better than the lead-free class. Except for 1941, the leaded group was higher than in any other year and was 81 percent above the annual average for 1925–29. The lead-free class, on the other hand, was 35 percent below the 1925–29 average. Leaded zinc oxide is made entirely from ores, and although these supplies were not abundant they were notably larger than those for metal and scrap. Paint consumes virtually all of the leaded zinc oxide made. The figures for leaded zinc oxide include basic lead sulfate used in blending as indicated under "Basic lead sulfate."

Distribution of leaded zinc oxide sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Paints	37,348	41,519	44,341	67,472	47,052
Rubber		1		1	
Other	868	1,164	1,021	1,447	1,076
	38,216	42,684	45,362	68,920	48,128

Lithopone.—Lithopone statistics are reported on the basis of the regular lithopone content of high-strength lithopone plus normal lithopone sold as such. Lithopone sales in 1942 held up better than

the average for the zinc-pigment group, having fallen 22 percent from 1941; sales for the year 1941 were close to the level for the 1925–29 period. The distribution of lithopone for paints—the principal use—dropped 18 percent in 1942 but was above the record for the total; sales for floor coverings and textiles were 25 percent lower and rubber 70 percent lower. Based on somewhat incomplete information, separation of the 1942 quantities shown in the following table for floor coverings and textiles indicates that 9,600 tons were used for linoleum and felt-base floor coverings and the remainder for coated fabrics and textiles (oil cloth, shade cloth, artificial leather, and similar products). Other sales in 1942 included 3,423 tons for paper and 555 (incomplete) for printing ink. Figures for an additional quantity for printing ink cannot be separated from the totals for paints. The principal item under "other" uses covers exports. One company, at least, has classified part of its exports according to the end use so that the "other" class is too small to cover total exports.

Plant capacity for the production of lithopone was reported to total 182,000 tons at the end of 1942, unchanged from 1941.

Order M–128 of the War Production Board, issued in May 1942, provided for the establishment of a monthly producers' pool in zinc sulfide pigments, of which lithopone is the chief one. By the time the order had been completed, however, the situation had eased, and virtually no use was made of the power provided. The order is being kept on the books should it be needed.

Distribution of lithopone sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Paints, etc.	101,924	113,995	[1] 117,075	[1] 132,691	[1] 109,216
Floor coverings and textiles	15,400	17,429	18,738	21,114	15,775
Rubber	3,148	3,189	3,387	3,547	1,047
Other	5,274	8,146	12,602	19,290	11,282
	125,746	142,759	151,802	176,642	137,320

[1] Includes a quantity, not separable, used for printing ink.

The consumption of ordinary-strength lithopone in the manufacture of titanated lithopone (which usually contains 15 percent TiO_2) reached a peak in 1937, when 19,400 tons were so used; this use took only about half of the record amount, or 9,900 tons in 1942. The lithopone figures in the following table are included in the totals for ordinary lithopone in the preceding table.

Titanated lithopone produced in the United States and ordinary lithopone used in its manufacture, 1938–42, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1938	20,100	17,000	1941	16,800	14,100
1939	16,100	13,700	1942	11,700	9,900
1940	18,100	15,200			

Zinc sulfide.—In recent years as many as four plants have reported production of zinc sulfide, but one company has always dominated the production. For that reason the Bureau of Mines is not at liberty to publish the figures for this pigment. Only this one company produced in 1942.

Zinc chloride.—Sales of zinc chloride, in terms of 50° B. solution, totaled 52,374 tons in 1942. These figures include the zinc chloride equivalent of zinc ammonium chloride and chromated zinc chloride produced. Comparable data for recent earlier years are not available.

Zinc sulfate.—Although sales of zinc sulfate declined 25 percent from 1941, they were the highest ever recorded, except for that year. One reason for the recent records for this salt is its increasing use for agricultural purposes. This use made noteworthy gains in 1942 as against the declines in most other uses. Much less zinc sulfate was consumed in the manufacture of rayon, chemicals, and glue in 1942 than in 1941, but the amounts so used compared favorably with other years. Consumption of zinc sulfate in paint and varnish processing has been increasing rapidly in recent years, and it reached new heights in 1942 when it rose 35 percent over 1941. Its use as a flotation reagent has also been gaining.

The large quantity of zinc sulfate produced as an intermediate product in the manufacture of lithopone is excluded from the zinc-sulfate statistics.

Distribution of zinc sulfate sales, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Agriculture	1,664	2,168	2,366	3,038	4,123
Rayon	2,851	3,897	3,649	5,170	3,149
Chemicals	947	1,309	2,151	5,555	2,595
Paints and varnish processing	656	583	1,509	1,422	1,917
Glue	285	172	320	1,203	750
Flotation reagent	63	266	241	312	355
Electrogalvanizing	284	556	348	502	219
Textile dyeing and printing	59		54	130	60
Other	948	1,206	1,299	1,869	1,163
	7,757	10,157	11,937	19,201	14,331

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND ZINC 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 1942, 93 percent of the lead pigments was derived from pig lead and 7 percent from ore. A small part of the ore used was foreign. The proportion for zinc pigments in 1942 was 79 percent from ore, 6 percent from slab zinc, and 15 percent from secondary materials; 9 percent of the ore used was foreign.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1941–42, by sources, in short tons

Source	1941		1942	
	Lead in pigments [1]	Zinc in pigments	Lead in pigments [1]	Zinc in pigments
Ore:				
Domestic	23,951	129,520	15,949	103,445
Foreign	290	2,464	707	9,636
Metal	248,674	15,463	206,680	8,252
Secondary material [2]	400	31,703	2	21,663
	273,315	179,150	223,338	142,996

[1] Includes also lead recovered in 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 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 most of that in zinc chloride made in the United States are derived from secondary material. A decided increase has been noted in the quantity of secondary zinc consumed in the manufacture of zinc oxide since 1933. The scarcity of zinc metal and scrap in 1942 caused declines in the proportions of zinc oxide made from these two materials in that year.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1941–42, by sources, in short tons

Pigment	1941					1942				
	Lead in pigments produced from—				Total lead in pigments	Lead in pigments produced from—				Total lead in pigments
	Ore		Pig lead	Secondary material		Ore		Pig lead	Secondary material	
	Domestic	Foreign				Domestic	Foreign			
White lead			86,750		86,750			73,757		73,757
Red lead			47,615		47,615			45,228		45,228
Litharge			112,099		112,099			86,667		86,667
Orange mineral			172		172			81		81
Basic lead sulfate	6,122		1,126	400	7,648	4,760		827		5,587
Leaded zinc oxide	17,829	290	912		19,031	11,189	707	120	2	12,018
	23,951	290	248,674	400	273,315	15,949	707	206,680	2	223,338

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1941–42, by sources, in short tons

Pigment or salt	1941					1942				
	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
	Ore		Slab zinc	Secondary material		Ore		Slab zinc	Secondary material [1]	
	Domestic	Foreign				Domestic	Foreign			
Zinc oxide	87,999	373	15,435	12,826	116,633	74,289	313	8,247	5,585	88,434
Leaded zinc oxide	27,508	2,091		1,469	31,068	19,687	5,555		328	25,570
Lithopone	14,013		28	17,408	31,449	9,469	3,768	5	15,750	28,992
Zinc sulfide	[2]				[2]	[2]	[2]			[2]
Zinc chloride	[2]		[2]	[2]	[2]			10	11,777	11,787
Zinc sulfate	2,831			2,840	5,671	671	1,250	36	2,151	4,108

[1] These figures are higher than those shown in the report on Secondary Metals—Nonferrous because they include zinc recovered from byproduct sludges, residues, etc., not classified as purchased scrap material.
[2] Data not available.

PRICES

The total and average values reported by producers for lead and zinc pigments are given in the tables in the first part of this report. For all of the lead pigments average values were $9 to $32 a ton higher than in 1941; the small-tonnage orange mineral gained $5. All of them were at their lowest points for the year in January, which coincided with the highest levels attained in 1941. For each pigment, except basic lead sulfate (white), the gains in 1942 amounted to ¾ cent a pound. In general, the high points were reached in the first 2 months, and prices continued at these levels for the remainder of the year and beyond. Litharge did not reach a peak until June. Basic sulfate (white) advanced ¾ cent in April and dropped back ¼ cent in July.

Pig lead, price changes for which are usually followed closely by those for lead pigments, was under ceiling price limitations beginning January 1942. The ceiling price for common lead, delivered New York, was 6.50 cents a pound. Corroding lead and chemical lead were allowed premiums of 0.10 cent a pound.

Average values reported for all zinc pigments sold were also higher in 1942, the gains ranging from $13 a ton for zinc oxide to $8 for lithopone. The average value for zinc sulfate rose $8 a ton in 1942. The voluntary price ceilings on zinc oxide agreed to by producers, following requests in December 1941 from the Office of Price Administration, were given in the chapter of this series for 1941. On the whole, prices throughout 1942 were ¾ cent a pound above those of the previous year. Late in March negotiations were carried on to increase the voluntary ceilings on leaded zinc oxide containing 35 percent or more lead to 7 cents a pound. The proposed increase was caused by advances in the price of basic sulfate, a basic ingredient of leaded zinc oxide. Later in the month the sweeping General Maximum Price Regulation gathered all grades of zinc oxide among other chemicals, oils, paints, and other commodities under its provisions. Prices under the Regulation were not to exceed the highest ones prevailing in March 1942. In June the Office of Price Administration established the maximum price of 7 cents a pound for the leaded grade mentioned above, effective June 22. Later the effective date was moved back to May 11. A premium of ¼ cent a pound was permitted for delivery of oxide in barrels, another ¼ cent for delivery of less than carlots, and an additional ½ cent for delivery in less than carlots to consumers in California, Oregon, or Washington. Price Schedule 80 of the Office of Price Administration, effective February 2, 1942, set a maximum price of 4.25 cents a pound for the normal grade of lithopone.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1939–42, in cents per pound

Product	1939	1940	1941	1942
Basic lead sulfate, or sublimed lead, less than carlots, barrels	6.25– 6.50	6.25– 6.75	6.50– 7.00	7.00– 7.75
White lead, or basic lead carbonate, dry, carlots, barrels	7.00	7.00– 7.50	7.50	7.50– 8.25
Litharge, commercial, powdered, barrels	6.25– 7.75	6.25– 8.25	7.00– 8.25	7.35– 9.00
Red lead, dry, 95 percent or less, less than carlots, barrels	7.75– 9.00	7.75– 9.25	8.50– 9.25	8.75–10.00
Orange mineral, American, small lots, barrels	10.25–11.25	10.25–11.75	11.00–11.75	11.25–12.50
Zinc oxide:				
American process, lead-free, bags, carlots	6.25– 7.50	6.25– 7.50	6.50	7.25
American process, 5 to 35 percent lead, barrels, carlots	6.25– 6.38	6.25– 6.75	6.25– 6.75	7.00– 7.38
French process, red seal, bags, carlots	7.50	7.50– 7.75	7.75	8.50
French process, green seal, bags, carlots	8.00	8.00– 8.25	8.25	9.00
French process, white seal, barrels, carlots	8.75	8.75– 9.00	9.00	9.75
Lithopone, domestic, 5-ton lots, bags	4.00– 4.38	3.85– 4.00	4.10	4.50
Zinc sulfide, less than carlots, bags, barrels	7.75– 8.88	7.75– 8.00	8.00– 8.25	8.50– 8.75
Zinc chloride, works:				
Solution, tanks	2.25	2.25	2.25– 2.50	2.50
Fused, drums	4.25– 5.75	4.25– 5.75	4.25– 6.50	5.00– 6.50
Zinc sulfate, crystals, barrels	2.90– 3.65	2.90– 3.90	3.15– 4.40	3.65– 4.60

FOREIGN TRADE [4]

All of the most important items in foreign trade in lead and zinc pigments are in the export classification and cover white lead, red lead, litharge, zinc oxide, and lithopone. Except for the items specified, foreign trade in lead and zinc pigments has little significance. Exports of all of the important pigments in 1942 declined sharply from the previous year but compared favorably with the years immediately preceding 1941. Available data on imports and exports appear in the following tables.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1941–42

	1941		1942	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$389	$419,630		$392,812
Red lead	250	437,786	$182	257,921
Litharge		370,934	432	289,940
Orange mineral		(1)		1,887
Other lead pigments	11,694	(1)	3,221	14,600
	12,333	1,228,350	3,835	957,160
Zinc pigments:				
Zinc oxide	19,756	1,446,157	6,128	1,001,248
Lithopone	9	2,079,229		1,732,898
Zinc sulfide	1,866	(1)	1,677	6,328
	21,631	3,525,386	7,805	2,740,474
Lead and zinc salts:				
Lead arsenate		871,985		73,312
Other lead compounds	3,034	(1)	2,006	(1)
Zinc chloride		(1)		42,674
Zinc sulfate	8,204	(1)	18,585	53,624
Other zinc salts and compounds	(1)	(1)	(1)	76,023
	11,238	871,985	20,591	245,633
Grand total	45,202	5,625,721	32,231	3,943,267

[1] Data not available.

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

Lead pigments and salts imported for consumption in the United States, 1938–42

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	[redacted]ge[redacted]ral	Lead compounds	
1938	20	1	1	2	85	[1] $22,644
1939	11	2	----	1	104	[1] 28,248
1940	2	----	[2]	1	----	[1] 13,969
1941	2	3	----	----	17	[1] 15,367
1942	----	2	2	----	11	[1] 5,841

[1] Includes also—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., $13,571 (71,148 pounds); 1941: Suboxide of lead, n. s. p. f., $11,694 (65,268 pounds); 1942: Suboxide of lead, n. s. p. f., $3,221 (13,228 pounds).
[2] Less than 1 ton.

Lead pigments and salts exported from the United States, 1938–42

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
1938	1,411	806	1,694	[1]	[1]	511	$605,075
1939	2,024	1,324	2,077	[1]	[1]	856	875,235
1940	1,360	1,336	1,586	[1]	[1]	1,450	836,230
1941	2,901	2,966	2,892	[1]	[1]	4,797	2,100,335
1942	2,249	1,391	1,999	7	95	296	1,030,472

[1] Not compiled on an annual basis prior to 1942.

Zinc pigments and salts imported for consumption in the United States, 1938–42

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
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
1941	122	11	[1]	1	----	162	29,835
1942	13	1	----	1	----	362	26,390

[1] Less than 1 ton.

Zinc pigments and salts [1] exported from the United States, 1938–42

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1938	1,163	1,734	$339,415	1941	8,264	21,527	$3,525,386
1939	3,485	4,845	925,468	1942	6,013	17,036	[2] 2,912,795
1940	3,239	14,298	1,584,667				

[1] Zinc salts not separately recorded on an annual basis prior to 1942.
[2] Includes also: Zinc sulfide $6,328 (37,691 pounds); zinc chloride, $42,674 (648,343 pounds); zinc sulfate, $53,624 (1,025,554 pounds); other zinc salts and compounds, $76,023 (592,029 pounds).

GOLD, SILVER, COPPER, AND LEAD IN ALASKA

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY OUTLINE

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SUMMARY

Gold recovered from Alaska ores and gravels in 1942 totaled 487,621 fine ounces valued at $17,066,735, compared with 695,467 ounces valued at $24,341,345 in 1941. The value of the gold in 1942, as in 1941, was 99 percent of the total gross value of the gold, silver, copper, and lead produced. The silver, lead, and copper produced were byproducts of gold mining. The number of producing lode mines decreased from 56 in 1941 to 38 in 1942, floating connected-bucket dredges from 47 to 31, and other types of placer operations from 752 to 422.

The outbreak of the war in December 1941 affected Alaska mining enterprises, both large and small, in several ways and, in a broad sense, is virtually responsible for the decrease in metal output of Alaska lode and placer mines. The threat of enemy invasion prompted the expenditure of hundreds of millions of dollars for highways, airfields, pipe lines, Navy bases, Army cantonments, and other construction necessary for the defense of the Territory. The high wages offered laborers on these projects lured many mining men from their positions at the mines and created a serious labor shortage which closed several of the lode mines, kept certain dredging operations from opening in 1942, and forced all mining operations to work short-handed. Dragline operators whose property remained closed or who were unable to finish the 1942 season had no trouble in disposing of their equipment to contractors on Government defense projects.

War Production Board Gold Mining Limitation Order L–208, coming as it did on October 8, had very little effect on metal production in Alaska in 1942, inasmuch as the mining season for all placer mines and dredges and most lode mines usually ends in November. The full brunt of the order will be felt in 1943. All dredging except the Goodnews Bay platinum operations has ceased for the duration of the war. Only three important lode mines were active the first half of 1943, and these were permitted only under limited reprieves.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for overquota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for overquota production.
[5] $0.64646464.
[6] $0.67878787.
[7] $0.71111111.

The following tables show the mine production of gold, silver, copper, and lead in Alaska in 1938–42 and 1880–1942 in terms of recovered metals; the output of gold and silver in 1942, by types of operation; and the output of gold, silver, copper, and lead from amalgamation and cyanidation mills (with or without concentration equipment) in 1942, by regions.

Mine production of gold, silver, copper, and lead in Alaska, 1938–42, and total, 1880–1942, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
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
1941	695,467	24,341,345	191,522	136,193
1942	487,621	17,066,735	119,704	85,123
1880–1942	25,639,651	610,402,387	19,682,372	14,000,794

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
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
1941	144,000	16,992	1,324,000	75,468	24,569,998
1942	44,000	5,324	830,000	55,610	17,212,792
880–1942	[1] 685,830	226,554,306	[1] 24,556	2,710,631	853,668,118

[1] Short tons.

Mine production of gold and silver in Alaska in 1942, 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		
				1942	1941		1942	1941	
Lode mines	38	[1] 2,816,668	137,499	28	29	68,798	57	65	$4,861,388
Floating connected-bucket dredges	31	[2] 15,684,520	249,868	51	44	34,695	29	20	8,770,052
Placers (dragline and dry-land dredges, hydraulic, drift mining, and sluicing)	[3] 422	[4]	100,254	21	27	16,211	14	15	3,520,418
	491		487,621	100		119,704	100		17,151,858
Total, 1941	855		695,467		100	191,522		100	24,477,538

[1] Short tons of ore.
[2] Cubic yards of gravel (average recovered per yard, $0.56).
[3] Includes all types and sizes of placer operations, excluding floating connected-bucket dredges.
[4] Cubic yards of gravel; figures not available.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Alaska in 1942, by regions, in terms of recovered metals

Region	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)
Cook Inlet-Susitna	32,389	30,705	1,628	1,119	6,844	573	4,200	100
Copper River	1,420	1,703	359	88	353	106	200	
Kenai Peninsula	587	554	154	2	40	28		160
Kuskokwim	[1]	148	35					
Southeastern Alaska	2,770,434	68,094	16,780	1,586	14,353	44,196	37,437	798,849
Yukon River Basin	10,054	14,100	2,972	67	378	469		1,100
	2,814,884	115,304	21,928	2,862	21,968	45,372	41,837	800,209
Total, 1941	4,443,260	165,530	31,823	3,963	33,451	81,697	78,901	1,322,131

[1] Less than ½ ton.

Gold.—Floating connected-bucket dredges recovered 51 percent of the total Alaska output of gold in 1942 compared with 44 percent in 1941. The United States Smelting, Refining & Mining Co., operating seven dredges in the Fairbanks district and two in the Nome district, was the largest producer of gold from this source in the Territory in both years. Placer mines worked by dragline and dry-land dredges, bulldozers, and hydraulic giants, drifting, and sluicing together yielded 21 percent of the total gold in 1942 compared with 27 percent in 1941. A large part of the output from these types of operations came from the Fairbanks, Circle, Council-Bluff, Iditarod (Flat), Fairhaven, Tuluksak-Aniak, and Nome districts. Lode mines contributed 28 percent of the total Alaska output of gold in 1942 compared with 29 percent in 1941. The Alaska Juneau Gold Mining Co. continued to be much the largest producer of lode gold in Alaska.

Silver.—All the silver produced in Alaska in 1942 was a byproduct of gold mining.

Copper.—The output of recoverable copper in Alaska in 1942 came from dry and siliceous ores.

Lead.—Most of the recovered lead output of Alaska in 1942 came from lead concentrates produced at the flotation mill of the Alaska Juneau Gold Mining Co.

MARKETS AND METALLURGY

About 95 percent of the gold and 61 percent of the silver produced from Alaska ores and gravels in 1942 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. The largest purchasers (or agents) of gold-silver bullion in the Territory and in Seattle (Wash.) in 1942 were: The Bank of Alaska, Anchorage; the Bank of Fairbanks and the First National Bank of Fairbanks, Fairbanks; the First National Bank of Valdez, Valdez; the Miners and Merchants Bank of Alaska, Nome; the Miners and Merchants Bank of Iditarod, Flat; and the Northern Commercial Co., Seattle, Wash. The bullion purchased 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 operations.

Ore-dressing mills active in Alaska in 1942 included the 12,000-ton Alaska Juneau amalgamation-table concentration-flotation mill and and approximately 31 other mills, chiefly amalgamation or cyanidation plants, a few of which have some other supplementary concentrating equipment. With the exception of the Alaska Juneau, no mill had a daily capacity of over 75 tons. Virtually all the lead concentrates produced in 1942 were obtained from concentration by flotation of the dry gold ore of the Alaska Juneau Gold Mining Co. property at Juneau. Most of the small output of copper also came from lead concentrates produced at the Alaska Juneau property. Shipments of concentrates from amalgamation or cyanidation mills having concentrating equipment averaged 7.68 ounces of gold and 15.85 ounces of silver to the ton; concentrates from straight concentration mills averaged 1.58 ounces of gold and 10.54 ounces of silver to the ton. Many mills reported mill heads averaging more than 1 ounce of gold to the ton.

Bullion of Alaska origin deposited at United States Assay Office, Seattle, Wash., during year ended December 31, in fine ounces

1941

District	Gold	Silver [1]	District	Gold	Silver [1]
Circle	16,497	1,775	Kuskokwim	27,323	3,289
Cook Inlet	49,457	4,616	Nome	133,034	14,418
Copper River	7,322	1,205	Southeastern Alaska	106,180	24,139
Eagle	3,252	6,921	Tanana [2]	207,740	32,796
Iditarod	73,652	4,664			
Koyukuk	5,956	774		630,413	94,597

1942

Region	Gold	Silver	Region	Gold	Silver
Cook Inlet-Susitna	35,611	2,500	Seward Peninsula	68,116	7,723
Copper River	3,761	565	Southeastern Alaska	71,069	17,309
Kenai Peninsula	12	3	Yukon River Basin	268,579	42,370
Kuskokwim	16,543	1,666			
				463,691	72,136

[1] Revised figures.
[2] Includes manily 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 Iliamna, Valdez Creek, Willow Creek, and Yentna-Cache Creek districts, produced 27 percent of the total gold output from lode mines in Alaska in 1942. There were 7 producing lode mines compared with 10 in 1941.

The Alaska-Pacific Consolidated Mining Co., operating the Independence, Martin, Free Gold, and Ready Bullion mines near the head of Fishhook Creek in the Willow Creek district, continued to be the largest producer of gold in the Cook Inlet-Susitna region and the second-largest producer of lode gold in Alaska. The company 72-ton amalgamation-flotation mill and sorting plant were operated at capacity 7 days a week throughout the year. The ore treated averaged 1.34 ounces of gold and 0.48 ounce of silver to the ton. Because the ore contains scheelite, the War Production Board in November issued a special permit which enabled the company to continue its gold operations until midsummer of 1943. At that time, the exact quantity of scheelite will have been determined and necessary alterations for its recovery will have been made in the mill. The new installation will include 2 sand tables, slime decks, and 16 flotation cells. As the tailings assays from the gold-recovery operations show a scheelite content of 0.5 to 2½ percent, the mill procedure will be first to recover the gold, the tailing to be treated subsequently on tables and finally by flotation to produce tungsten concentrates.

The Willow Creek Mining Co. operated its Lucky Shot, War Baby, and Gold Bullion mines and 60-ton amalgamation-flotation-cyanidation mill on Craigie Creek, 22 miles north of Wasilla, until September 1942, when it ceased operations because of an acute shortage of labor. Methods of ore treatment are described in the Alaska chapter of Minerals Yearbook, 1941.

Other lode-gold producers in the Cook Inlet-Susitna region were the Fern Gold Leasing Co., operating its Fern and Talkeetna group of mines and 30-ton amalgamation-flotation mill; and the Gold Cord Mining Co., operating the Gold Cord lode and 20-ton amalgamation-flotation mill, and Gold Zone Mine, Inc., both of which closed in August because of labor shortage.

Placer operations, using principally hydraulic giants, continued to recover gold from stream and bench gravels. Placer production in the Yentna-Cache Creek district came from property around the Dutch and Peters Hills, part of the southern foothills of the Alaska Range. The productive placer creeks flowing from these hills are tributaries of Peters, Cache, or Granite Creeks. Among the larger producers of placer gold in the district were the Fairview Mining Co., C. M. Reeve & Son, Falls Creek Mining Co., and Talkeetna Mines, Inc. In the Valdez Creek district John E. Carlson worked several placers on Valdez Creek.

Copper River region.—The Copper River region includes the Chistochina, Nelchina, Nizina, Prince William Sound, and Yakataga (including Icy Bay) districts. Cliff Goldmines, Inc., operated the Cliff mine and 24-ton amalgamation-gravity concentration mill on Valdez Bay, 10 miles west of Valdez, until October, when operations ceased owing to inability to obtain sufficient supplies, equipment, and labor. Improvements at the mine in 1942 included installation of an electric hoist, a ventilating fan on the 500-foot level, and a telephone

communication system servicing all sections of the mine. In 1942 the property produced bullion yielding 1,617 fine ounces of gold and 338 fine ounces of silver, and 51 tons of gold-silver concentrates containing 78 ounces of gold and 22 ounces of silver. Other producers of lode gold included the Sun Ray Mining Co. and Don C. Preston, both operating in the Prince William Sound district. Yellow Band Gold Mines, Inc., was unable to open its property in the Nizina district in 1942 because of the War Production Board amendment to Order P–56 depriving gold and silver mines of an effective priority rating for obtaining equipment and supplies.

Placer gravels were worked in the Copper River region in 1942 chiefly by hydraulicking and ground sluicing. Larger placer-gold producers included Chititu Mines in Rex Gulch and Dan Creek Placer Mines, Inc., on Dan Creek 25 miles east of McCarthy in the Nizina district.

Kenai Peninsula region.—The Kenai Peninsula region includes the Moose Pass-Hope, Nuka Bay-Homer, and Turnagain Arm-Girdwood districts. Most of the output of lode gold in the Kenai Peninsula region came from the Marigold and Gilpatrick mines near the divide between Quartz and Canyon Creeks in the Moose Pass-Hope district; the Paystreak mine in the Nuka Bay-Homer district; and the Crow Creek Gold Corporation property at the head of Crow Creek in the Turnagain Arm-Girdwood district. Among the producing placers were the Hope Mining Co. on Resurrection Creek and Stetson Placers, Inc., on Stetson Creek in the Moose Pass-Hope district.

Kuskokwim region.—The Kuskokwim region includes the Bethel, Goodnews Bay, McGrath, and Tuluksak-Aniak mining districts. A clean-up of the mill at the Nixon Fork mine, owned and operated by Mespelt & Co., produced a small quantity of gold bullion, which was sold to the Seattle Assay Office.

In the Goodnews Bay district, the Goodnews Bay Mining Co., dredging for platinum, operated its dredge (equipped with 92 8-cubic foot buckets) on Salmon River from April 25 to November 10. The company also produced platinum from its dragline operations on Salmon River. The New York Alaska Gold Dredging Co. operated its two floating connected-bucket dredges (one with 4-cubic foot buckets and the other with 2½-cubic foot buckets) from May 9 to November 14 at its consolidated group of placer claims on upper Tuluksak River in the Tuluksak-Aniak district.

Larger producers of placer gold from dragline land dredge operations included the Marvel Creek Mining Co. and Garrison Co. in the Tuluksak-Aniak district.

Northwestern Alaska region.—A small quantity of placer gold was recovered by sluicing on the Kobuk River in 1942.

Seward Peninsula region.—Mining in the Seward Peninsula region—comprising the Council-Bluff, Fairhaven, Kougarok, Koyuk, Nome, Port Clarence, and Serpentine River districts—was confined to the recovery of placer gold. The region had 14 floating connected-bucket dredges in 1942 (compared with 22 in 1941) and numerous bulldozer, hydraulicking, dragline land dredging, drift mining, and ground-sluicing operations. A total of 4,228,071 cubic yards of gravel containing 52,528 fine ounces of gold and 5,960 fine ounces of silver was handled by the dredges of the region. The average value of the gravel worked by dredges was about 44 cents per cubic yard compared with 47 cents in 1941.

The United States Smelting, Refining & Mining Co., in the Nome district, was again the largest producer of gold in the region. The company operated two electrically powered Yuba dredges (one with 134 and one with 112 9-cubic foot buckets) from May 26 to October 15. Gravel washed in 1942 totaled 2,413,450 cubic yards compared with approximately 4,000,000 in 1941.

Arctic Circle Exploration, Inc., operated two dredges, each with 70 4-cubic foot buckets, on Candle Creek in the Fairhaven district and again ranked second in production of gold in the region.

Lee Bros. Dredging Co., third-largest producer of placer gold in the region, operated two Diesel-powered floating connected-bucket dredges (one with 74 and one with 66 buckets) on the Solomon River in the Nome district from June to October.

Castleton & Keenan operated a Washington Iron Works Diesel-powered dredge equipped with 85 2¼-cubic foot buckets on the Kougarok River in the Kougarok district from May 15 to October 6.

Other companies operating floating connected-bucket dredges in the Seward Peninsula region were: The Alaska Placer Co., Camp Creek Dredging Co., and Inland Dredging Co., all in the Council-Bluff district; Dry Creek Dredging Co. and Forsgren Dredging Co., both operating on the Inmachuk River in the Fairhaven district; Fox Bar Dredging Co. in the Kougarok district; and Casa de Paga Gold Co. on Beaver Creek in the Nome district.

Larger producers of gold from placers worked by hydraulic giants, with some additional combination of bulldozers, draglines, and pumping equipment, were: Crabtree & Sullivan in the Council-Bluff district; Mud Creek Mines in the Fairhaven district; Castleton & Keenan, Dahl Creek Mining Co., Gold Bullion, Inc., and Grant Mining Co., all in the Kougarok district; B. F. Gillette, Gabe Johnson & Co., and E. W. Quigley in the Nome district; and Frank L. Rice and Gilbert Fidjeland in the Port Clarence district.

Southeastern Alaska region.—Southeastern Alaska—including the Admiralty Island, Chichagof Island, Hyder, Juneau, Ketchikan, and Windham Bay districts—produced 60 percent of the total lode gold and most of the silver, copper, and lead output of Alaska as a whole in 1942. There were 12 active mines in 1942 compared with 16 mines in 1941.

The Alaska Juneau was the largest producer of silver and lead and was second only to the United States Smelting, Refining & Mining Co. in output of gold in Alaska in 1942. In the Twenty-Eighth Annual Report of the Alaska Juneau Gold Mining Co., for the year ended December 31, 1942, the president's report (dated March 4, 1943) says—

> On October 8, 1942, there was issued by the War Production Board in Washington, "Limitation Order L–208," the purpose of which was to close down "in the shortest possible time" all "nonessential mine" operations, with particular reference to gold mines. The purpose of the order was the freeing of labor for use in mining those metals needed for war purposes. There were certain exceptions embraced in the order which made it possible for the Alaska Juneau mine to continue operating on a limited scale. It so happens also that your company's operations, taken as a single unit, are of such value in the supplying of many indispensable services to the Juneau community and to the military and naval forces located therein, as to far outweigh any benefits that might arise through their discontinuance. The release of manpower contemplated by the order could only be small for the reason that our crew has already become reduced from a normal

full production working crew of about 1,000 men to the present crew of 350 men, the employees having been drawn away by higher wages offered in the war industries than the company can afford to pay.

With this curtailed crew it is still possible to make a small operating profit. It may be considered, of course, that operation at this reduced capacity is merely a matter of exhausting our ore reserves to no point, but as against this view it must be considered that a complete shut-down would not only involve a very considerable standby expense but would also result in the loss of many of our key men whose training, experience, and general efficiency is a highly essential factor in the successful operation of the Alaska Juneau mine. If, for some reason arising out of the present emergency, mining had to be discontinued altogether, then resumption at a later date with a crew of men green to the operation and unacquainted with each other, would have a decided adverse effect on the smooth and efficient handling of the property. From all points of view, therefore, it is most fortunate that the operations have been continuous throughout even on a limited scale; although, as far as can now be foreseen, there will be no change in the situation until the present emergency has terminated.

There has been no important change in the mine or in the plant during the past year as, owing to the scarcity of labor, no new work of any kind has been undertaken; in fact, the operations have consisted of merely marking time with all effort being made to prevent an operating loss.

As was stated in the annual report for last year, there has been an attempt made to find profitable mining ventures in the strategic minerals field, and, while much work was done in this direction and many properties examined, nothing worth while has been found. This exploratory work, however, still continues.

During the year some plans were entered into with the Metals Reserve Co., an agency of the Federal Government, for the treatment of Alaska chrome ores in our mill at Juneau, but upon investigation they have decided that the physical obstacles involved did not justify going ahead with these plans, particularly in view of the large increase in the production of chrome from other sources where conditions for cheap operations were much more favorable.

The general superintendent's report (dated February 1, 1943) says—

The present war has greatly interfered with the operation of the mine. During the year 1942, the amount of rock trammed from the mine was 2,765,190 tons as compared to the previous year's output of 4,354,770. The difference represents a decrease of about 4,400 tons per day on the average. The North ore body furnished 20 percent of the year's tonnage, the South ore body 23 percent, while the Perseverance division of the mine supplied 57 percent of the total.

During the year 235,750 pounds of powder were used in blasting powder drifts, or 0.09 pound per ton trammed. Total powder consumption for primary and secondary breaking was 0.28 pound per ton trammed in 1942, as against 0.29 pound in 1941 and 0.32 pound in 1940. This gives a tonnage ratio of 3.55 tons of ore per pound of powder in 1942, as against 3.45 tons in 1941.

The past year also saw a great reduction in the amount of development and preparatory mining work. During the year, however, the main haulage level on 13 level in the Deep North ore body was completed between the main shaft and the principal oreway. All exploratory work has been discontinued.

In June the operation of the mine and the mill was reduced from three shifts per day to two shifts per day. In December, however, the mill was again operated on all three shifts, mainly in order to make more efficient use of the company's hydroelectric power and to conserve fuel oil.

Construction work.—The only construction work of importance during the year was that done in connection with a plan for the beneficiation of chrome ore in our mill. This work consisted of building conveyors, aerial tramway, bins, etc.

Labor.—All during the year there was a great shortage of both skilled and unskilled labor in the various departments. The labor turn-over was high, and the actual loss of employees was great. The number of employees at the beginning of the year was 866 as against 478 at the end of the year. The average labor turn-over for the year was over 100 percent.

In May 1942, wage increases amounting to about 12 percent were incorporated into the agreement with the Juneau Mine & Mill Workers Union.

The average wage per day in 1942 was $7.67 as against $7.17 in 1941.

The overall cost per man per day was $11.93 in 1942, as compared to $11.14 in 1941.

Gold content of ore from Alaska Juneau mine, 1938–42, and total, 1893–1942

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	
1938	2,478,928	2,184,952	0.0515	0.0081	0.0090	0.0071	0.0398
1939	2,377,718	2,270,342	.0454	.0088	.0083	.0066	.0352
1940	2,308,397	2,431,393	.0442	.0089	.0081	.0065	.0331
1941	2,211,211	2,143,559	.0451	.0092	.0078	.0063	.0347
1942	1,624,601	1,140,589	.0392	.0071	.0079	.0064	.0345
Total and average, 1893–1942	46,052,845	40,572,603	.0503	.0112	.0118	.0084	.0429

Gold, silver, and lead recoveries from Alaska Juneau mine, 1893–1942

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
1914–37	2,204,495.44	54,112,836.84	1,412,388.41	$846,023.53	31,449,148	$1,740,136.72	56,698,997.09
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
1941	120,501.24	4,217,897.67	95,776.56	67,753.89	1,464,956	85,268.93	4,370,920.49
1942	75,537.00	2,643,795.77	62,298.21	44,003.46	938,117	61,318.96	2,749,118.19
Total	2,834,358.01	75,667,662.06	1,904,064.06	1,183,100.18	39,711,231	2,183,200.20	79,033,962.44

[1] Lost in tailings.

Summary of production and operating costs, Alaska Juneau mine, 1914–42, inclusive

	2,765,190 tons		4,354,770 tons		86,118,194 tons	
	1942	Per ton trammed	1941	Per ton trammed	1914–42	Per ton trammed
Production (gross recovered gold, silver, and lead values):						
Bullion	$2,242,104.03	$0.811	$3,509,421.76	$0.806	$62,337,260.39	$0.724
Concentrates	507,014.16	.183	861,498.73	.198	15,988,971.90	.186
	2,749,118.19	.994	4,370,920.49	1.004	78,326,232.29	.910
Costs:						
Mining	1,095,681.58	.396	1,649,946.97	.379	26,269,453.47	.305
Milling	791,041.94	.286	1,005,054.65	.231	20,972,055.47	.244
Other Juneau operating and marketing costs	167,492.84	.061	265,220.42	.061	4,170,038.01	.048
General corporation and pay-roll taxes	139,947.19	.051	220,706.62	.051	1,867,546.20	.022
Total Juneau operating and marketing costs	2,194,163.55	.794	3,140,928.66	.722	53,279,093.15	.619
All other costs	56,392.04	.020	77,531.84	.018	3,595,047.66	.042
Total operating costs and expenses	2,250,555.59	.814	3,218,460.50	.740	56,874,140.81	.661
Juneau operating profit	554,954.64	.200	1,229,991.83	.282	25,047,139.14	.291
Net operating profit	498,562.60	.180	1,152,459.99	.264	21,452,091.48	.249
Other revenue (interest, etc.)	75,738.81		50,504.47		795,391.19	
Profit before depreciation, depletion, and income taxes	574,301.41		1,202,964.46		22,247,482.67	

The Hirst-Chichagof Mining Co. on Chichagof Island, 65 miles northwest of Sitka, operated its mine and 35-ton amalgamation-flotation mill continuously until closed on October 15 by the Gold Mining Limitation Order. The mill treated 3,584 tons of gold-silver ore, which yielded bullion containing 3,716 fine ounces of gold and 809 fine ounces of silver, and 110 tons of gold-silver concentrates containing 726 ounces of gold, 331 ounces of silver, and a minor amount of copper. Bullion produced was sent direct to the Seattle Assay Office, and the concentrates were shipped to the Tacoma (Wash.) smelter.

The Chichagof Mining Co. at Klag Bay on Chichagof Island shipped gold-silver concentrates and gold bullion recovered from milling operations conducted in 1941. The company did not operate the mine or mill in 1942.

The output from other lode mines in the region was small and included production from the Williams mine in the Admiralty Island district; the Leroy and Rainbow lodes in the Juneau district; and the Gold Standard, Lucky Jack, Jessie, Dawson, and N & T mines in the Ketchikan district.

The Riverside tungsten mine in the Hyder district, owned and operated by J. H. Scott, shipped lead-silver-gold concentrates to the Bunker Hill & Sullivan smelter at Kellogg, Idaho. Tungsten concentrates stock-piled for a number of years because of the Jones Act of 1920 requiring shipments of concentrates to be made in American vessels are now being sent to the United States on Canadian boats owing to a recent Department of Commerce ruling.

Sluicing in the Juneau district in 1942 recovered small amounts of placer gold.

Yukon River Basin region.—The Yukon River Basin region includes the following mining districts: Bonnifield-Nenana, Chandalar, Chisana, Circle, Delta River, Eagle, Fairbanks, Fortymile, Goodpaster, Hot Springs, Hughes, Iditarod, Innoko, Kantishna, Koyukuk, Marshall, Rampart, Ruby, Tolovana, and Yukon Flats. The region yielded 75 percent of the total output from connected-bucket dredges in Alaska during 1942; it again ranked third in gold recovered from lode mines.

Fifteen floating connected-bucket dredges were operating in the region in 1942 compared with 22 in 1941.

The United States Smelting, Refining & Mining Co., operating seven floating connected-bucket dredges in the Fairbanks district, was much 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 Yuba dredge (with 106 buckets), one 3-cubic foot Yuba dredge (with 68 buckets), and three 6-cubic foot Bethlehem dredges (with 78, 78, and 68 buckets, respectively); all the dredges were electrically operated. Other equipment used (chiefly for removing overburden) included 315 Joshua Hendy hydraulic giants, one 8- to 12-cubic yard electric-powered Bucyrus 10–W dragline, and one oil-burning caterpillar bulldozer. Of the dredges operated in 1942, two were on Cleary Creek, two on Goldstream Creek, and one each on Cripple, Ester, and Pedro Creeks.

The Thirty-Seventh Annual Report of the United States Smelting, Refining & Mining Co., for the year ended December 31, 1942 (dated March 23, 1943), says—

At the Alaska gold properties favorable development continued but the operations were shut down by Government order in the fall of 1942. Maintenance crews are keeping the dredges and plants in repair and in readiness for resumption of operations when that becomes possible. Some of the buildings and equipment have been leased to the Government and revenues will help to defray some of the shut-down expenses.

In the Circle district three dredges were again active in 1942. Alluvial Golds, Inc., operated its W. W. Johnson Co. dredge (with 72 4-cubic foot buckets) on Woodchopper Creek from May 27 to October 12. Gold Placers, Inc., operated a similar type of dredge equipped with 60 4-cubic foot buckets on Coal Creek from June 1 to October 13. The C. J. Berry Dredging Co. operated its steam-powered dredge (with 58 3-cubic foot buckets) and handled about 239,800 cubic yards of gravel.

In the Fairbanks district the Brinker-Johnson Co. operated its W. W. Johnson dredge (with 78 4½-cubic foot buckets) on Caribou Creek from May 11 to October 4, 1942.

The North American Dredging Co. operated its Washington Iron Works dredge (with 70 3½-cubic foot buckets) on Otter Creek from June 1 to October 29. The J. E. Riley Investment Co. also operated a dredge on Otter Creek.

Two dredges were active in the Innoko district in 1942; the Ganes Mining Co. and Moss & Larson Mining Co. operated one each on Ganes Creek.

All types of placer operations—other than floating connected-bucket dredges—were to be found throughout the Yukon River Basin region in 1942.

The largest producers of placer gold in the Bonnifield-Nenana district in 1942 were Dan Cole and the Gold King mine, both bulldozer and hydraulic operations.

Among the larger producers in the Circle district using hydraulic giants and bulldozers or draglines with screening and sluicing plants were: The Berry Holding Co., John Frasca & Co., Half Dollar Mining Co., Switch Creek Mining Co., and Deadwood Mining Co.

In the Fairbanks district Helmer Johnson handled approximately 23,000 cubic yards of gravel with two hydraulic giants and a bulldozer at his placer on upper Cleary Creek. The Wolf Creek Mining Co. operated its dragline and washing plant on Wolf Creek and continued to be an important producer of placer gold. The Faith Creek Mining Co. on Faith Creek and the Fish Creek Mining Co. on upper Fish Creek recovered placer gold by hydraulicking, bulldozing, and sluicing. Other important producers in the Fairbanks district included the Alder Creek Mining Co., Brown & Reeves, A. A. Zimmerman, and Fred Parker.

The Wade Creek Dredging Co. confined its operations in 1942 to hydraulicking and bulldozing gravels at its claims on Uhler and Jack Wade Creeks from May 1 to September 12.

Larger placer operators in the Hot Springs district were the Cleary Hill Mines Co., operating six hydraulic giants, one dragline, and two bulldozers on Sullivan and Eureka Creeks; J. R. Frank & Co., hydraulicking on Pioneer Creek; and Gold Mines, Ltd., operating a bulldozer and dragline on American Creek.

In the Iditarod district the Awe Mining Co., Granite Mining Co., Hatten, Bauquier & Turner, Peter Miscovich & Sons, Moore Creek

Mining Co., Turner & Remington, and Uotila & Ogriz all operated during the 1942 season, using draglines, bulldozers, and hydraulics.

Hard & Uotila operated their hydraulic, bulldozer, and dragline equipment from April to October on Beaver and Ophir Creeks. Degnan & Rosander and the Cripple Creek Mining Co. operated similar equipment on Little Creek and Cripple Creek, respectively. Other large placer operators were McFarland & Hartley, S. R. Paulson, and Savage & Matheson.

On Caribou Creek in the Kantishna district Caribou Mines handled 125,925 cubic yards of gravel from June 15 to September 28, using a 1½-cubic yard dragline, washing plant, and stacker mounted on crawlers.

The principal producer of gold in the Koyukuk district in 1942 again was Repo & Schwaesdall, operating hydraulic giants, bulldozers, and a dragline on Myrtle Creek.

The Yukon Mining Co. did sluicing on bedrock from June 1 to September 15 on Buster and Windy Creeks in the Marshall district. Johnston & Ostnes and the Willow Creek Mining Co. worked gravels along Willow Creek with hydraulics, bulldozers, and draglines.

Other large producers among these types of placer operations in the Yukon River Basin region in 1942 were the Long Creek Mining Co. and the Midnight Mines, Developing & Operating Co., in the Ruby district, and the Amy Creek Mining Co., A. S. Warwick, and Parker & Son in the Tolovana district.

Lode mining in the Yukon River Basin region produced 14,478 fine ounces of gold and 3,441 fine ounces of silver in 1942 compared with 16,763 ounces of gold and 8,114 ounces of silver in 1941.

The leading producer of lode gold in the region in 1942 was Cleary Hill Mines, Inc., operating the Cleary Hill mine and amalgamation-flotation mill in the Fairbanks district 27 miles northeast of Fairbanks. The United States Smelting, Refining & Mining Co. operated its McCarty mine on Fairbanks Creek until October 15; the mine is equipped with a 10-ton amalgamation mill. The Hi Yu Mining Co. continued small-scale operations at its Hi Yu mine and 50-ton amalgamation mill on Fairbanks Creek until July, when the property was closed because of inadequate labor. Additional production of lode gold in the Fairbanks district in 1942 came from the Clipper, Rambone, Lookout, Oregon, and Wyoming claims.

In the Kantishna district the Red Top Mining Co. operated its Banjo mine and 50-ton jig-, table-, and flotation-concentration mill until September, when a shortage of labor forced operations to cease.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

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SUMMARY

The total value of the output of recoverable metals from mines in Arizona was $114,525,600 in 1942 compared with $97,638,310 in 1941—an increase of 17 percent (see fig. 1); it was the greatest value since 1929, when the total was $155,567,133. Both the quantity and value of copper and zinc increased substantially in 1942; the quantity of lead decreased, but the value increased owing to the higher average price of the metal. The total value of the copper was $95,199,654—a 24-percent gain over 1941; lead, $1,979,448—an 11-percent gain; and zinc, $3,445,092—a 39-percent gain. The value of the gold was $8,877,785—a 20-percent loss; and silver, $5,023,621—a 6-percent loss. The gold production represented 8 percent of the State total value, silver 4 percent, copper 83 percent, lead 2 percent, and zinc 3 percent. The value of the metals recovered from copper ore was $103,195,449 in 1942, or 90 percent of the State total. The output of copper was greater in 1942 than in any year except 1929, when it was 830,628,411 pounds, and the output of zinc exceeded the record output of 1941.

Production of copper, lead, and zinc (especially copper) in Arizona in 1942 was affected by several factors: Premium prices for copper, lead, and zinc; labor shortage; difficulty in obtaining sufficient supplies; disputes on rates of pay; and inexperience and inefficiency of employee replacements. The Metals Reserve Co. announced that, effective February 1, 1942, premiums of 5 cents a pound for copper and 2¾ cents a pound for both lead and zinc would be paid for these metals produced in excess of certain fixed basic quotas. Each mine has its basic quota fixed according to 1941 production. Also, effective December 1, 1942, the Metals Reserve Co. announced that it would pay an additional premium of 2¾ cents a pound for lead and two additional premiums of 2¾ cents a pound for zinc for over-quota metal production. Special contracts were negotiated during the last quarter of the year with Metals Reserve Co., which provided for the mining of marginal or low-grade copper ores from certain areas of some of the large Arizona copper producers.

A labor shortage began in April at the mines, mills, and smelters in Arizona, resulting from men leaving to take jobs on Government construction projects and in war industries where abnormally high wages were paid. This shortage became so acute during the summer that the output of ore from some of the mines was curtailed as much as 50 percent. The seriousness of the condition was recognized by the War Department, which in October furloughed about 1,100 soldiers for service in Arizona mines. This action tended to relieve the shortage but did not insure an adequate labor supply. The labor shortage at the Morenci open pit was partly relieved by the employment of a number of Navajo Indians.

The Government gold-mine closing order affected some of the gold producers in Arizona, but a majority of them had shut down several months before the order was issued.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1938–42, and total, 1860–1942, 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
1938	885	329	14,203,164	305,043	$10,676,505	7,479,153	$4,835,008
1939	976	142	18,793,260	316,453	11,075,855	7,824,004	5,310,839
1940	1,024	276	21,572,175	294,807	10,318,245	7,075,215	5,031,264
1941	805	184	25,491,794	315,392	11,038,720	7,498,260	5,332,096
1942	515	163	33,920,731	253,651	8,877,785	7,064,467	5,023,621
1860–1942	--------	--------	(1)	10,427,940	252,473,055	275,752,505	204,905,390

[1] Figures not available.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1938–42, and total, 1860–1942, in terms of recovered metals—Continued

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	652, 634, 000	77, 010, 812	31, 276, 000	1, 782, 732	32, 986, 000	2, 473, 950	97, 638, 310
1942	786, 774, 000	95, 199, 654	29, 544, 000	1, 979, 448	37, 044, 000	3, 445, 092	114, 525, 600
1860–1942	[2] 9, 840, 182	2, 936, 454, 870	[2] 296, 826	34, 479, 098	[2] 144, 825	22, 587, 893	3, 450, 900, 306

[2] Short tons.

Gold and silver produced at placer mines in Arizona, 1938–42, in fine ounces, in terms of recovered metals

Year	Sluicing [1]		Drift mining		Dredges				Total	
					Dry-land [2]		Dragline floating [2]			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1938	1, 624	213	328	35	(3)	(3)	[3] 3, 033	[3] 380	4, 985	628
1939	1, 919	227	1, 850	125	(3)	(3)	[3] 2, 640	[3] 339	6, 409	691
1940	1, 625	207	646	41	1, 186	464	2, 784	396	6, 241	1, 108
1941	976	125	77	5	824	717	10, 054	1, 358	11, 931	2, 205
1942	885	176	----------	----------	35	5	1, 916	217	2, 836	398

[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.

Gold.—The output of recoverable gold in Arizona in 1942 was 253,651 fine ounces—a decrease of nearly 20 percent from 1941. Gold from siliceous ores (chiefly dry and siliceous gold ore) declined more than 34 percent and that from zinc-lead ore 38 percent; gold from copper ore increased only 2 percent. Gold from placers decreased from 11,931 to 2,836 ounces; half of the total placer gold in 1942 was recovered by dragline dredging at properties on Big Bug Creek in Yavapai County. The Copper Queen (Bisbee) branch of the Phelps Dodge Corporation continued to be 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 United Verde mine in Yavapai County, the Goldroad mine (United States Smelting, Refining & Mining Co.) in Mohave County, and the Magma mine in Pinal County; these six properties produced nearly 72 percent of the State total output. Copper ore yielded 57 percent of the State total gold, siliceous ores 37 percent, and zinc-lead ore 3 percent. The chief gold-producing districts in Arizona were the Warren, Ajo, San Francisco, Verde, Old Hat, Weaver (Yavapai County), Pioneer (Superior), and Big Bug.

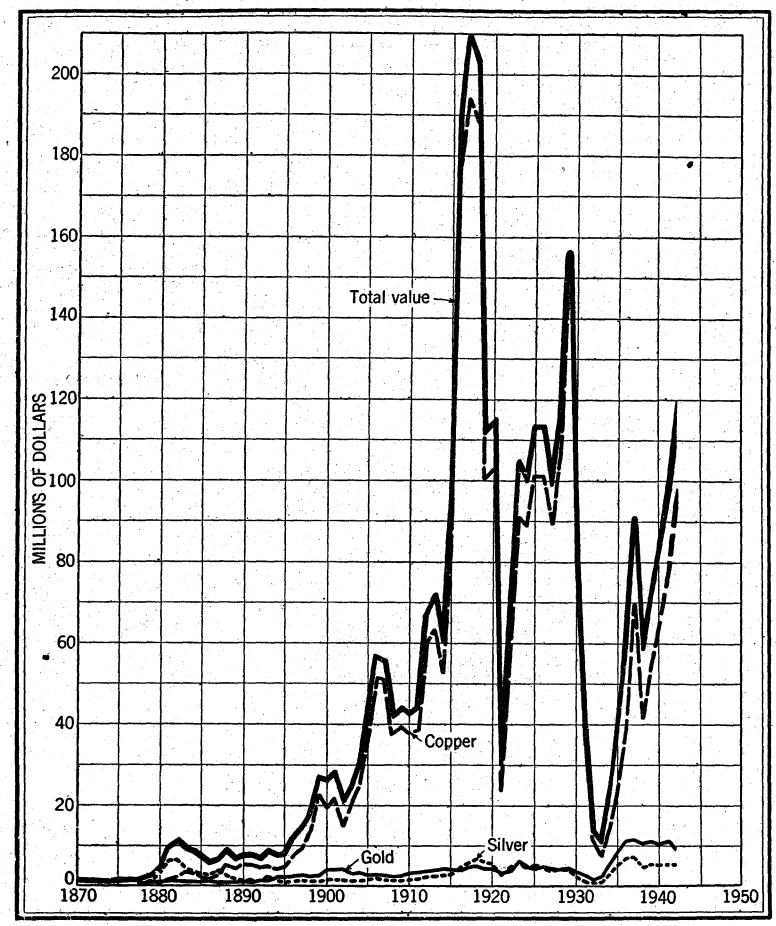

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1942. The value of lead and zinc has been less than $2,000,000 annually, except in a few years.

Silver.—The output of recoverable silver in Arizona in 1942 was 7,064,467 fine ounces—a decrease of 6 percent from 1941. The chief decreases were 270,508 ounces in silver from siliceous ores, 85,554 ounces from zinc-lead ore, 32,237 ounces from zinc ore and zinc-copper ore, and 29,516 ounces from lead ore. Copper ore yielded 71 percent of the State total silver, siliceous ores 13 percent, zinc-lead ore 12 percent, zinc ore nearly 3 percent, and lead ore 1 percent. The Phelps Dodge Corporation continued to be the chief silver producer in Arizona, and its output was 4 percent greater than in 1941; its four properties (Copper Queen, Morenci, New Cornelia, and United Verde) produced 50 percent of the State gold output, 60 percent of the silver, and 56 percent of the copper. Other large silver producers in Arizona in 1942 were the Magma, Trench-Flux, Iron King, and Shattuck Denn properties. The chief silver-producing districts were the Warren (Bisbee), Verde (Jerome), Pioneer (Superior), Ajo, Harshaw, and Big Bug; 57 percent of the State total silver came from the Warren and Verde districts.

Copper.—Arizona has been the largest producer of copper in the United States since 1907 except in 1909, when Montana held first place. The output of recoverable copper in Arizona in 1942 was 786,774,000 pounds—an increase of more than 20 percent over 1941 and larger than in any year except 1929, when it was 830,628,411 pounds. The Globe-Miami district, with a production of 188,529,000 net pounds of copper, continued to be the leading copper-producing area in Arizona; it was followed by the Ajo district with 133,293,800 pounds, Copper Mountain (Morenci) with 120,711,000 pounds, Warren (Bisbee) with 106,555,000 pounds, Mineral Creek (Ray) with 100,724,000 pounds, Verde with 87,874,000 pounds, and Pioneer (Superior) with 41,402,800 pounds. These seven districts contributed 99 percent of the State total copper. Copper ore and its products yielded 781,457,631 pounds of copper, as follows: 26,703,329 tons of copper ore treated by concentration yielded 63 percent; 1,954,374 tons of copper ore shipped crude to smelters, 21 percent; and 4,199,268 tons of copper ore leached and 26,781 tons of cement copper (from mine-water precipitates and underground leaching operations), 16 percent. The New Cornelia property continued to be the largest copper producer in Arizona; it was followed in order by the Morenci branch of the Phelps Dodge Corporation, Inspiration, Ray (Nevada Consolidated Copper Corporation), Copper Queen, United Verde, Miami, and Magma properties.

Lead and zinc.—The output of recoverable lead in Arizona in 1942 was 29,544,000 pounds—a decrease of more than 5 percent from the record output of 1941; the output of recoverable zinc was 37,044,000 pounds—the largest in any year in the history of the State and an increase of 12 percent over the record output of 1941. About 47 percent of the State total lead and 36 percent of the zinc came from Santa Cruz County, 13 percent of the lead and 24 percent of the zinc from Pinal County, and 11 percent of the lead and 12 percent of the zinc from Mohave County; most of the remainder of the lead and zinc came from Cochise and Yavapai Counties. About 75 percent of the total lead and more than 72 percent of the total zinc came from zinc-lead ore; nearly all the rest of the lead came from lead ore, siliceous ores, zinc ore, and copper ore; and nearly all the rest of the zinc came from zinc ore. The Trench-Flux group of the American Smelting & Refining Co. near Patagonia in Santa Cruz County was by far the largest producer of lead in the State and the largest producer of zinc; other large producers of lead were the Mammoth-St. Anthony Limited property at Tiger, Tennessee mine at Chloride, Iron King mine at Humboldt, Shattuck Denn mine at Bisbee, and Duquesne property near Patagonia; and other large producers of zinc were the Magma, Iron King, Duquesne, Tennessee, Shattuck Denn, Davenport and Mammoth-St. Anthony Limited properties.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1942, 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	31	1	59,332	$2,076,620	2,539,779	$1,806,065
Coconino	5		15	525	727	517
Gila	32		2,130	74,550	102,915	73,184
Graham	6		22	770	3,877	2,757
Greenlee	7	4	5,707	199,745	336,202	239,077
Maricopa	40	8	2,932	102,620	8,969	6,378
Mohave	97	9	36,246	1,268,610	193,109	137,322
Pima	37	7	45,603	1,596,105	514,381	365,782
Pinal	34		38,500	1,347,500	839,506	596,982
Santa Cruz	33	1	516	18,060	514,845	366,112
Yavapai	149	81	61,430	2,150,050	1,960,529	1,394,154
Yuma	44	52	1,218	42,630	49,628	35,291
Total, 1941	515	163	253,651	8,877,785	7,064,467	5,023,621
	805	184	315,392	11,038,720	7,498,260	5,332,096

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	107,002,000	$12,947,242	2,979,000	$199,593	3,534,000	$328,662	$17,358,182
Coconino	172,000	20,812	1,000	67			21,921
Gila	190,257,000	23,021,097	873,000	58,491	695,000	64,635	23,291,957
Graham	8,000	968	305,400	20,462			24,957
Greenlee	120,711,000	14,606,031	11,300	757			15,045,610
Maricopa	178,200	21,562	507,300	33,989			164,549
Mohave	365,200	44,189	3,318,300	222,326	4,487,700	417,356	2,089,803
Pima	134,517,900	16,276,666	236,000	15,812	226,300	21,046	18,275,411
Pinal	142,348,000	17,224,108	3,980,600	266,700	8,925,000	830,025	20,265,315
Santa Cruz	1,201,000	145,321	13,853,000	928,151	13,506,000	1,256,058	2,713,702
Yavapai	89,881,700	10,875,686	2,624,300	175,828	5,670,000	527,310	15,123,028
Yuma	132,000	15,972	854,800	57,272			151,165
Total, 1941	786,774,000	95,199,654	29,544,000	1,979,448	37,044,000	3,445,092	114,525,600
	652,634,000	77,010,812	31,276,000	1,782,732	32,986,000	2,473,950	97,638,310

Gold and silver produced at lode mines in Arizona in 1942, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Cochise	1,225,285	59,331	2,539,779
Coconino	1,619	15	727
Gila	11,019,394	2,130	102,915
Graham	1,304	22	3,877
Greenlee	7,715,637	5,697	336,202
Maricopa	41,004	2,921	8,969
Mohave	269,499	36,192	193,102
Pima	8,344,994	45,597	514,381
Pinal	3,590,696	38,500	839,506
Santa Cruz	111,198	515	514,845
Yavapai	1,585,322	58,890	1,960,252
Yuma	14,779	1,005	49,514
Total, 1941	33,920,731	250,815	7,064,069
	25,491,794	303,461	7,496,055

Gold and silver produced at placer mines in Arizona in 1942, by counties, in fine ounces, in terms of recovered metals

County	Sluicing [1]		Drift mining		Dredges				Total	
					Dry-land [2]		Dragline floating [2]			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Cochise	1								1	
Greenlee	10								10	
Maricopa	11								11	
Mohave	54	7							54	7
Pima	6								6	
Santa Cruz	1								1	
Yavapai	589	55			35	5	1,916	217	2,540	277
Yuma	213	114							213	114
	885	176			35	5	1,916	217	2,836	398
Total, 1941	976	125	77	5	824	717	10,054	1,358	11,931	2,205

[1] Includes placer sands treated by dry concentration plants.
[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

In spite of a serious labor shortage during the summer months in the large copper-producing and zinc-lead districts in Arizona, more ore was mined in 1942 than in any year in the history of the State. The total output (33,920,731 tons) exceeded the peak year 1929 by 8,059,959 tons. The output of copper ore was 32,856,971 tons—a 36-percent gain over 1941; zinc-lead ore, 265,780 tons—a 2-percent gain; lead ore, 25,898 tons—a 41-percent gain; and zinc ore and zinc-copper ore, 113,667 tons—a 37-percent gain. Most of the gold mines in Arizona shut down before July 1, and the output of siliceous ores (chiefly gold ore) was 657,942 tons—a 33-percent loss from 1941. A total of 32,717,333 tons (96 percent of the State total ore output) was copper ore mined in the Globe-Miami, Ajo, Copper Mountain (Morenci), Mineral Creek (Ray), Verde (Jerome), Warren (Bisbee), and Pioneer (Superior) districts; most of the zinc-lead ore was mined in the Big Bug, Harshaw, Wallapai (Chloride), Patagonia, Old Hat (Oracle), and Warren (Bisbee) districts. Placer mining declined considerably, owing to exhaustion of commercial dredging ground.

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 1942, 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	216	498,879	83,586	123,520	323,807	2,290,607	----------
Dry and siliceous gold-silver ore	28	124,668	9,691	379,480	693,839	56,071	----------
Dry and siliceous silver ore	36	34,395	1,033	422,306	27,840	46,967	----------
	[1] 278	657,942	94,310	925,306	1,045,486	2,393,645	----------
Copper ore	125	32,856,971	144,764	4,993,551	[2] 781,457,631	318,900	----------
Lead ore	113	25,898	2,174	101,469	85,258	4,251,345	----------
Lead-copper ore	9	473	15	2,397	18,733	34,966	----------
Zinc ore	4	106,400	1,152	198,954	2,128,230	478,000	9,503,100
Zinc-copper ore	2	7,267	10	6,377	356,300	43,640	679,060
Zinc-lead ore	18	265,780	8,390	836,015	1,682,362	22,023,504	26,861,840
Total, lode mines	[1] 515	33,920,731	250,815	7,064,069	[2] 786,774,000	29,544,000	37,044,000
Total, placers	163	----------	2,836	398	----------	----------	----------
	678	33,920,731	253,651	7,064,467	[3] 786,774,000	29,544,000	37,044,000
Total, 1941	989	25,491,794	315,392	7,498,260	[3] 652,634,000	31,276,000	32,986,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 129,292,755 pounds recovered from ore leached and mine-water precipitates.
[3] Includes 118,450,902 pounds recovered from ore leached and mine-water precipitates.

METALLURGIC INDUSTRY

Of the 33,920,731 tons of ore produced in 1942 in Arizona, 27,102,358 tons (80 percent) were treated at concentration plants, 4,199,268 tons (12 percent) at a leaching plant, 543,681 tons (2 percent) at amalgamation, cyanidation, and cyanidation-concentration mills, and 2,075,424 tons (6 percent) were shipped crude to smelters.

Gold ore treated at amalgamation mills decreased from 7,517 tons in 1941 to 765 tons in 1942 and siliceous material treated at cyanidation and cyanidation-concentration plants from 826,393 to 542,916 tons; 15 straight cyanidation plants treated 337,350 tons of material in 1942. The most important plants were those at the Goldroad, Gold Standard, Producers Mines, Inc., Congress, Octave, Mammoth-St. Anthony Limited, Alvarado, Yarnell, Vulture, Vivian, and Iron King properties. Nine companies reported cyaniding 386,332 tons of siliceous material and using 51,400 pounds of sodium cyanide, 666,265 pounds of Aero Brand calcium cyanide, 56,248 pounds of zinc dust, 2,000,000 pounds of lime, 1,277 pounds of Aerosol, and 8,800 pounds of caustic soda.

Ore treated at concentration plants in 1942 comprised chiefly 26,703,329 tons of copper ore, 265,505 tons of zinc-lead ore, 105,971 tons of zinc ore, and 12,121 tons of lead ore. Copper ore from the Miami property (5,922,250 tons) was treated by a combination of leaching and concentration, and copper ore from the Inspiration mine was treated by straight leaching and by leaching and concentration. The large copper-concentration plants at Ajo, Clarkdale, Hayden, Miami, Morenci, and Superior were operated at capacity in 1942, as well as the copper-leaching plants at Inspiration and Miami and the copper smelters at Clarkdale, Douglas, Hayden, Miami, Morenci, and Superior. The rated capacity of charge of the six copper smelters was as follows: Clarkdale 1,400,000 tons per year, Douglas 1,600,000,

Hayden 360,000, Miami 360,000, Morenci 450,000, and Superior (Magma) 210,000. In 1942 these plants treated copper material chiefly from one property, with the exception of the Douglas plant, which treated material from various properties in Arizona, New Mexico, and Mexico. The new 25,000-ton concentrator at the Morenci branch of the Phelps Dodge Corporation started running in January, and the new 1,200-ton-per-day copper smelter at Morenci began operating in April. The 20-ton smelter at Tiger is the only lead smelter in Arizona, and it operated exclusively on concentrates from the mill of Mammoth-St. Anthony Limited.

The following tables give details of the treatment of all ores produced in Arizona in 1942.

Mine production of metals in Arizona in 1942, 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	765	327	146			
Ore, old tailings, and current tailings cyanided	539,154	45,713	103,800			
Concentrates smelted	1,322,817	105,078	2,668,316	495,590,461	25,760,110	36,734,500
Ore smelted	2,075,424	99,697	4,291,807	161,890,784	3,783,890	309,500
Copper precipitates smelted	26,781			[1] 41,734,764		
Copper ore leached	[2] 4,199,268			87,557,991		
Placer		2,836	398			
		253,651	7,064,467	786,774,000	29,544,000	37,044,000
Total, 1941		315,392	7,498,260	652,634,000	31,276,000	32,986,000

[1] Distributed as follows: Cochise County, 1,067,000 pounds; Gila County, 11,441,500 pounds; Greenlee County, 13,750,000 pounds; Pinal County, 14,749,964 pounds; Santa Cruz County, 1,600 pounds; and Yavapai County, 724,700 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 1942, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Cochise	2	12	3					
Maricopa	210	9	4					
Mohave	207	187	99	3	13	23		610
Santa Cruz	105	9	7	2	4	17		
Yavapai	225	107	32					
Yuma	16	3	1					
	765	327	146	5	17	40		610
Total, 1941	7,517	888	297	73	320	145	1,200	1,505

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Arizona in 1942, by types of mills and by counties, in terms of recovered metals—Continued

CYANIDATION MILLS

County	Material treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Cochise	250	10	353					
Maricopa	35,085	1,582	1,358	351	720	300	865	1,300
Mohave	189,843	30,778	39,530					
Pima	1,700	307	1,298					
Pinal	147,483	2,877	7,121	3,292	22,027	21,150	11,070	2,163,000
Yavapai	168,555	10,159	54,140	470	6,141	7,421	12,426	69,900
	542,916	45,713	103,800	4,113	28,888	28,871	24,361	2,234,200
Total, 1941	826,393	77,627	182,503	5,978	37,445	41,856	34,856	4,455,570
Grand total: 1942		46,040	103,946	4,118	28,905	28,911	24,361	2,234,810
1941		78,515	182,800	6,051	37,765	42,001	36,056	4,457,075

Mine production of metals from concentrating mills in Arizona in 1942, 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	22,132	5,953	402	43,030	505,278	1,285,678	3,464,000
Gila	6,763,756	171,133	1,894	86,514	88,560,151	502,700	683,600
Greenlee	7,640,890	267,549	4,089	157,971	106,100,000		
Maricopa	1,300	163	141	959	515	143,250	
Mohave	73,090	10,390	3,265	138,967	169,215	3,235,322	4,487,700
Pima	8,338,033	227,949	45,068	499,824	134,047,982		
Pinal	3,352,395	302,503	9,054	508,622	114,889,055	1,765,900	8,925,000
Santa Cruz	108,443	26,062	229	477,313	1,169,099	13,630,685	13,506,000
Yavapai	791,277	306,249	12,018	719,883	50,124,005	2,161,765	5,668,200
Yuma	11,042	748	13	6,322	800	800,000	
	27,102,358	1,318,699	76,173	2,639,405	495,566,100	23,525,300	36,734,500
Total, 1941	19,001,720	1,022,801	77,209	2,740,172	378,807,603	22,524,350	32,693,800

Gross metal content of concentrates produced from ores mined in Arizona in 1942, 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	560	1,549	2,268	3,457	8,214	
Copper	1,251,630	66,122	1,706,798	508,491,234	513,555	3,274,010
Lead	25,468	32,703	626,002	454,094	22,366,797	2,781,192
Lead-copper	4,793	637	195,440	438,751	4,086,862	973,900
Zinc	37,667	1,182	129,247	765,241	1,708,450	39,321,089
Zinc-copper	575	8	1,000	42,500	5,000	602,000
Zinc-lead	1,454	55	3,224	41,793	391,337	1,357,244
Iron	670	2,822	4,337	5,992	62,342	24,630
	1,322,817	105,078	2,668,316	510,243,062	29,142,557	48,334,065
Total, 1941	1,028,852	114,974	2,782,173	392,814,679	29,511,821	43,318,947

Mine production of metals from Arizona concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	5,953	402	43,030	505,278	1,285,678	3,464,000
Gila	171,133	1,894	86,514	88,560,151	502,700	683,600
Greenlee	267,549	4,089	157,971	106,100,000	----------	----------
Maricopa	514	861	1,259	1,380	144,550	----------
Mohave	10,393	3,278	138,990	169,215	3,235,932	4,487,700
Pima	227,949	45,068	499,824	134,047,982	----------	----------
Pinal	305,795	31,081	529,772	114,900,125	3,928,900	8,925,000
Santa Cruz	26,064	233	477,330	1,169,099	13,630,685	13,506,000
Yavapai	306,719	18,159	727,304	50,136,431	2,231,665	5,668,200
Yuma	748	13	6,322	800	800,000	----------
Total, 1941	1,322,817	105,078	2,668,316	495,590,461	25,760,110	36,734,500
	1,028,852	114,974	2,782,173	378,843,659	26,981,425	32,693,800

BY CLASSES OF CONCENTRATES

Dry gold	560	1,549	2,268	2,761	6,700	----------
Copper	1,251,630	66,122	1,706,798	494,181,808	64,190	----------
Lead	25,468	32,703	626,002	361,747	20,560,103	----------
Lead-copper	4,793	637	195,440	359,365	3,712,545	----------
Zinc	37,667	1,182	129,247	611,889	1,109,047	35,004,415
Zinc-copper	575	8	1,000	34,500	3,300	522,360
Zinc-lead	1,454	55	3,224	33,643	248,192	1,207,725
Iron	670	2,822	4,337	4,748	56,033	----------
	1,322,817	105,078	2,668,316	495,590,461	25,760,110	36,734,500

Gross metal content of Arizona crude ore shipped to smelters in 1942, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	16,607	9,157	33,020	307,018	37,144	----------
Dry and siliceous gold-silver	56,911	7,994	328,208	714,640	74,457	----------
Dry and siliceous silver	32,944	961	410,182	25,517	17,122	----------
Copper	1,954,374	79,420	3,425,115	173,003,746	514,546	----------
Lead	13,777	2,157	93,581	104,243	3,618,216	----------
Lead-copper	107	8	1,573	9,446	28,849	----------
Zinc	429	----------	----------	----------	28,400	279,468
Zinc-lead	275	----------	128	----------	46,763	104,017
Total, 1941	2,075,424	99,697	4,291,807	174,164,610	4,365,497	383,485
	1,870,510	109,972	4,531,082	166,596,538	4,960,747	343,601

Mine production of metals from Arizona crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds
Cochise	1,202,901	58,907	2,496,393	105,429,722	1,693,322	70,000
Coconino	1,619	15	727	172,000	1,000	----------
Gila	56,370	236	16,401	2,697,358	370,300	11,400
Graham	1,304	22	3,877	8,000	305,400	----------
Greenlee	74,747	1,608	178,231	861,000	11,300	----------
Maricopa	4,409	469	6,348	176,820	362,750	----------
Mohave	6,359	1,949	14,483	195,985	82,368	----------
Pima	5,261	222	13,259	469,918	236,000	226,300
Pinal	90,818	4,542	302,613	12,697,911	51,700	----------
Santa Cruz	2,650	273	37,508	30,301	222,315	----------
Yavapai	625,265	30,465	1,178,776	39,020,569	392,635	1,800
Yuma	3,721	989	43,191	131,200	54,800	----------
	2,075,424	99,697	4,291,807	161,890,784	3,783,890	309,500
Total, 1941	1,870,510	109,972	4,531,082	155,339,439	4,294,575	292,200

BY CLASSES OF ORE

Dry and siliceous gold	16,607	9,157	33,020	292,503	24,747	----------
Dry and siliceous gold-silver	56,911	7,994	328,208	673,227	56,071	----------
Dry and siliceous silver	32,944	961	410,182	24,434	11,252	----------
Copper	1,954,374	79,420	3,425,115	160,808,794	318,900	----------
Lead	13,777	2,157	93,581	83,948	3,294,754	----------
Lead-copper	107	8	1,573	7,878	24,066	----------
Zinc	429	----------	----------	----------	20,000	226,300
Zinc-lead	275	----------	128	----------	34,100	83,200
	2,075,424	99,697	4,291,807	161,890,784	3,783,890	309,500

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1942, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Cochise County:													
California	5		123	1		1	609		609	1,300	14,300		$1,583
Cochise	3		7,395	17		17	3,631		3,631	413,000	17,300	567,000	107,040
Dos Cabezas and Tevis	3		512	138		138	353		353	7,000	4,000		6,196
Golden Rule (Dragoon)	1		78	24		24	156		156	200	8,000		1,511
Hartford (Huachuca Mountains)	2	1	74	3	1	4	509		509	300	25,000		2,213
Swisshelm	4		2,283	52		52	17,415		17,415	4,600	701,300		61,748
Tombstone	5		3,674	354		354	29,319		29,319	17,900	399,000		62,138
Turquoise	5		970	50		50	3,652		3,652	2,700	183,300	70,000	23,465
Warren	3		1,210,176	58,692		58,692	2,484,135		2,484,135	106,555,000	1,626,800	2,897,000	17,092,288
Coconino County:													
Francis	1		31				14		14	2,000			252
Jacob Canyon and Warm Springs	3		1,463	15		15	661		661	159,000	1,000		20,301
Navajo Reservation	1		125				52		52	11,000			1,368
Gila County:													
Banner and Dripping Springs	8		44,708	171		171	20,260		20,260	1,723,200	679,300	683,600	337,987
Globe-Miami	16		10,974,497	1,924		1,924	81,644		81,644	188,529,000	193,700	11,400	22,951,445
Green Valley	2		105	30		30	14		14	3,000			1,423
Mazatzal Mountain	1		3	1		1							35
Pioneer (Pinal Mountains)	4		69	4		4	997		997	1,000			970
Summit	1		12							800			97
Graham County:													
Aravaipa	5		1,295	22		22	3,853		3,853	6,000	305,400		24,698
Lone Star	1		9				24		24	2,000			259
Greenlee County:													
Ash Peak	2		20,756	778		778	170,519		170,519				148,488
Copper Mountain (Morenci)	4		7,694,849	4,906		4,906	165,645		165,645	120,711,000	7,600		14,896,042
Metcalf (Greenlee)	1		32	13		13	38		38		3,700		730
San Francisco		4			10	10							350
Maricopa County:													
Big Horn	3	1	25	12	1	13					300		475
Blue Tanks		1			3	3							105
Cave Creek and Camp Creek	6		250	66		66	322		322	1,300			2,696
Ellsworth (Harqua Hala)[1]	1		4							300			36
Estrella Mountain	1		25	24		24	14		14				850
New River	5		1,927	55		55	737		737	161,600			22,003
Osborn	2		1,624	99		99	2,925		2,925	11,800	313,400		27,971
Pikes Peak (Morgan City)	3		20	20		20	14		14				710
Salt River Mountains	2		663	248		248	201		201	300			8,859

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1942, 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				
Maricopa County—Continued.													
San Domingo	2	6	9	14	7	21					200		$748
Sunflower	1		52	48		48	38		38				1,707
Vulture	12		35,397	2,273		2,273	4,604		4,604	2,900	193,400		96,138
Wickenburg	1		1,000	56		56	114		114				2,041
Winifred	1		8	6		6							210
Mohave County:													
Bentley	1		36				104		104	17,900	200		2,253
Cedar Ridge	1		113				14		14	2,700			337
Cedar Valley	1		10.000	4		4	959		959	39,100			5,553
Chemehuevis		1			17	17		7	7				600
Cottonwood	1		2,030	165		165	682		682	58,300			13,314
Gold Basin	4	4	249	108	19	127	24		24				4,462
Greenwood	2		11	2		2	14		14	100			92
Indian Secret (White Hills)	1		250	3		3	1,156		1,156				927
Lost Basin		4			18	18							630
Maynard and McConnico	2		125	22		22	83		83	100	1,800		962
Minnesota	6		171	65		65	502		502		400		2,659
Music Mountain	5		259	328		328	689		689		2,700		12,151
Owens	13		2,976	498		498	720		720	106,300	600		30,844
Peacock	1		26				7		7	3,900			477
San Francisco (Oatman, Goldroad, Katherine, Vivian)	17		178,859	28,570		28,570	30,804		30,804				1,021,855
Wallapai	36		70,533	5,406		5,406	157,112		157,112	136,800	3,312,600	4,487,700	956,787
Weaver	6		3,861	1,021		1,021	232		232				35,900
Pima County:													
Ajo	1		8,324,737	45,081		45,081	489,759		489,759	133,293,800			18,054,658
Amole	2		618	89		89	1,523		1,523	3,200	78,600		9,851
Arivaca	6	3	79	57	2	59	239		239	300			2,271
Baboquivari	1		1,700	307		307	1,298		1,298				11,668
Cababi (Comobabi)	5		85	9		9	149		149	2,700	2,600		922
Cerro Colorado	1		67	1		1	2,589		2,589	1,200	1,700		2,135
Empire	1		574	6		6	720		720	2,000	77,000	226,300	27,169
Greaterville		1			2	2							70
Helvetia (Rosemont)	3		4,465	11		11	3,631		3,631	449,000	3,000		57,497
Old Hat [2]	3		12,149	25		25	11,091		11,091	742,000			98,544
Pima (Sierritas, Papago, Twin Buttes)	9		166	8		8	1,028		1,028	9,700	22,000		3,659
Quijotoa	3	3	65		2	2	121		121	4,000	4,700		955
Roskruge and Waterman	1		189	1		1	1,409		1,409	8,000	27,300		3,834
Silver Bell	1		100	2		2	824		824	2,000	19,100		2,178
Pinal County:													
Bunker Hill	2		580	8		8	976		976	48,000	14,300		7,740
Casa Grande	7		443	39		39	5,362		5,362	8,200	8,700		6,753

Cottonwood and Black Mountain	2		30	16		16	52		52	200			621
Goldfields	1		140	7		7	31		31				267
Hackberry	1		12				21		21	3,400			243
Mineral Creek	2		2,969,544	852		852	66,025		66,025	100,724,000			12,264,375
Mineral Hill	6		1,123	269		269	1,035		1,035	38,000	26,600		16,531
Old Hat [3]	4		163,143	26,175		26,175	40,621		40,621	125,600	3,602,600	1,157,000	1,309,184
Pioneer (Superior)	7		455,651	11,130		11,130	725,137		725,137	41,402,800	325,000	7,768,000	6,659,141
Saddle Mountain	2		30	4		4	246		246	1,200			460
Santa Cruz County:													
Harshaw	4		77,152	199		199	343,357		343,357	296,000	12,264,400	9,650,000	2,006,111
Oro Blanco	10	1	1,811	269	1	270	28,149		28,149	9,800	12,000		31,457
Pajarito	1		1								300		20
Palmetto	1		7				142		142		1,300		188
Patagonia	8		31,374	38		38	138,659		138,659	886,300	1,380,300	3,826,700	655,537
Tyndall	7		816	8		8	4,185		4,185	7,200	187,000	29,300	19,381
Wrightson	2		37	1		1	353		353	1,700	7,700		1,008
Yavapai County:													
Agua Fria	2		450	15		15	111		111	39,900			5,432
Bear Canyon	1		24				7		7	1,300			162
Big Bug	10	17	155,910	7,898	1,584	9,482	316,807	114	316,921	260,700	1,905,700	5,300,000	1,209,363
Black Canyon	7	1	1,214	247	2	249	6,781		6,781	1,300	25,000		15,369
Black Hills	3		277	74		74	294		294	4,100			3,295
Black Rock	7		1,284	172		172	159		159	11,200	6,700		7,937
Blue Tank	1	3	43	16	9	25	17		17				887
Bullard (Pierce)	3		290	58		58	76		76	13,900			3,766
Castle Creek	7		96	7		7	111		111	3,300	17,400		1,889
Cherry Creek	8		258	150		150	114		114				5,331
Copper Basin	5	7	9,425	108	15	123	450		450	456,700	1,000	66,000	66,091
Copper Creek	1		4				7		7	300			41
Eureka	12		60,066	841		841	20,513		20,513	1,107,700	128,600	128,000	198,574
Hassayampa	17	9	285	433	546	979	2,520	128	2,648	700	7,600		36,742
Humbug	1	3	6	7	15	22	21		21		400		812
Kirkland	1		47	43		43	7		7				1,510
Lynx Creek		13			87	87		14	14				3,055
Martinez	5		33,853	3,107		3,107	7,882		7,882				114,350
Peck	3		209	5		5	4,666		4,666	2,300			3,771
Pine Grove	6		4,689	2,740		2,740	19,049		19,049	23,700	133,600	121,000	132,518
Pocket Creek		1			201	201		7	7				7,040
Silver Mountain	4		10	2		2	585		585		1,000		553
Tiger	6		263	149		149	675		675	1,700	4,300		6,189
Tip Top	4		14	1		1	128		128	1,700	1,000		399
Turkey Creek	1		7	1		1	239		239		4,000		473
Verde	6		1,242,133	28,429		28,429	1,532,108		1,532,108	87,874,000			12,717,268
Wagoner		2			4	4							140
Walker	11	9	2,767	1,132	20	1,152	13,213	7	13,220	60,300	72,700	55,000	67,003
Walnut Grove	2	1	7	4	1	5	7		7	700			265
Weaver	12	15	70,520	13,245	56	13,301	13,410	7	13,417	15,300	84,000		482,555
White Picacho	3		1,171	6		6	20,295		20,295	900	231,300		30,248

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1942, 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				
Yuma County:													
Castle Dome	3	1	11,053	41	111	152	6,954	107	7,061	800	821,400		$65,472
Cienega	2		826	152		152	59		59	28,800			8,847
Dome (Gila City)		10			10	10							350
Ellsworth (Harqua Hala)[1]	26		640	126		126	294		294	44,800	300		10,060
Kofa	2	5	2	4	9	13							455
Laguna		2			1	1							35
LaPaz		3			5	5							175
La Posa	1		7	1		1	7		7	400			88
Middle Camp and La Cholla		10			18	18							630
Muggins Mountains		2			1	1							35
New Water	1		35	7		7	7		7				250
Plomosa	8	13	1,923	673	51	724	42,141	7	42,148	10,000	33,100		58,740
Santa Maria (Planet, Bill Williams)	1		293	1		1	52		52	47,200			5,783
Trigo		6			7	7							245
Total Arizona	515	163	33,920,731	250,815	2,836	253,651	7,064,069	398	7,064,467	786,774,000	29,544,000	37,044,000	114,525,600

[1] Ellsworth district lies in both Maricopa and Yuma Counties.
[2] Old Hat district lies in both Pima and Pinal Counties.

Comment on districts with small production has been omitted owing to lack of space.

COCHISE COUNTY

California district (*Hilltop*).—Nearly all the output in the California district in 1942 was crude lead ore (62 tons) from the Blue Mountain and Silver Hill properties and crude silver ore (59 tons) from the Paradise No. 1 claim.

Cochise district.—Lessees operated the Republic mine near Dragoon in 1942 and shipped 925 tons of copper ore to various smelters in Arizona and 6,300 tons of zinc-copper ore to custom flotation mills in Arizona and New Mexico. The rest of the district output was 112 tons of zinc-lead ore from the Lewis property and 58 tons of copper ore from the Peacock mine.

Dos Cabezas and Tevis district.—The output of the Dos Cabezas and Tevis district in 1942 was principally gold ore (500 tons) from the Dives mine treated in a concentration mill.

Golden Rule (*Dragoon*) *district.*—Lessees operated the Golden Rule mine in 1942 and produced 78 tons of silver-lead-gold ore.

Hartford (*Huachuca Mountains*) *district.*—Virtually all the output in the Hartford district in 1942 was crude silver-lead ore (73 tons) from the Armistice group near Hereford.

Swisshelm district (*Elfrida*).—Of the total ore (2,283 tons) produced in the Swisshelm district in 1942, 2,239 tons were crude silver-lead ore from the Scribner mine; the remainder was principally high-grade silver ore from the Silver Leaf claim.

Tombstone district.—The Tombstone Development Co. operated its mine continuously in 1942, shipped 1,130 tons of gold-silver ore and 564 tons of silver-lead ore to the smelter at El Paso, Tex., and treated 250 tons of old tailings (gold-silver) by cyanidation. At the end of the year the company had to abandon its gold-silver-lead operations, owing to Government restriction, but started opening up manganese areas for production. The rest of the district output was mainly crude silver-lead ore (1,568 tons) from the Tombstone Extension mine operated by lessees.

Turquoise district (*Courtland, Pearce, Gleeson*).—J. P. Giacoma operated the Defiance mine near Gleeson in 1942 and shipped 526 tons of silver-lead ore to the smelter at El Paso, Tex., and 220 tons of carbonate zinc-lead ore to an eastern zinc smelter. The remainder of the district output was largely crude lead ore (139 tons) from the Mystery and Cyclone properties and gold-silver ore (82 tons) from the Commonwealth mine.

Warren district (*Bisbee, Warren*).—The principal output in the Warren district in 1942 was, as usual, copper ore from the Copper Queen branch of the Phelps Dodge Corporation; 1,111,762 tons of ore were shipped direct to the copper smelters at Douglas and Clarkdale, Ariz. The company also shipped 466 tons of gold-silver fluxing ore, 194 tons of zinc-lead ore, and 1,018 tons of copper precipitates.

According to the company-printed annual report for 1942, development and exploration during the year encountered no new large ore bodies. However, the exploration and development can be considered satisfactory, especially at the Cole and Junction mines. In November, at the request of the War Department and the War Production Board, an agreement was negotiated with Metals Reserve

Company which provides for mining marginal ores from certain areas of the Copper Queen Limestone property that are not economic at a 12-cent copper price. Metals Reserve Company pays the cost of this operation plus a small operating profit and receives the copper produced. These ores are shipped to the United Verde smelter at Clarkdale, as there is no furnace capacity for them at the Copper Queen smelter at Douglas.

The Shattuck Denn Mining Corporation operated its Denn mine and 150-ton flotation mill at Bisbee continuously; it shipped 77,857 tons of copper ore to the smelter at El Paso, Tex., and treated 14,876 tons of zinc-lead ore in the mill. This mill also treated several thousand tons of custom ore. The rest of the district output was 5,021 tons of crude ore, mainly copper ore, from the Shattuck mine operated by lessees.

COCONINO COUNTY

Jacob Canyon and Warm Springs district.—Lessees operated the Mackin-Kennedy-Ryan group near Jacob Lake in 1942 and shipped 1,116 tons of carbonate ore to a smelter in Utah. Other producers of similar ore were the Kaibab and Petoskey properties.

Navajo Reservation district.—About 125 tons of carbonate copper ore were produced in 1942 from the Mardun mine east of Cameron.

GILA COUNTY

Banner and Dripping Springs district.—The principal output in the Banner and Dripping Springs district in 1942 was copper ore (39,837 tons) from the Christmas mine shipped direct to a smelter and zinc-lead ore (4,043 tons) and lead ore (620 tons) from the "79" mine. The zinc-lead ore from the "79" mine was shipped to the Denn mill at Bisbee for treatment.

Globe-Miami district.—The Globe-Miami district, with a production of 188,529,000 net pounds of copper in 1942 (164,837,300 net pounds in 1941), remained the chief copper-producing area in Arizona. The Inspiration property, with a yield of 104,320,491 net pounds of copper, was again the largest producer of copper in the district and ranked third in the State. The Inspiration Consolidated Copper Co. reported that 4,199,268 tons of copper ore from which the slimes had been removed were treated by ferric sulfate leaching; the slimes (333,784 tons) removed from the ore and 503,648 tons of additional crude copper ore were treated at the concentrator to recover the sulfide copper, and the tailings were treated with sulfuric acid to dissolve the oxide copper.

According to the printed annual report of the company for 1942, the mine, main leaching plant, slimes leaching plant, and that part of the concentrator treating slimes for the recovery of their sulfide copper content operated continuously throughout the year. The original flotation concentrator was altered during the year to provide treatment facilities for 4,000 tons of mixed crude ore a day by the leach-float process. This process involves sulfuric acid leaching of the oxide copper content of the ore, precipitating the dissolved copper as cement copper and floating it, with the sulfide copper content of the ore, as a concentrate. Treatment of crude ore by this process commenced July 13, 1942, and continued throughout the remainder of the year. Construction of a 100-ton daily capacity sulfuric acid plant was com-

in September and put in operation. An acute shortage of able labor continued throughout the year. A number of women employed in several sections of the plant, and their work has ed satisfactory. In October the Army furloughed 100 soldiers for underground work which, in part, alleviated the labor shortage.

The Miami Copper Co. operated its mine, 18,000-ton concentrator, and 3,000-ton leaching plant continuously; 5,922,250 tons of copper ore were treated by the leach-float process (as at Inspiration). In addition, 3,778 tons of copper precipitates were produced from leaching in place, and 426 tons of molybdenum concentrate were recovered from the copper ore.

According to the company printed annual report for 1942, operations were continuous throughout the year in both the mixed and sulfide ore bodies and in leaching copper from broken gob overlying worked-out portions of the ore body. The tonnage of ore mined was the largest (except 1930) in the 32-year life of the property, and copper production was greater than in any previous year. A shortage of labor was considerably alleviated toward the end of the year through the furloughing of essential mine labor from the Army and through the assistance of the United States Employment Service. In spite of a labor shortage, copper production was maintained at a maximum rate throughout the year at the expense of mine development, which fell behind to such an extent that a reduction in copper production is expected until such time as the necessary manpower becomes available to bring mine development back to normal, and every effort is being made in this direction. Exhaustion of the mixed-ore body, estimated to take place in the fall of 1942, has not yet occurred and it will probably continue in production through the first quarter of 1943.

The rest of the district output was largely crude copper ore (15,152 tons), principally from the Carlota mine near Miami.

The Castle Dome Copper Co., Inc., a wholly owned subsidiary of the Miami Copper Co., started in January 1942 to develop the Castle Dome ore body near Miami and to erect a treatment plant. It is expected that the mill will be completed and ore developed during the summer of 1943. The mill is straight flotation; mining is conducted by the open-cut method.

Green Valley district (*Payson*).—About 100 tons of gold ore were shipped in 1942 from the Summit mine dump near Payson and 5 tons of copper ore from the Copper King claim.

Pioneer (*Pinal Mountains*) *district*.—Nearly all (58 tons) the output in the Pioneer district in 1942 was silver ore from the Bob Tail, Pioneer, and Vindicator properties south of Globe.

GRAHAM COUNTY

The output of Graham County in 1942 was mainly 929 tons of crude lead ore from the Aravaipa mine near Klondyke and 311 tons of similar ore from the Ten Strike claim, both in the Aravaipa district.

GREENLEE COUNTY

Ash Peak district (*Duncan*).—The output of the Ash Peak district in 1942 was 20,756 tons of silver ore shipped direct to a smelter. Leasing operations at the Ash Peak mine produced 19,041 tons, and the remainder (1,715 tons) came from the Hardy mine.

Copper Mountain district (*Morenci*).—The most important o in the Copper Mountain district continued in 1942 to be coppe and copper precipitates from the Morenci branch of the Phelps D Corporation; the output comprised 7,640,890 tons of copper treated by concentration, 53,006 tons of copper ore shipped direct to the new Morenci smelter, and 8,986 tons of copper precipitates smelted. The rest of the district output was 837 tons of gold ore shipped to a smelter from the Climax (Emma Gomez) and Gold Belt properties and 116 tons of copper ore from the Keating mine.

According to the annual report of the Phelps Dodge Corporation for 1942, regular production from the Morenci open pit commenced at the end of January, and the new 25,000-ton concentrator received its first ore January 30. The initial charging of the first smelter furnace started in April, and full capacity of all operations occurred in the following 6-week period. Until July a portion of the concentrate production was shipped to the Copper Queen smelter at Douglas. Production of copper from leaching operations was increased in 1942 by the output from the new Metcalf precipitation plant, which treats copper-bearing waters from the old Coronado mine. At the close of the year, 15 mining benches were operated at the open pit. In March 1942 the corporation concluded negotiations with the Defense Plant Corporation for enlargement of operations at the Morenci open pit and reduction works and also of the capacity of the El Paso copper refinery. It is estimated that construction work on the program will be completed about August 1, 1943, and that the new facilities will be operating at capacity some time during the last quarter of the year.

MARICOPA COUNTY

Cave Creek and Camp Creek district.—Virtually all the output in the Cave Creek and Camp Creek district in 1942 was gold ore; most of it (210 tons) was from the Maricopa mine, treated by amalgamation.

New River (*Moors*) *district.*—The Orizaba Mining Co. operated the Orizaba mine in 1942 and shipped 1,898 tons of copper ore to a smelter. A little gold ore was shipped from the Leland, Minnie Lee, and Moore properties.

Osborn district.—A total of 1,624 tons of ore was produced from two mines in the Osborn district in 1942; the output comprised 1,155 tons of crude lead ore from the Moon Anchor mine and 434 tons of lead ore and 35 tons of lead-copper ore from the Belmont-McNeil mine.

Salt River Mountains district.—The Park View Mining Co. operated the Delta mine near Phoenix 4 months in 1942; about 450 tons of gold ore were treated in a flotation mill, and 211 tons of similar ore were shipped to a smelter. Gold ore was produced also from the North Delta claim.

Sunflower (*Mazatzal*) *district.*—A lessee operated the Little Daisy mine 3 months in 1942 and shipped 52 tons of gold ore to a smelter.

Vulture district.—Gold ore (34,143 tons) from the Vulture mine was again the most important output in the Vulture district in 1942. The East Vulture Mining Co. operated the mine and its 300-ton

cyanide and concentration mill continuously until December 15. The rest of the district output was mainly lead ore (926 tons) from the Montezuma mine and silver ore (269 tons) from the Newsboy (Pitt) mine.

Wickenburg district.—About 1,000 tons of old tailings (gold) from a dump near Wickenburg were treated in 1942 by cyanidation.

MOHAVE COUNTY

Bentley (Grand Wash) district.—Carbonate ore (36 tons) averaging 26 percent copper to the ton was shipped in 1942 from the Grand Gulch mine.

Cedar Valley district.—Molybdenum Corporation of America operated the Boriana mine near Yucca throughout 1942 and treated 10,000 tons of tungsten-copper ore by gravity concentration and flotation; copper concentrates were shipped to a smelter in Arizona and tungsten concentrates to an eastern market.

Cottonwood district.—Lessees operated the Copper Giant mine near Hackberry in 1942 and shipped 2,030 tons of gold-copper ore to a smelter.

Gold Basin district.—Nearly all the output of the Gold Basin district in 1942 was gold ore and old tailings treated in a custom cyanide mill; the chief producers were the O. K., Excelsior, and Golden Link properties. Placer gold (19 fine ounces) was recovered by various operators working at the Gold Basin Placers.

Indian Secret (White Hills) district.—A 40-ton cyanide leaching plant was built in 1942 at the White Hills property, and during the year 250 tons of silver ore were treated.

Maynard and McConnico district.—Mining and milling at the Bimetal open-pit mine near Kingman ceased in January 1942; before closing about 100 tons of gold ore were treated by flotation. The rest of the district output was 25 tons of gold ore from the Columbus-Lead Carbonate group.

Minnesota district.—The output of ore in the Minnesota district totaled 171 tons in 1942; most of it was gold-silver ore cyanided from the Horn Silver mine and gold ore cyanided from the Blue Rock mine.

Music Mountain district.—Lessees operated the Mohawk mine near Valentine in 1942 and treated 153 tons of gold ore by amalgamation and concentration. The remainder of the district output was principally rich gold ore (74 tons) from the Roosevelt mine, shipped to a smelter.

Owens (McCracken and Potts Mountain) district.—The Cleopatra mine was operated nearly all year by Strong & Harris, who shipped 2,798 tons of gold-copper ore to the smelter at Clarkdale. The rest of the district output was mainly small lots of gold ore and copper-gold ore produced from various claims and sold to the Wickenburg Ore Market.

San Francisco (Oatman, Goldroad, Katherine, Vivian) district.—Production of gold in the San Francisco district was 28,570 fine ounces in 1942 compared with 42,098 fine ounces in 1941. More than 74 percent of the output came from the Goldroad mine at Goldroad and most of the remainder from the Tyro mine at Katherine. The United

States Smelting, Refining & Mining Co. operated the Goldroad mine continuously until September 20 and treated 99,298 tons of gold ore in the company 300-ton cyanide plant. The Tyro mine and 300-ton cyanide mill of the Gold Standard Mines Corporation were operated throughout the year; the company treated 77,089 tons of low-grade gold ore from the Tyro mine and 510 tons of custom ore. The Vivian Mining Co. operated its 100-ton custom cyanide mill until March 1; about 1,450 tons of gold ore were treated, principally from the Vivian-Lelande-Mitchell and Pioneer properties. Other gold producers included the Big Jim, Burt, Gold Dust, King of Secret Pass, Minnie, Philadelphia, Ruth-Rattan, and Telluride properties.

Wallapai district (Cerbat, Chloride, Mineral Park, Stockton Hill).—Approximately 70,500 tons of ore were produced in the Wallapai district in 1942; nearly 57 percent of it was zinc-lead ore from the Tennessee mine, 26 percent was zinc ore from the Middle Golconda-Oro Plata group, and the remainder was largely gold ore from various properties. The Tennessee mine at Chloride was operated throughout the year by the Tennessee-Schuylkill Corporation; 40,055 tons of zinc-lead ore were treated in the company 150-ton flotation mill. The Davenport Mining & Reduction Co. operated the Middle Golconda-Oro Plata group continuously until September 11, when operations ceased, owing to a shortage of available labor. During the year 18,636 tons of zinc ore were treated in the company 100-ton flotation mill. About 2,800 tons of gold ore from the Golden Gem mine were concentrated in a mill on the property, and 1,026 tons of similar ore from the mine dump were cyanided in a custom mill. Silver ore (1,000 tons) from the C. O. D. mine was concentrated, a total of 1,076 tons of gold-silver ore from the Juno and Nighthawk mines was cyanided, and 446 tons of zinc-lead ore from the Minnesota-Connor property were concentrated. Other producers of gold ore included the Emerson, Flores, Hidden Treasure, O'Brien, Rambler, Red Seal, Rico, and Summit properties.

Weaver (Mocking Bird, Pilgrim, Portland) district.—Output of ore in the Weaver district declined from 18,858 tons in 1941 to 3,861 tons in 1942. The principal output in 1942 was 3,733 tons of gold ore from the Golden Door mine treated in the custom cyanide mill of Producers Mines, Inc. This company operated its 300-ton cyanide mill continuously on custom ore until May 15, when it closed permanently.

PIMA COUNTY

Ajo district.—The New Cornelia open-pit mine, the only producer in the Ajo district in 1942, was operated at capacity throughout the year by the Phelps Dodge Corporation; 8,324,033 tons of copper ore were treated by flotation, and 704 tons of crude copper ore were shipped direct to a smelter. The capacity of the concentrator was increased from 22,500 to 25,000 tons of ore a day, and the mine remained the largest producer of copper in Arizona. According to the annual report of the corporation for 1942, necessary work was done in the open pit with a view to meeting the increased production problem; double tracking was done on several of the waste dumps. At the concentrator certain structural changes in milling equipment, designed to increase production still further, were completed and satisfactory results obtained.

Amole district.—Virtually all the output of the Amole district in 1942 was crude lead ore (607 tons) from the Old Yuma mine near Tucson; the property was worked part of the year by the Tucson Ore Milling Co.

Arivaca district.—Gold ore (70 tons) shipped to a smelter from the Backbone and Oreona mines was the chief output in the Arivaca district in 1942.

Baboquivari district.—All the output (1,700 tons) in the Baboquivari district in 1942 was gold ore from the Allison mine, operated by the Gold Bar Mining Co.; both the mine and 50-ton cyanide mill shut down March 1.

Cababi (Comobabi) district.—About 85 tons of ore were produced in the Cababi district in 1942; most of it was copper ore from the Serenake mine, gold ore from the Grand Central mine, and lead ore from the Stepp claim.

Cerro Colorado district.—Silver ore (62 tons) and lead-copper ore (5 tons) were produced in 1942 from the Mary "G" mine.

Empire district.—E. P. Hilton operated the State of Maine mine in 1942 and shipped 145 tons of carbonate lead ore to El Paso, Tex., and 429 tons of carbonate zinc ore to Coffeyville, Kans.

Helvetia (Rosemont) district.—The Helvetia Mining & Milling Co. was organized in 1942 to operate the Copper World (Leader) mine; during the year 2,000 tons of copper ore were treated in a concentration mill, and 1,599 tons of similar ore were shipped direct to a smelter. Copper ore (855 tons) was shipped also from the Rosemont mine by a lessee and lead-copper ore (11 tons) from the Mohawk claim.

Old Hat district (Oracle).—Three mines in the Old Hat district in Pima County produced 12,149 tons of copper ore in 1942; most (12,000 tons) of it was treated in a 100-ton flotation mill and came from the Daily and Geeseman groups operated by Control Mines, Inc.

Pima (Sierritas, Papago, Twin Buttes) district.—Nearly all the output in the Pima district in 1942 was crude silver-lead ore (96 tons) from the Esperanza, High Hill, and Two Friends properties and crude copper ore (65 tons) from the Armargoza, Copper Glance, and King properties.

Quijotoa district.—Copper ore (35 tons) was produced in 1942 from the Highland and Coplen mines and lead ore (30 tons) from the Tres Metals claim.

Roskruge and Waterman (Silver Hill) district.—Leasing operations at the Silver Hill mine in 1942 produced 145 tons of silver-lead ore and 44 tons of copper ore.

Silver Bell district.—George T. Harford operated the Arizona Copper & Mint property in 1942 and shipped 100 tons of silver-lead-copper ore to a smelter.

PINAL COUNTY

Bunker Hill district (Copper Creek).—The Bunker Hill and Magma Chief properties were operated in 1942; 370 tons of lead-copper ore from the Bunker Hill mine were concentrated, and 210 tons of copper ore from the Magma Chief mine were shipped direct to a smelter.

Casa Grande district.—The output of the Casa Grande district in 1942 comprised 253 tons of silver ore from the Silver Reef mine, 89 tons of gold ore from the Old Jonah and Turning Point mines, 57 tons of copper ore from the Slate Mountain and Andrade properties, and 44 tons of lead ore from the Sheridan Range and Sunrise properties.

Mineral Creek district (Ray).—Nevada Consolidated Copper Corporation (subsidiary of Kennecott Copper Corporation) operated its mine at Ray and 12,000-ton concentrator at Hayden at capacity throughout the year; 2,967,941 tons of copper ore were treated by flotation, and 1,327 tons of crude copper ore and 8,371 tons of copper precipitates were shipped to the smelter at Hayden. The rest of the district output was 276 tons of copper ore from the Copper Butte mine.

Mineral Hill district.—The principal output in the Mineral Hill district in 1942 was gold ore (1,079 tons) shipped to a smelter from the Consolidated Gold, Sunset, and Wedge properties.

Old Hat district (Oracle).—In June 1942 the Mammoth-St. Anthony Limited installed additional flotation equipment in its 550-ton mill to treat sulfide zinc-lead ore; heretofore, the mill had treated only oxidized gold-silver-lead-molybdenum-vanadium ore. During the year 147,293 tons of such ore were treated by gravity concentration, followed by flotation, the flotation tailings were treated by cyanidation, and 15,700 tons of zinc-lead ore were treated by straight flotation. The oxide lead concentrates were smelted in the company 20-ton lead furnace, and the sulfide lead concentrates were shipped to El Paso, Tex. Gold precipitates, as well as molybdenum and vanadium products, were shipped East and zinc concentrates to Amarillo, Tex. The rest of the district output was mainly 45 tons of crude lead ore from the Mammoth Tiger Extension mine.

Pioneer district (Superior).—Copper ore and zinc-copper ore from the Magma mine continued in 1942 to be the principal output in the Pioneer district. The Magma Copper Co. operated its mine, 850-ton concentrator, and 450-ton copper smelter throughout the year, except for brief shut-downs to allow for repairs. The company reported that 281,283 tons of copper ore and 87,105 tons of zinc-copper ore were treated in the concentrator, and 77,728 tons of copper ore were sent direct to the smelter. The zinc concentrates (8,748 tons) were shipped to Amarillo, Tex.

According to the company printed annual report for 1942, the average net cost of producing copper after deduction of gold, silver, and zinc concentrate values was 9.66 cents a pound compared with 7.90 cents a pound in 1941. Development in 1942 comprised 8,647 feet of drifting, 4,985 feet of raising, 749 feet of sinking, and 4,073 feet of cross-cutting; the shaft is now down to the 4,908 level. During the summer months production of ore dropped because of four retarding factors—excessive heat throughout the lower levels of the mine, loss of many skilled employees to other higher-paid war industries and to the armed forces, inexperience and inefficiency of many of the labor replacements, and inability to obtain a sufficient number of labor replacements of any kind from August to October. In October the company obtained some experienced miners released from the Army and some gold miners from the Colorado gold mines closed by Government regulations. Commencing with October production increased; however, it took approximately 10 percent more men underground to attain this increase. The tonnage of zinc-copper ore mined in 1942 was greater than in any previous year, but during December 1942 to June 1943 the zinc content of the ore has diminished greatly; the gold and silver content of the copper ore on the lower levels of the mine has also decreased seriously.

The rest of the district output was mainly crude silver ore (8,096 tons) from the Reymert mine, crude gold ore (759 tons) from the Lake Superior & Arizona property, and silver ore (601 tons) from the Belmont and Queen Creek properties.

SANTA CRUZ COUNTY

Harshaw district.—In 1942, as in 1941, the principal output in the Harshaw district was zinc-lead-silver ore from the Trench and Flux groups operated by the American Smelting & Refining Co. The company 200-ton flotation mill ran continuously and treated 76,855 tons of zinc-lead-silver ore; it was the largest producer of lead and zinc in Arizona in 1942. The rest of the district output was crude silver-lead ore (297 tons) from the American, Hardshell, and World's Fair properties.

Oro Blanco district (Ruby).—About 1,800 tons of ore were produced in the Oro Blanco district in 1942; most of it was crude silver ore (1,133 tons) from the Brick mines, gold ore (269 tons) from the Noon and Oro Blanco properties, and gold-silver ore (237 tons) from the Old Soldier and Tres Amigos group.

Patagonia (Duquesne) district.—In 1942 zinc-lead-copper ore from the Duquesne mine, operated by the Callahan Zinc-Lead Co., was the most important output in the Patagonia district. The company 125-ton flotation mill ran continuously and treated 31,136 tons of zinc-lead-copper ore (including 967 tons of custom ore); copper concentrates (1,432 tons) and lead-copper concentrates (1,016 tons) were shipped to El Paso, Tex., and zinc concentrates (4,011 tons) to Amarillo, Tex. The remainder of the district output was chiefly zinc-lead-copper ore (967 tons) from the Pride of the West mine treated in the Duquesne mill.

Tyndall district.—The output of the Tyndall district in 1942 was principally crude lead ore (207 tons) and zinc-lead milling ore (337 tons) from the Jefferson mine, and silver-lead ore (238 tons) from the Alto and Eureka properties.

Wrightson district.—Lead-copper ore (30 tons) was produced in 1942 from the Armada mine and lead ore (7 tons) from the Lead King claim.

YAVAPAI COUNTY

Agua Fria district.—All the output of the Agua Fria district in 1942 was crude copper ore (450 tons) from the Burzog (Old Minor) and Stoddard properties east of Mayer.

Big Bug district.—The principal output in the Big Bug district in 1942 was, as in 1941, zinc-lead ore and gold-silver ore from the Iron King mine at Humboldt. The mine was operated continuously—the first 6 months of 1942 by the Iron King Mining Co. and the last 6 months by the Shattuck Denn Mining Corporation, which purchased the property July 1; 76,757 tons of zinc-lead ore were treated in the company 240-ton flotation mill, 65,018 tons of current flotation tailings (gold-silver) were treated by cyanidation, and 12,393 tons of crude gold-silver ore were shipped to a smelter. The remainder of the district lode output was largely old tailings (1,298 tons) containing gold, silver, and copper shipped from the Humboldt tailing dump. More than one-half of the State placer gold production in 1942 was

recovered from properties in this district; the chief producer was the Arical Mines, Inc., operating a dragline floating dredge at the Black Walnut, Farnum, and Shanks properties.

Black Canyon district.—The Golden Turkey Mining Co., Inc., a large producer of gold from 1933 to 1941, inclusive, closed its mine and 200-ton mill near Cordes in January 1942; the mill treated 1,140 tons of gold ore in 1942. The rest of the district output was mainly gold-silver ore (33 tons) from the Hidden Treasure mine and silver ore (30 tons) from the Thunderbolt mine.

Black Hills district.—The output of the Black Hills district in 1942 was 245 tons of gold ore from the Ambassador and D. & M. properties near Dewey and 32 tons of copper ore from the Yaeger mine.

Black Rock district.—The Super X (Atos) mine near Wickenburg was worked until May 31, 1942, and 900 tons of gold ore were treated by cyanide leaching. The remainder of the district output was chiefly crude gold ore (376 tons) from the George Washington, Gold Crown, and Golden Gate properties.

Blue Tank district.—Leasing operations at the Franklin D. mine produced 43 tons of gold ore in 1942, and 9 fine ounces of placer gold were recovered from claims along the Hassayampa River.

Bullard (Pierce) district.—Virtually all the output in the Bullard district in 1942 was crude gold-copper ore (289 tons) from the Bullard and Metz properties near Aguila.

Castle Creek district.—Small lots of various classes of ore were produced from claims in the Castle Creek district in 1942 and sold to the Wickenburg Ore Market.

Cherry Creek district.—Eight mines in the Cherry Creek district produced a total of 258 tons of crude gold ore in 1942; the chief producers were the Gray Eagle, Bugler, Sitting Bull, Black Hawk, and Volcano properties.

Copper Basin district.—The Commercial mine near Skull Valley was worked by a lessee in 1942, and 9,167 tons of copper ore were shipped to a smelter. The rest of the district lode output was mainly sulfide zinc ore (230 tons) from the Boston-Arizona mine and high-grade gold ore (15 tons) from the Stanley A. claim. About 15 fine ounces of placer gold were recovered from various claims along Copper Basin Wash.

Eureka district.—Copper ore from the Bagdad mine, operated by the Bagdad Copper Corporation, was the principal output in the Eureka district in 1942; 56,392 tons of ore were treated in the company 250-ton flotation mill. The company also built a new 2,500-ton mill and prepared the mine for greatly increased output in 1943. The Hillside mine—a large producer of gold, silver, lead, and zinc in 1941—was shut down in January 1942; during the month about 3,000 tons of zinc-lead ore were treated by flotation. Later in the year a lessee operated the mine and shipped 200 tons of crude gold-silver ore to a smelter. The remainder of the district output was chiefly gold ore (377 tons) from the April Showers, Big Stick, Bland, Crosby, Homestake, and New Year properties.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) district.—Seventeen lode mines in the Hassayampa district produced 285 tons of ore in 1942; most of it was gold ore (205 tons) shipped direct to a smelter from the Eureka, Golden Summer, Independence,

Oro Flame, and Railroad properties. The output of placer gold totaled 546 fine ounces, which was recovered chiefly at the Hobbs property by a dragline floating dredge during the first 2 months of the year.

Kirkland district.—The only output in the Kirkland district in 1942 was 47 tons of gold ore from the Venus mine.

Lynx Creek district.—The output of placer gold in the Lynx Creek district decreased from 4,372 fine ounces in 1941 to 87 fine ounces in 1942; most of the gold in 1942 was recovered by a dry-land dredge in January at the Speck-Lynx Creek property.

Martinez (Congress) district.—The Congress Mining Corporation, a large producer of gold since 1938, closed its 300-ton cyanide mill May 1, 1942. During the first 4 months of the year the mill treated 32,800 tons of gold ore and old tailings from the Congress property. From June 1 to the end of the year lessees worked in the mine and shipped 378 tons of crude gold ore to a smelter. The rest of the district output was mainly 600 tons of gold ore (concentrated) from the Niagara-Congress waste dump.

Peck district.—Virtually all the output in the Peck district in 1942 was crude silver ore (204 tons) shipped to a smelter from the Battle Flat and Swastika mines near Crown King.

Pine Grove district (Crown King).—The most important producer in the Pine Grove district in 1942 was, as in 1941, the Gladiator-War Eagle group operated by the Gladiator Mining Co. During the first 7 months of the year 1,952 tons of crude gold ore were shipped direct to a smelter; in August the company completed the erecting of a 50-ton mill, and during the remainder of the year 2,500 tons of zinc-lead-gold ore were treated by flotation. Lead concentrates containing an average of 6.31 ounces of gold to the ton were shipped to El Paso, Tex., and zinc concentrates to Amarillo, Tex. The rest of the district output was mainly 206 tons of crude gold-lead ore from the Del Pasco mine.

Pocket Creek district:—Sluicing at the Pocket Creek Placer in 1942 recovered 201 fine ounces of gold and 7 fine ounces of silver.

Tiger district.—Six mines in the Tiger district produced 263 tons of ore in 1942; most of it was gold ore (153 tons) from the Fortuna, Pilgrim, and Snowdrift properties and silver ore (100 tons) from the Tiger mine.

Verde district (Jerome).—The principal output in the Verde district in 1942 was, as usual, copper ore from the United Verde mine of the Phelps Dodge Corporation. The mine and 2,100-ton concentrator were operated throughout the year; 563,140 tons of copper ore and old tailings and 413 tons of copper precipitates were shipped direct to the company smelter at Clarkdale, and 649,108 tons of copper ore were treated in the concentrator.

According to the printed annual report of the corporation for 1942 ore production at the United Verde mine was confined to the underground areas. By the end of the year all copper mining areas above the 1,650 level had been abandoned on account of depletion of available ores. The development program for the lower levels was pushed, and the No. 8 shaft sinking was completed to the 4,631 level. An adjustment of the production quota for the United Verde mine under

the premium-price plan made it possible to make a moderate increase in copper production by mining certain marginal or low-grade ores during the last quarter of the year.

Lessees continued to work the Iron King-Equator group and shipped 24,477 tons of siliceous gold-silver ore to a smelter. The rest of the district output was chiefly 4,012 tons of crude copper ore from the Dundee-Arizona mine and 1,337 tons of crude gold-silver ore from the Silver Plate property.

Walker district.—The French Sheldon Mines operated the Sheldon property until October 20; about 1,000 tons of gold-silver ore were treated in the 100-ton concentration mill, and 1,036 tons of crude gold ore were shipped to a smelter. The remainder of the district lode output was largely 377 tons of zinc-lead milling ore from the New Strike mine and 341 tons of high-grade gold ore shipped to a smelter from the Champion, Emma, Good Luck, Lost Wonder, and Oro Plata properties. Approximately 20 fine ounces of placer gold were recovered from various claims on Lynx Creek near Walker.

Weaver district (Octave).—The principal output in the Weaver district in 1942 was, as usual, gold ore from the Alvarado, Octave, and Yarnell properties. However, the Octave mine, the largest producer of gold in the district since 1934, was closed in December, the Alvarado in June, and the Yarnell in September. The 80-ton flotation mill at the Octave mine treated 24,188 tons of gold ore, and the flotation tailings (23,718 tons) were cyanided. In addition, 471 tons of crude gold ore were shipped to a smelter. The Alvarado mine and 100-ton mill were worked by the Liberty Hill Gold Mines until June 30; 18,993 tons of gold ore were treated by cyanide leaching. About 26,500 tons of similar ore from the Yarnell mine were treated also by cyanide leaching. The remainder of the district lode output was chiefly gold ore (267 tons) shipped to a smelter from the Monica, May Queen, and Turtle properties. The output (56 fine ounces) of placer gold was recovered from various claims along Weaver Creek and at Rich Hill.

White Picacho district.—Nearly all the output in the White Picacho district in 1942 was silver-lead ore (1,155 tons) shipped to a smelter from the Diamond Joe mine near Wickenburg.

YUMA COUNTY

Castle Dome district.—The Arizona Lead Co. leased the Eliza DeLuce group in 1942 and built a 100-ton concentration mill on the property; from August 13 to the end of the year the mill treated 11,007 tons of silver-lead ore and old tailings. The rest of the district output was mainly 111 fine ounces of placer gold recovered by a Stebbins dry concentrator at the Ocatilla property.

Cienega district.—Leasing operations at the Empire Arizona and Mavis properties near Parker produced 826 tons of crude gold-copper ore in 1942.

Ellsworth district (Salome).—About 640 tons of ore were produced in the Ellsworth district in 1942; most of it was crude gold-copper ore (436 tons) from the Centroid, Critic, Moore, Sheba, and Yuma Copper properties and crude gold ore (100 tons) from the Bunker Hill and Hercules mines.

Plomosa district.—Nearly all the lode output in the Plomosa district in 1942 was crude silver ore (984 tons) from the R. & A. mine and crude gold ore (847 tons) and crude gold-copper ore (67 tons) from the Little Butte mine near Bouse. The output of 51 fine ounces of placer gold was recovered chiefly from the Can Do (Erdman), Cave Creek, and Sax properties.

Santa Maria (Planet, Bill Williams) district.—The Swansea Development Co. worked the Swansea mine throughout the year and shipped 293 tons of crude copper ore to a smelter. The property is equipped with a 250-ton flotation mill, and plans were made in December to bring the mine back to capacity production.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By CHARLES WHITE MERRILL AND H. M. GAYLORD

SUMMARY OUTLINE

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SUMMARY

The 39-percent decline in the total value of California output of gold, silver, copper, lead, and zinc in 1942 compared with 1941 does not nearly picture the disastrous effect of war on the industry. The production rate in December sank below the monthly average for any year since 1848. Gold, silver, and copper output in 1942 was below 1941 levels, but lead and zinc production rose. Higher wages, enlistment of miners in the armed forces, migration of miners to war industries, rising prices of supplies and equipment and difficulties in obtaining them, increased taxes, and the fixed prices for gold and silver (the most important of the five metals in California) were factors accelerating the downward trend, which was already under way in 1941. Although War Production Board Order L–208 popularly was assigned as the cause of the great decline in California's gold industry, a review of the 1941–42 monthly production record does not substantiate this view. The recession was virtually uninterrupted for the 2 years, and the rate of decline in October and November 1942, when the order was taking effect, did not deviate from the general 2-year pattern. (See Gold and Silver chapter of this volume for text of Order L–208.)

Comparing 1942 with 1941, gold decreased 40 percent and silver 33 percent in both quantity and value; copper decreased 73 percent in quantity and 72 percent in value; lead increased 49 percent in quantity and 75 percent in value; and zinc increased 39 percent in quantity and 73 percent in value. Of the total value of the five metals in 1942, gold represented 93 percent, silver 3 percent, lead 2 percent, and copper and zinc 1 percent each.

Despite a 42-percent slump for 1942 in total value of production, Nevada County continued to be the largest contributor to the metal-mining output of California; it supplied 18 percent of the State total value of the five metals, 19 percent of the total gold, and 40 percent of the lode gold. Sacramento County (largely from gold dredging) contributed 14 percent of the total value of the five metals; Yuba County (largely from gold dredging) and Kern County (largely from gold ore

and old tailings), 8 percent each; Butte County (largely from placer gravels), 7 percent; Amador County (largely from gold ore) and Inyo County (from gold, lead, tungsten, and zinc ores), 5 percent each; Siskiyou County (largely from placer gravels), 4 percent; and Calaveras County (from gold ore, gravels, and copper ore) and Mariposa County (two-thirds from gold ore and one-third from gravels), 3 percent each. Thus, each of the foregoing 10 of the 36 counties producing the five metals in California in 1942 contributed over 1 million

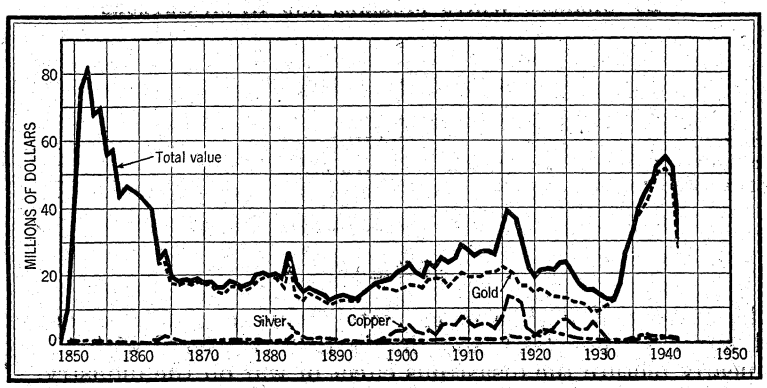

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in California, 1848-1942. The value of lead and zinc has exceeded $1,000,000 in only a few years.

dollars worth; together, they supplied over three-fourths of the total for these metals.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in California, 1938–42, and total, 1848–1942, 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
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
1941	835	724	4,280,185	1,408,793	49,307,755	2,154,188	1,531,867
1942	434	428	2,503,198	847,997	29,679,895	1,450,440	1,031,424
1848–1942	--------	--------	(2)	101,110,756	2,240,980,112	104,482,628	84,367,327

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	7,886,000	930,548	6,928,000	394,896	880,000	66,000	52,231,066
1942	2,116,000	256,036	10,302,000	690,234	1,226,000	114,018	31,771,607
1848–1942	[3] 593,628	192,459,604	[3] 131,003	15,455,155	[3] 53,096	9,569,482	2,542,831,680

[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 California, 1938–42, by classes of mines and by methods of recovery, and total, 1848–1942 [1]

Class and method	Mines producing [2]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average per cubic yard
Surface placers:						
Gravel mechanically handled:						
Connected-bucket dredges:						
1938	33	48	117,080,000	375,296	$13,135,360	$0.112
1939	34	47	121,655,000	370,264	12,959,240	.107
1940	32	46	132,461,000	414,966	14,523,810	.110
1941	37	47	135,757,000	418,282	14,639,870	.108
1942	30	44	106,543,000	310,937	10,882,795	.102
Dragline dredges:						
1938	77	68	24,560,000	118,108	4,133,780	.168
1939	142	109	31,618,000	172,519	6,038,165	.191
1940	198	106	42,747,000	205,181	7,181,335	.168
1941	234	112	45,579,000	225,019	7,875,665	.173
1942	122	79	24,526,000	117,906	4,126,710	.168
Becker-Hopkins dredges:						
1940 [3]	2	2	35,000	148	5,180	.148
1941	3	2	52,000	244	8,540	.164
1942	1	----------	5,000	23	805	.161
Suction dredges: [4]						
1940 [3]	4	4	64,000	584	20,440	.319
1941	17	17	357,000	1,763	61,705	.173
1942	18	15	278,000	1,419	49,665	.179
Nonfloating washing plants: [5]						
1938	74	71	3,538,000	23,046	806,610	.228
1939	114	101	5,512,000	41,694	1,459,290	.265
1940	131	105	5,908,000	28,232	988,120	.167
1941	85	76	5,656,000	28,703	1,004,605	.178
1942	46	40	1,637,000	10,044	351,540	.215

See footnotes at end of table.

Gold produced at placer mines in California, 1938–42, by classes of mines and by methods of recovery, and total, 1848–1942 [1]—Continued

Class and method	Mines producing [2]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average per cubic yard
Surface placers—Continued.						
Gravel hydraulically handled:						
Hydraulic:						
1938	86		1,719,000	7,061	247,135	$0.144
1939	74		921,000	6,059	212,065	.230
1940	92		2,401,000	12,059	422,065	.176
1941	79		2,886,000	10,145	355,075	.123
1942	45		1,980,000	6,106	213,710	.108
Small-scale-hand methods: [6]						
Wet:						
1938	292		2,863,500	41,686	1,459,010	.510
1939	267		2,534,100	38,815	1,358,525	.536
1940	278		1,710,200	38,526	1,348,410	.788
1941	182		1,599,700	29,040	1,016,400	.635
1942	119		1,152,900	16,079	562,765	.488
Dry:						
1938	15		6,500	172	6,020	.926
1939	25		11,900	169	5,915	.497
1940	17		10,800	211	7,385	.684
1941	13		7,300	220	7,700	1.055
1942	7		1,100	73	2,555	2.323
Underground placers:						
Drift:						
1938	99		97,000	7,144	250,040	2.578
1939	94		83,000	6,525	228,375	2.752
1940	96		88,000	5,045	176,575	2.007
1941	74		90,000	4,597	160,895	1.788
1942	45		22,000	2,339	81,865	3.721
Grand total placer:						
1938	676		149,864,000	572,513	20,037,955	.134
1939	[7] 749		162,335,000	636,045	22,261,575	.137
1940	[7] 836		185,425,000	704,952	24,673,320	.133
1941	724		191,984,000	718,013	25,130,455	.131
1942	[7] 428		136,145,000	464,926	16,272,410	.120
1848–1942 [1]			([8])	65,005,068	1,410,915,026	([8])

[1] For historic data by years see Minerals Yearbook, Review of 1940, p. 219.
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property worked.
[3] First year for which this method was reported used in California.
[4] Includes all placer operations using suction pump for delivering gravel to floating washing plant, except those producing less than 100 ounces of gold which are included under "Small-scale hand methods."
[5] 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."
[6] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[7] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.
[8] Complete data not available.

Gold.—An uninterrupted rise beginning in 1929 culminated in the production of $50,948,485 in gold in 1940, the largest value since 1856. In 1941, however, a reaction set in and gained headway in 1942. Monthly production declined approximately 4 percent a month fairly regularly from January 1941 to May 1942, when the downward trend greatly accelerated and continued at about 16 percent a month to December 1942. Strangely, the period when War Production Board Order L–208 was becoming effective did not mark a substantial change in the trend. Apparently, economic forces were curtailing gold production so rapidly in 1942 that exercise of Federal authority was not needed to accomplish a most drastic curtailment in gold mining in California. Production in December was at an annual rate of 246,612 fine ounces or $8,631,420, which, except for 1929 (when California

gold output was valued at $8,526,703), represented the lowest level since 1848.

The 25 leading gold-producing mines in California in 1942, listed in the following table, yielded 60 percent of the total gold output of the State. In 1942, six placers (five connected-bucket dredges and one dragline dredge) and two lode mines (gold ore) displaced two placers (connected-bucket dredges) and six lodes (five gold ore and one copper ore). Of those displaced, none was working at the end of 1942. Of those on the 1942 list, only four were producing at the close of the year.

Twenty-five leading gold-producing mines in California in 1942, in order of output

Rank	Mine	District	County	Rank in 1941	Operator	Source of gold
1	Natomas Co	Folsom	Sacramento	2	Natomas Co	Dredge.
2	Yuba Unit	Yuba River	Yuba	4	Yuba Consolidated Gold Fields.	Do.
3	Idaho Maryland-Brunswick.	Grass Valley-Nevada City.	Nevada	1	Idaho Maryland Mines Corporation.	Gold ore.
4	Empire Star mines	do	do	3	Empire Star Mines Co., Ltd.	Do.
5	Lava Cap	do	do	5	Lava Cap Gold Mining Corporation.	Do.
6	Capital dredges	Folsom	Sacramento	8	Capital Dredging Co	Dredge.
7	Butte Unit	Oroville	Butte	6	Yuba Consolidated Gold Fields.	Do.
8	Golden Queen	Mojave	Kern	9	Golden Queen Mining Co.	Gold ore.
9	Cactus Queen	do	do	13	Cactus Mines Co	Do.
10	Central Eureka	Mother Lode	Amador	7	Central Eureka Mining Co.	Do.
11	Eagle-Shawmut	do	Tuolumne	[1]23	Miller & Clemson	Do.
12	Carson Hill	do	Calaveras	10	Carson Hill Gold Mining Corporation.	Do.
13	Alabama	Ophir	Placer	12	Alabama California Gold Mines Co.	Do.
14	Original Sixteen to One.	Alleghany	Sierra	17	Original Sixteen to One Mine, Inc.	Do.
15	Placer Properties Co.	Knights Ferry	Stanislaus	31	Placer Properties Co	Dragline.
16	Snelling	Snelling	Merced	16	Snelling Gold Dredging Co.	Dredge.
17	Dredge No. 4	La Grange	Stanislaus	30	La Grange Gold Dredging Co.	Do.
18	Argonaut	Mother Lode	Amador	11	Argonaut Mining Co	Gold ore.
19	Siskiyou Unit	Callahan	Siskiyou	[1]26	Yuba Consolidated Gold Fields.	Dredge.
20	Junction City dredge.	Junction City	Trinity	33	Junction City Mining Co.	Do.
21	Surcease	Yankee Hill	Butte	22	Hoefling Bros	Gold ore.
22	Carr ranch	Trinity Center	Trinity	29	Carrville Gold Co	Dredge.
23	Mount Gaines	Mother Lode	Mariposa	50	Mount Gaines Mining Co.	Gold ore.
24	Cosumnes dredge	Cosumnes River	San Joaquin	32	Cosumnes Gold Dredging Co.	Dredge.
25	Kister property	Oroville	Butte	43	Gold Hill Dredging Co.	Do.

[1] Corrected figure.

Silver.—Most of the silver output in California in 1942 was more localized than that of the gold; the 10 leading silver-producing mines, listed in the following table, yielded 85 percent of the State total recoverable silver in that year. The list is similar to that of 1941, except for some changes in rank and the displacement of the Starlight mine (consolidated with its neighbor), Walker, and Grigsby mines, which suspended operations in 1941. By December, 6 of the 10 leading silver mines had suspended operations.

Ten leading silver-producing mines in California in 1942, in order of output

Rank	Mine	District	County	Rank in 1941	Operator	Source of silver
1	Cactus Queen	Mojave	Kern	1	Cactus Mines Co	Gold-silver ore.
2	Lava Cap	Grass Valley-Nevada City.	Nevada	2	Lava Cap Gold Mining Corporation.	Gold ore.
3	Columbia No. 2	Resting Springs	Inyo	6	Shoshone Mines, Inc.	Lead ore
4	Golden Queen	Mojave	Kern	3	Golden Queen Mining Co.	Gold ore.
5	Pine Creek	Bishop Creek	Inyo	19	United States Vanadium Corporation.	Tungsten-molybdenum-copper ore.
6	Essex-Columbia (Darwin Lead).	Coso	do	16	Imperial Metals, Inc.	Silver ore and lead ore.
7	Kelly	Randsburg	San Bernardino.	7	Frank W. Royer	Silver ore.
8	Empire Star mines	Grass Valley-Nevada City.	Nevada	8	Empire Star Mines Co., Ltd.	Gold ore.
9	Alabama	Ophir	Placer	9	Alabama California Gold Mines Co.	Do.
10	Idaho Maryland-Brunswick.	Grass Valley-Nevada City.	Nevada	17	Idaho Maryland Mines Corporation.	Do.

Copper.—Copper production in California was small in 1942 because the Walker mine in the Genesee district of Plumas County, which had contributed over 92 percent of the State copper in 1941, was inactive. The leading copper producer for 1942 was the Pine

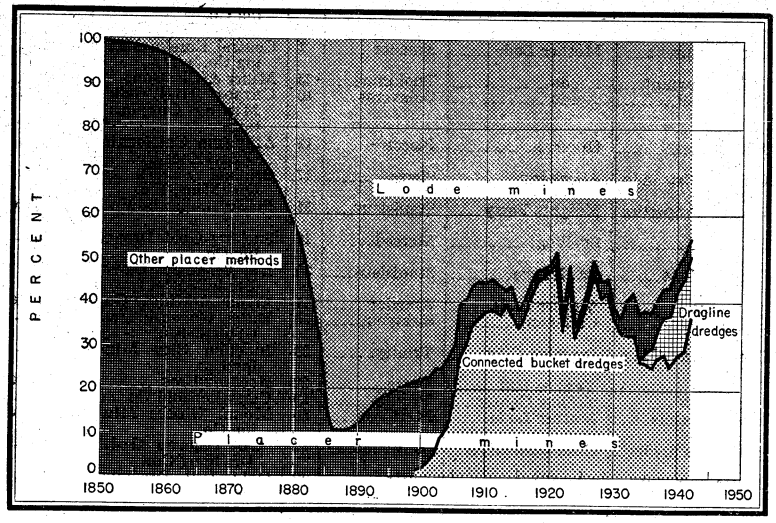

FIGURE 2.—Percentage of total California gold produced at lode and placer mines and by various methods of placer mining, 1850–1942.

Creek mine of the United States Vanadium Corporation, in the Bishop Creek district of Inyo County, where copper concentrate was recovered as a byproduct from ore worked principally for tungsten. In October, however, the Keystone Copper Co. made an initial shipment of copper concentrate from Copperopolis in Calaveras County; by the end of the year, the company attained the highest production rate of any mine in the State. Development work at copper proper-

ties was carried on by the Gray Eagle Copper Co. near Happy Camp in Siskiyou County, where a 550-ton plant was under construction, and by the Mountain Copper Co., Ltd., near Kennett in Shasta County, with a 350-ton plant under construction.

Lead.—The expansion in California's lead production from 990,000 pounds in 1938 to 10,302,000 pounds in 1942 resulted in lead displacing copper as the third most valuable of the five metals produced in the State. The Shoshone Mines, Inc., operator of the Columbia No. 2 mine, was the leading producer, and the Imperial Metals, Inc., operator of a group of mines at Darwin, was the second-largest lead producer; both operations are in Inyo County.

Zinc.—Zinc production in California, although still very small, continued to expand for the fourth successive year. The Combined Metals Reduction Co., operator of the Colorado group in the Modoc district of Inyo County, and W. F. Huston, operator of the Carbonate King mine in the Ivanpah district of San Bernardino County, contributed 77 percent of the State total.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1942, by counties, in terms of recovered metals

County	Mines producing [1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	2		17	$595			17	$595
Amador	14	25	39,418	1,379,630	10,056	$351,960	49,474	1,731,590
Butte	3	33	7,363	257,705	53,553	1,874,355	60,916	2,132,060
Calaveras	23	27	16,638	582,330	11,366	397,810	28,004	980,140
Del Norte		1			5	175	5	175
Eldorado	22	26	6,145	215,075	12,049	421,715	18,194	636,790
Fresno		6			1,166	40,810	1,166	40,810
Humboldt	2	6	3	105	4,020	140,700	4,023	140,805
Imperial	4	1	126	4,410	48	1,680	174	6,090
Inyo	42	1	11,703	409,605	7	245	11,710	409,850
Kern	58	7	56,554	1,979,390	360	12,600	56,914	1,991,990
Los Angeles	8	4	356	12,460	123	4,305	479	16,765
Madera	5	16	27	945	690	24,150	717	25,095
Mariposa	42	14	20,503	717,605	8,789	307,615	29,292	1,025,220
Merced		6			20,053	701,855	20,053	701,855
Mono	11	1	1,831	64,085	2	70	1,833	64,155
Nevada	14	17	154,927	5,422,445	6,666	233,310	161,593	5,655,755
Orange	2		5	175			5	175
Placer	10	36	14,929	522,515	8,362	292,670	23,291	815,185
Plumas	9	12	6,867	240,345	1,298	45,430	8,165	285,775
Riverside	8	2	337	11,795	11	385	348	12,180
Sacramento	2	15	6	210	125,114	4,378,990	125,120	4,379,200
San Bernardino	44	5	9,640	337,400	25	875	9,665	338,275
San Diego	3		7	245			7	245
San Francisco		(3)			4	140	4	140
San Joaquin		10			18,103	633,605	18,103	633,605
San Luis Obispo		1			4	140	4	140
Santa Barbara and Shasta [2]	18	16	4,192	146,720	17,347	607,145	21,539	753,865
Sierra	13	31	11,787	412,545	6,243	218,505	18,030	631,050
Siskiyou	29	49	1,073	37,555	37,685	1,318,975	38,758	1,356,530
Stanislaus		5			27,795	972,825	27,795	972,825
Trinity	16	38	740	25,900	23,457	820,995	24,197	846,895
Tulare	4		134	4,690			134	4,690
Tuolumne	24	7	11,739	410,865	934	32,690	12,673	443,555
Yuba	2	10	6,004	210,140	69,591	2,435,685	75,595	2,645,825
Total, 1941	434	428	383,071	13,407,485	464,926	16,272,410	847,997	29,679,895
	835	724	690,780	24,177,300	718,013	25,130,455	1,408,793	49,307,755

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1942, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	3	$2			3	$2
Amador	9,831	6,991	1,260	$896	11,091	7,887
Butte	15,999	11,377	4,351	3,094	20,350	14,471
Calaveras	7,214	5,130	1,166	829	8,380	5,959
Del Norte			3	2	3	2
Eldorado	647	460	1,637	1,164	2,284	1,624
Fresno			201	143	201	143
Humboldt	14	10	623	443	637	453
Imperial	169	120			169	120
Inyo	333,367	237,061	1	1	333,368	237,062
Kern	597,614	424,970	69	49	597,683	425,019
Los Angeles	208	148	21	15	229	163
Madera	52	37	190	135	242	172
Mariposa	7,875	5,600	1,744	1,240	9,619	6,840
Merced			1,942	1,381	1,942	1,381
Mono	15,580	11,079	1	1	15,581	11,080
Nevada	300,240	213,504	723	514	300,963	214,018
Orange	3,323	2,363			3,323	2,363
Placer	30,517	21,701	994	707	31,511	22,408
Plumas	838	596	121	86	959	682
Riverside	180	128	1	1	181	129
Sacramento	1	1	6,386	4,541	6,387	4,542
San Bernardino	65,717	46,732			65,717	46,732
San Diego	3	2			3	2
San Francisco						
San Joaquin			1,762	1,253	1,762	1,253
San Luis Obispo						
Santa Barbara and Shasta [3]	13,195	9,383	2,001	1,423	15,196	10,806
Sierra	2,129	1,514	502	357	2,631	1,871
Siskiyou	315	224	5,573	3,963	5,888	4,187
Stanislaus			2,544	1,809	2,544	1,809
Trinity	308	219	2,506	1,782	2,814	2,001
Tulare	57	41			57	41
Tuolumne	3,538	2,516	83	59	3,621	2,575
Yuba	871	619	4,230	3,008	5,101	3,627
Total, 1941	1,409,805	1,002,528	40,635	28,896	1,450,440	1,031,424
	2,088,713	1,485,307	65,475	46,560	2,154,188	1,531,867

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine							$597
Amador	4,000	$484	2,000	$134			1,740,095
Butte							2,146,531
Calaveras	532,000	64,372			8,000	$744	1,051,215
Del Norte							177
Eldorado	2,000	242					638,656
Fresno							40,953
Humboldt	6,000	726					141,984
Imperial							6,210
Inyo	740,000	89,540	10,170,000	681,390	754,000	70,122	1,487,964
Kern	2,000	242	8,000	536			2,417,787
Los Angeles							16,928
Madera	66,000	7,986					33,253
Mariposa	18,000	2,178	16,000	1,072			1,035,310
Merced							703,236
Mono							75,235
Nevada	14,000	1,694	14,000	938			5,872,405
Orange			4,000	268	6,000	558	3,364
Placer	6,000	726	24,000	1,608			839,927
Plumas			2,000	134			286,591
Riverside	2,000	242					12,551
Sacramento							4,383,742
San Bernardino	154,000	18,634	60,000	4,020	458,000	42,594	450,255
San Diego							247
San Francisco							140
San Joaquin							634,858
San Luis Obispo							140

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1942, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Santa Barbara and Shasta [3]	562,000	$68,002	2,000	$134			$832,807
Sierra							632,921
Siskiyou	4,000	484					1,361,201
Stanislaus							974,634
Trinity							848,896
Tulare							4,731
Tuolumne	4,000	484					446,614
Yuba							2,649,452
Total, 1941	2,116,000	256,036	10,302,000	690,234	1,226,000	$114,018	31,771,607
	7,886,000	930,548	6,928,000	394,896	880,000	66,000	52,231,066

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Output from property not classed as a "mine."
[3] Combined to avoid disclosure of individual output.

MINING INDUSTRY

The tonnage of material from lode mines in California treated in 1942 decreased 42 percent compared with 1941, and the yardage at placer mines decreased 29 percent; the output of lode gold declined 45 percent and that of placer gold 35 percent. The average recoverable gold content of gravels declined 8 percent. Of the State total gold output in 1942, 45 percent was from lode mines and 55 percent from placers; this represented the highest placer : lode ratio since 1900, when separate annual data were first compiled, and almost certainly the highest since large-scale hydraulicking was terminated by the Sawyer Decision of 1884.

Dredges of the connected-bucket type washed 78 percent of the gravel mined and recovered 67 percent of the State total placer gold in 1942.

Dragline dredging, which had had such a spectacular rise during the years following its inception in California in 1933, reacted most unfavorably to war conditions; gold production by this method decreased 48 percent. The great demand for dragline excavators and for labor skilled in earth-moving caused rapid abandonment of dragline-dredge operations. The following table gives partial data on equipment in the dragline industry over a 4-year period; information on bucket size was supplied for 52 dredges in 1939, 89 in 1940, 94 in 1941, and 72 in 1942.

Size of buckets (cubic yards)	Number of boats				Size of buckets (cubic yards)	Number of boats			
	1939	1940	1941	1942		1939	1940	1941	1942
7½		1			1¾	2	3	8	5
6	1		2	1	1½	17	25	19	17
5		2	6	7	1¼	5	9	6	4
4		1			1	4	9	6	3
3½	1				⅞			1	
3	3	4	5	7	¾	1	7	8	6
2½	4	8	19	12	½	2	3		
2¼	2	1	1	1	⅜		1		
2	10	15	13	9					

Other placer-mining methods all showed decreases in quantity of gravel washed and gold recovered. The only gold credited to the Becker-Hopkins type of dredging resulted from the clean-up of a dredge, which suspended operations in 1941. Nonfloating washing plants to which gravel was delivered by mechanical means (dragline excavators, power shovels, slackline excavators, trucks, bulldozers) treated much less gravel in 1942 than in 1941. Many of these operators found that their equipment could be employed more profitably on war contracts; competition for labor skilled in operating earth-moving machines was very keen.

Suction dredging, which to date in California has been confined almost entirely to Fresno and Madera Counties, seemed to be expanding early in 1942, but by the end of the year these operations were largely suspended. The prospect that new techniques developed in relatively small scale suction dredging would be applied more widely in California after the war seemed favorable.

Hydraulic mining at established mines found itself singularly free from shortages of materials and power, but labor conditions caused marked reductions in operations. Very few hydraulic mines reopened for the 1942–43 season. Gold production from small-scale hand methods was sharply curtailed. In normal times, a large number of such operations are carried on independently by marginal workers, but the increasing labor shortage in California in 1942 caused many small-scale hand miners to abandon the streams and dry diggings for employment at wages. Drift mining, once very productive in California, also declined owing to war conditions.

Consumption of quicksilver at California placer mines totaled 13,944 pounds in 1942 compared with 19,949 pounds in 1941. The following quantities of gold were recovered to the pound of quicksilver used in 1942 (1941 figures in parentheses): Connected-bucket dredging, 34 ounces (40); dragline dredging, 40 ounces (37); suction dredging, 15 ounces (13); nonfloating washing plants with mechanical gravel handling, 17 ounces (42); hydraulicking, 16 ounces (22); small-scale hand operation, 18 ounces (15); and drift mining, 146 ounces (72).

ORE CLASSIFICATION

Of the 2,503,198 tons of ore (including 625,564 tons of old tailings) sold or treated in 1942, 82 percent was dry gold ore and old tailings, 16 percent copper ore (including a large quantity of ore valued more for its tungsten and molybdenum than copper), 1 percent lead ore, and most of the remainder dry 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 1942, 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	1,437,480	625,119	377,249	1,008,308	189,500	66,200	
Dry and siliceous gold-silver ore	621		168	8,597	3,700	600	
Dry and siliceous silver ore	12,886	445	285	69,342	1,500	594,000	6,000
	1,450,987	625,564	377,702	1,086,247	194,700	660,800	6,000
Copper ore [1]	393,944		436	71,175	[2] 1,898,800	6,600	
Lead ore	29,857		4,916	248,240	20,100	9,454,400	
Lead-copper ore	5		3	301	300	1,600	
Zinc ore	2,089		9	2,304	1,000	47,200	957,000
Zinc-lead ore	752		5	1,538	1,100	131,400	263,000
Total, lode mines	1,877,634	625,564	383,071	1,409,805	[2] 2,116,000	10,302,000	1,226,000
Total, placers			464,926	40,635			
	1,877,634	625,564	847,997	1,450,440	[2] 2,116,000	10,302,000	1,226,000
Total, 1941	3,435,109	845,076	[3] 1,408,793	[3] 2,154,188	[3] 7,886,000	6,928,000	880,000

[1] Includes ore valued principally for tungsten and molybdenum.
[2] Includes 71,100 pounds from precipitates.
[3] Includes metals recovered from tungsten ore.

METALLURGIC INDUSTRY

During 1942, 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); 80 percent of the total ore and old tailings was treated at such mills in 1942. Almost all the remaining ore was treated at concentrating mills; only 60,395 tons of crude ore were shipped for direct smelting. Smelters also received 21,314 tons of flotation concentrates and 288 tons of gravity concentrates from California mine operators. Comparing 1942 with 1941, material treated at amalgamation mills decreased 63 percent, material treated at cyanidation mills decreased 55 percent, and quantity of crude ore and old tailings smelted increased 35 percent; the quantities of ore concentrated in 1941 and 1942 are not comparable because a substantial quantity of tungsten ore was included in the latter year and excluded in the former.

Quicksilver consumption at California amalgamation mills totaled 3,040 pounds, used in the treatment of 785,945 tons of material to recover 144,004 ounces of gold and 29,010 ounces of silver in 1942. In the treatment of 503,551 tons of ore, 135,896 tons of old tailings, and 5,918 tons of concentrates to recover 106,092 ounces of gold and 344,476 ounces of silver, cyanide consumption was 110,701 pounds of 91-percent sodium cyanide and 744,246 pounds of commercial calcium cyanide (50-percent NaCN equivalent); in terms of 98-percent NaCN, the consumption was 467,475 pounds or 0.72 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 1942 owned and operated their own metallurgical plants, but a number of custom mills were active. 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; 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. The zinc oxide plant of the Pacific Zinc Oxide Co. (formerly Western Zinc Oxide Co.), Richmond, Contra Costa County, which had treated oxidized zinc ores in 1941, suspended operations early in 1942. The largest metallurgical custom plant in California—the Selby lead plant of the American Smelting & Refining Co. at Selby, Contra Costa County—continued to be the State's only smelter. By the end of the year, all these custom plants except the Selby smelter had suspended operations.

Mine production of metals in California in 1942, 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	785,945	144,004	29,010			
Ore, old tailings, sands, slimes, and concentrates cyanided	1,006,361	133,710	395,350			
Concentrates smelted:						
Flotation	21,314	89,818	657,374	1,284,200	713,300	547,000
Gravity	288	2,168	2,041	100	100	
Ore and old tailings smelted	60,395	13,371	326,030	760,600	9,588,600	679,000
Precipitates				71,100		
Total, lode mines		383,071	1,409,805	2,116,000	10,302,000	1,226,000
Total, placers		464,926	40,635			
		847,997	1,450,440	2,116,000	10,302,000	1,226,000
Total, 1941		1,408,793	2,154,188	7,886,000	6,928,000	880,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1942, 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*
Alpine	58		17	3					
Amador	88,201		24,038	4,954	1,311	5,086	753	2,000	1,800
Butte	76		720	90	4	13	2		
Calaveras	7,557		6,603	956	960	4,548	2,709	2,500	
Eldorado	4,533	400	2,701	295	1,325	3,165	221	2,000	
Imperial	188		124	143					
Inyo	981		176	317					
Kern	20,573	2,450	1,945	809	354	1,325	4,585	300	6,900
Los Angeles	1,187		98	22	14	39	24		
Madera	6		8	3					
Mariposa	86,830		7,573	1,871	1,609	10,709	3,829	2,000	16,000
Mono	13		26	26					
Nevada	291,225		67,280	12,085	1	33	7	100	
Placer	64,935		12,175	4,045	496	2,149	25,919	3,500	23,400
Plumas	702		104	21					
Riverside	100		45	16					
Sacramento	2		6	1					
San Bernardino	4,170		390	63	1	7	2		
San Diego	24		4	3					
Shasta	6,941		1,709	400	323	1,259	299	100	
Sierra	26,811	5,800	11,283	1,977	127	504	152		
Siskiyou	2,522		1,039	294	2	10	5		
Trinity	6,174		529	107	25	59	18		
Tulare	363	8	65	29	21	69	28		
Tuolumne	144,281		942	209	3,872	10,756	3,286	4,000	
Yuba	18,834		4,404	271					
	777,287	8,658	144,004	29,010	10,445	39,731	41,839	16,500	48,100
Total, 1941	2,102,150	2,148	285,038	65,978	14,666	115,466	401,151	64,800	102,000

See footnotes at end of table.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1942, by types of mills and by counties, in terms of recovered metals—Continued.

CYANIDATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	18,688	133,756	9,711	3,847					
Butte	27,480		6,630	15,907					
Calaveras	144,954		5,242	2,400					
Eldorado	514		154	67					
Inyo	24,997	280	6,005	3,181	4	175	91		100
Kern	128,000	301,080	39,473	295,248	194	13,805	296,961	1,700	1,100
Los Angeles	602		216	144					
Mariposa		1,745	99	61					
Mono	21,471		1,805	15,443					
Nevada	168,682		56,710	54,483	4,912	30,804	233,130	13,200	12,000
Placer	153		543	238					
Plumas	13,392		2,331	59	23	171	50		2,000
Riverside	228		275	150					
San Bernardino	7,743	445	2,042	2,836	17	203	548		
San Diego	1		3						
Shasta	11,050		863	685					
Siskiyou		100	8	1					
Yuba	1,000		1,600	600					
	568,955	437,406	133,710	395,350	5,150	45,158	530,780	14,900	15,200
Total, 1941	1,382,119	842,983	232,695	771,977	361	16,234	319,900	2,300	5,500
Grand total: 1942	1,346,242	446,064	277,714	424,360	15,595	84,889	572,619	31,400	63,300
1941	3,484,269	845,131	517,733	837,955	15,027	131,700	721,051	67,100	107,500

[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 1942, by counties, in terms of recovered metals

County	Ore	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Calaveras	13,107	1,682	237	987	528,200		8,000
Eldorado	350	35	106	41			
Inyo	[1] 390,973	2,747	245	82,126	721,900	646,100	533,000
Mariposa	4,916	277	2,107	1,711			
Nevada	200	40	45	348	700	2,000	
Orange	100	12	2	550		2,000	6,000
Placer	80	21	10	140	2,100		
Plumas	25,376	1,179	4,221	696			
Trinity	100	4	84	156			
Tuolumne	130	10	40	41			
	435,332	6,007	7,097	86,796	1,252,900	650,100	547,000
Total, 1941	392,406	[2] 19,593	[2] 26,013	[2] 240,288	[2] 7,520,300	95,000	183,300

[1] Includes ore valued principally for tungsten and molybdenum.
[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 1942, 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	17,020	78,212	279,036	51,282	76,277	
Dry gold-silver	195	13,600	296,982	3,633	816	1,877
Copper	2,981	111	57,944	1,285,549	6,392	
Lead	1,294	62	25,092	106	668,029	51,286
Zinc	112	1	361	375	4,061	608,429
	21,602	91,986	659,415	1,340,945	755,575	661,592
Total, 1941	34,620	157,713	961,339	7,863,822	239,878	237,122

Mine production of metals from California concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Amador	1,311	5,086	753	2,000	1,800	
Butte	4	13	2			
Calaveras	2,642	4,785	3,696	530,700		8,000
Eldorado	1,360	3,271	262	2,000		
Inyo	2,751	420	82,217	721,900	646,200	533,000
Kern	548	15,136	301,546	2,000	8,000	
Los Angeles	14	39	24			
Mariposa	1,886	12,816	5,540	2,000	16,000	
Nevada	4,953	30,882	233,485	14,000	14,000	
Orange	12	2	550		2,000	6,000
Placer	517	2,159	26,059	5,600	23,400	
Plumas	1,202	4,392	746		2,000	
San Bernardino	18	210	550			
Shasta	323	1,259	299	100		
Sierra	127	504	152			
Siskiyou	2	10	5			
Trinity	29	143	174			
Tulare	21	69	28			
Tuolumne	3,882	10,796	3,327	4,000		
	21,602	91,986	659,415	1,284,300	713,400	547,000
Total, 1941	34,620	157,713	961,339	7,587,400	202,500	183,300

BY CLASSES OF CONCENTRATES

Dry gold	17,020	78,212	279,036	30,500	64,900	
Dry gold-silver	195	13,600	296,982	2,400	700	
Copper	2,981	111	57,944	1,251,100	3,800	
Lead	1,294	62	25,092		640,300	
Zinc	112	1	361	300	3,700	547,000
	21,602	91,986	659,415	1,284,300	713,400	547,000

Gross metal content of California crude ore shipped to smelters in 1942, by classes of ore

Class of ore	Material shipped		Gross metal content				
	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	23,907		7,865	17,522	169,877	1,505	
Dry gold-silver	139		20	635	4,261	670	
Dry silver	1,334		226	44,242	2,385	5,887	
Copper	3,736		335	13,371	[1] 669,430	4,183	
Lead	29,857		4,916	247,931	24,998	9,862,383	2,846,962
Lead-copper	5		3	301	523	1,761	
Zinc	749		1	543	61	16,745	567,163
Zinc-lead	668		5	1,485	1,296	151,218	288,211
	60,395		13,371	326,030	[1] 872,831	10,044,352	3,702,336
Total, 1941	44,810	9	15,334	289,419	335,534	7,009,914	773,844

[1] Includes 71,445 pounds contained in precipitates.

Mine production of metals from California crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Material shipped		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Amador	220		583	277	2,000	200	
Calaveras	49		8	162	1,300		
Eldorado	39		19	23			
Humboldt	41		3	14	6,000		
Imperial	22		2	26			
Inyo	30,329		5,102	247,652	18,100	9,523,800	221,000
Kern	5		6	11			
Los Angeles	9		3	18			
Madera	26		19	49	[1] 66,000		
Mariposa	144		15	403	16,000		
Mono	1			111			
Nevada	42		55	187			
Orange	40		3	2,773		2,000	
Placer	60		52	175	400	600	
Plumas	3		40	12			
Riverside	45		17	14	2,000		
San Bernardino	23,761		6,998	62,268	154,000	60,000	458,000
Santa Barbara and Shasta [2]	5,483		361	11,811	[3] 561,900	2,000	
Siskiyou	48		16	15	4,000		
Trinity	12		68	27			
Tuolumne	16		1	2			
Total, 1941	60,395		13,371	326,030	[4] 831,700	9,588,600	679,000
	44,810	9	15,334	289,419	298,600	6,725,500	696,700

BY CLASSES OF ORE

Dry gold	23,907		[5] 7,865	17,522	154,700	600	
Dry gold-silver	139		20	635	3,700	600	
Dry silver	1,334		226	44,242	1,500	4,500	
Copper	3,736		335	13,371	[4] 649,800	2,800	
Lead	29,857		4,916	247,931	20,600	9,454,400	
Lead-copper	5		3	301	300	1,600	
Zinc	749		1	543		12,100	458,000
Zinc-lead	668		5	1,485	1,100	112,000	221,000
	60,395		13,371	326,030	[4] 831,700	9,588,600	679,000

[1] Includes 60,000 pounds from precipitates.
[2] Combined to avoid disclosure of individual output.
[3] Includes 11,100 pounds from precipitates.
[4] Includes 71,100 pounds from precipitates.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in California in 1942, 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	2		58	17		17	3				$597
Amador County:											
Camanche [4]		2			137	137	14				4,805
East Belt [5]	5	3	2,748	2,995	1,133	4,128	1,730	2,000	200		145,965
Ione		6			2,581	2,581	212				90,486
Lancha Plana		1			227	227	17				7,957
Mother Lode [6]	9	13	400,837	36,423	5,978	42,401	9,118	2,000	1,800		1,490,882
Butte County:											
Butte Creek		6			3,088	3,088	277				108,277
Enterprise		1			28	28	3				982
Forbestown		(7)			50	50	7				1,755
Magalia		3			134	134	14				4,700
Merrimac		(7)			25	25	3				877
Oroville	1	21	47	17	50,012	50,029	4,015				1,753,870
Yankee Hill	2	2	27,484	7,346	216	7,562	16,031				276,070
Calaveras County:											
Camanche [4]		5			805	805	52				28,212
Campo Seco		1			93	93	28				3,275
Copperopolis	4		13,294	389		389	1,059	527,200			78,159
East Belt [5]	9	2	6,247	2,271	152	2,423	322	500			85,095
Jenny Lind [8]	1	4	700	862	5,232	6,094	962	200			213,998
Mother Lode [6]	8	15	194,743	13,108	5,084	18,192	5,569	1,800			640,898
West Belt [9]	1		106	8		8	388	2,300		8,000	1,578
Del Norte County: French Hill		1			5	5	3				177
Eldorado County:											
East Belt [5]	3	4	950	139	2,516	2,655	550				93,316
Mother Lode [6]	16	17	36,403	5,853	7,494	13,347	1,487	2,000			468,444
West Belt [9]	3	5	442	153	2,039	2,192	247				76,896
Fresno County:											
Auberry		(7)			27	27	7				950
Friant		6			1,139	1,139	194				40,003
Humboldt County:											
China Flat		1			3	3					105
Gold Bluff		1			18	18	3				632
Orleans	2	4	41	3	3,999	4,002	634	6,000			141,247
Imperial County:											
Cargo Muchacho	1	(7)	1	14	8	22	7				775
Mesquite Diggings	3	(7)	209	112	20	132	162				4,735
Picacho		(7)			19	19					665
Pot Holes		1			1	1					35

Inyo County:											
Alabama Hills	1		12				107		2,200		223
Cerro Gordo	1		471	5		5	1,485	1,100	71,400	159,000	20,935
Chloride Cliff	2		236	131		131	138		300		4,703
Confidence	1		28	11		11	38				412
Coso	3		15,075	175		175	53,072	2,900	1,510,900		145,446
Fish Springs	1		5	3		3	301	300	1,600		462
Marble Canyon		1			7	7	1				246
Modoc	6		1,466	53		53	2,210	300	88,500	491,000	55,056
Resting Springs	2		25,001	4,776		4,776	210,503	13,000	8,088,000		860,320
Sherman	3		20,475	3,725		3,725	111		300		130,474
Slate Range	3		780	101		101	2,658	500	245,100		21,908
South Park	10		2,319	393		393	2,042		148,600	104,000	34,835
Ubehebe	2		38	25		25	180		8,900		1,599
Union	2		873	886		886	2,361		300		32,709
Wild Rose	4		2,781	1,333		1,333	959		100		47,344
Kern County:											
Amalie	4		139	22		22	21				785
China Grade		1			255	255	45				8,957
Cove	1		16,467	2,325		2,325	4,640	300	6,900		85,173
Frazier Mountain	1		16	14		14	3				492
Goler		(7)			10	10					350
Green Mountain	6		401	216		216	128				7,651
Havilah	2	1	53	23	1	24	10				847
Keyes	4	1	216	81	2	83	45				2,937
Long Tom		1			1	1					35
Mojave	15		126,982	46,494		46,494	589,839	1,700	1,100		2,047,011
Rademacher	2		79	50		50	3				1,752
Randsburg [10]	21	3	307,686	7,302	91	7,393	2,935				260,842
Sageland	1		12	13		13	7				460
White River [11]	1		5	14		14	7				495
Los Angeles County:											
Cedar	3		950	149		149	48				5,249
Iron Mountain	1		317	20		20	7				705
Muroc	1		3	2		2					70
Neenach	3		528	185		185	153				6,584
San Gabriel		4			123	123	21				4,320
Madera County:											
Chowchilla River [12]		2			49	49	14				1,725
Dennis		9			270	270	79				9,506
Hildreth	2		5	7		7	3				247
Potter Ridge	1	5	1	1	371	372	97				13,089
Mariposa County:											
East Belt [8]	13	1	4,566	2,968	37	3,005	506				105,535
Hunter Valley [13]	9	6	7,229	2,281	5,672	7,953	3,537	16,000			282,806
Mother Lode [6]	20	7	81,840	15,254	3,080	18,334	5,576	2,000	16,000		646,969
Merced County:											
Chowchilla River [12]		1			30	30	7				1,055
Hunter Valley [13]		1			37	37	7				1,300
Snelling		4			19,986	19,986	1,928				700,881

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1942, 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					
Mono County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Blind Springs	5		38				495				$352
Chidago	2		27	18		18	31				652
Homer	1	1	5	2	2	4	15				151
Masonic	1		17	37		37	197				1,435
Nevada County:											
French Corral		1			469	469	79				16,471
Graniteville	2	(7)	95	73	12	85	17				2,987
Grass Valley-Nevada City	7	3	427,937	153,887	1,910	155,797	299,933	13,200	12,000		5,668,582
North Bloomfield	1	6	200	13	2,059	2,072	180				72,648
Washington	3	2	418	934	1,952	2,886	720	800	2,000		101,753
You Bet	1	5	1	20	264	284	34				9,964
Orange County: Santa Rosa	2		140	5		5	3,323		4,000	6,000	3,364
Placer County:											
Auburn	3	2	47	15	554	569	242	400	600		20,175
Butcher Ranch		1			16	16	3				562
Dutch Flat		6			335	335	35				11,750
Foresthill	1	6	250	198	452	650	76				22,804
Iowa Hill		4			802	802	107				28,146
Last Chance		5			399	399	43				13,996
Lincoln		1			122	122	24				4,287
Michigan Bluff		2			911	911	80				31,942
Ophir	6	9	64,806	14,716	4,771	19,487	30,901	5,600	23,400		706,265
Plumas County:											
Genesee		1			10	10					350
Granite Basin	2	(7)	145	35	21	56	10				1,967
Greenville	2	1	13,394	2,360	41	2,401	73				84,087
Johnsville	1	1	506	209	15	224	62		2,000		8,018
La Porte		2			189	189	17				6,627
Lights Canyon		1			9	9	5				319
Quincy	3	4	52	42	959	1,001	93				35,101
Seneca		2			54	54	3				1,892
Riverside County:											
Bendigo	1		37	8		8	3	1,600			476
Chuckawalla		1			2	2					70
Dale [14]	4		305	319		319	174	400			11,337
Eagle Mountain		1			4	4					140
Gold Park	1		23	7		7	3				247
Pinacate	2	(7)	8	3	5	8	1				281

acramento County:											
Cosumnes River		6			15,909	15,909	834				557,408
Folsom	1	9	1	1	109,205	109,206	5,552				3,826,158
Walltown	1		1	5		5	1				176
San Bernardino County:											
Amargosa	1		11	30		30	17				1,062
Bellville	4		1,185	236		236	187	44,500	1,300		13,865
Black Hawk	1		27	54		54	38				1,917
Buckeye	1		18,103	6,019		6,019	15,785	93,000			235,143
Calico	4		471				2,904				2,065
Clark Mountain	5		372	55		55	2,212	2,100	16,000		4,324
Coolgardie		1			11	11					385
Dale [14]	3		4,383	1,178		1,178	986				41,931
Holcomb Valley	2	2	4,103	480	11	491	509				17,547
Kelso	1		35	10		10	69				399
New York Mountains	1		114	1		1	682	3,200	12,200		1,724
Old Woman Mountains	3		69	12		12	509				782
Randsburg [16]	3	2	3,905	734	3	737	39,479	1,100			54,002
Ship Mountain	1		2,155	505		505	266	8,000			18,332
Silver Mountain	4		62	18		18	536		7,000		1,480
Slate Range	1		1				50		400		63
Solo	4		269	281		281	291	200	6,400		10,495
Vanderbilt	1		21	17		17	34		100		626
Whipple Mountains	2		16	7		7		1,500			427
San Diego County:											
El Cajon	1		4	3		3	3				107
Julian	1		20	1		1					35
Pine Valley	1		1	3		3					105
San Francisco County: San Francisco		(7)			4	4					140
San Joaquin County:											
Camanche [4]		7			16,169	16,169	1,630				567,074
Jenny Lind [5]		3			1,934	1,934	132				67,784
San Luis Obispo County: La Panza		1			4	4					140
Shasta County:											
French Gulch	5	(15)	10,093	2,778	(15)	[16] 2,778	[16] 616	100			[16] 97,680
Igo	1	13	40		9,594	9,594	928				336,450
North Cow Creek		(7)			50	50	7				1,755
Old Diggings	1	(7)	55	47	75	122	72	100			4,333
Redding	5	(15)	417	128	(15)	[16] 128	[16] 66	100			[16] 4,539
Shasta	2	1	145	59	144	203	38				7,132
Slate Creek	1	(7)	60	28	39	62	21				2,185
Sierra County:											
Alleghany	6	9	28,986	10,613	688	11,301	1,928				396,906
Depot Hill		2			128	128	10				4,487
Downieville	(15)	11	(15)	(15)	954	[17] 954	[17] 124				[17] 33,478
Pike	3	1	3,548	1,056	78	1,134	294				39,899
Poker Flat		7			404	404	43				14,171
Sierra City	2	(7)	22	5	73	78	25				2,748

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1942, 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					
Siskiyou County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Callahan	4	7	33	44	8,296	8,340	1,042				$292,641
Deadwood	3	4	129	44	2,246	2,290	426				80,453
Gazelle	1		10	5		5					175
Greenhorn		9			3,596	3,596	502				126,217
Humbug	3	(15)	53	21	(15)	[16] 21	[16] 3				[16] 737
Klamath River	7	11	140	100	21,595	21,695	3,399	4,000			762,226
Liberty	6	12	460	236	1,443	1,679	252				58,944
Quartz Valley	3	1	535	189	42	231	73				8,137
Salmon River		3			174	174	28				6,110
Scott Bar	2	1	1,310	434	59	493	122				17,342
Stanislaus County: La Grange		3			17,514	17,514	1,561				614,100
Trinity County:											
Big Bar	1	1	4	1	165	166	21				5,825
Coffee Creek	(15)	1	(15)	(15)	99	[17] 99	[17] 10				[17] 3,472
Crow Creek		2			126	126					4,410
Hayfork	3	3	52	170	811	981	173				34,458
Helena	1	3	1	11	210	221	24				7,752
Junction City	2	6	137	48	8,561	8,609	810				301,891
Lewiston	4	6	5,961	390	2,481	2,871	353				100,736
New River	1	1	5	3	36	39	3				1,367
Salyer		2			50	50	7				1,755
Trinity Center	1	(15)	100	84	(15)	[16] 84	[16] 156				[16] 3,051
Weaverville	1	11	20	9	3,727	3,736	322				130,989
Tulare County: White River [11]	4		371	134		134	57				4,731
Tuolumne County:											
East Belt [5]	16	3	285	331	120	451	97				15,854
Mother Lode [6]	7	4	144,141	11,399	764	12,163	3,517	4,000			428,690
West Belt [9]	1	(7)	1	9	50	59	7				2,070
Yuba County:											
Bear River		(7)			120	120	10				4,207
Brown Valley	1		18,744	5,994		5,994	871				210,409
Camptonville		4			125	125	17				4,387
Challenge		(7)			6	6					210
Dobbins	1	1	90	10	39	49	3				1,717
Smartville		3			7,273	7,273	540				254,939
Strawberry Valley		1			219	219	22				7,681
Other districts [18]	15	9	442,115	7,397	90,878	98,275	93,205	[19] 1,350,000	22,400	458,000	3,713,349
Total California	434	428	2,503,198	383,071	464,926	847,997	1,450,440	[19] 2,116,000	10,302,000	1,226,000	31,771,607

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 18 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: 1,409,805 ounces from lode mines and 40,635 ounces from placers.
[4] Camanche district lies in Amador, Calaveras, and San Joaquin Counties.
[5] East Belt district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[6] Mother Lode district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[7] Output of property not classed as a "mine."
[8] Jenny Lind district lies in Calaveras and San Joaquin Counties.
[9] West Belt district lies in Calaveras, Eldorado, and Tuolumne Counties.
[10] Randsburg district lies in Kern and San Bernardino Counties.
[11] White River district lies in Kern and Tulare Counties.
[12] Chowchilla River district lies in Madera and Merced Counties.
[13] Hunter Valley district lies in Mariposa and Merced Counties.
[14] Dale district lies in Riverside and San Bernardino Counties.
[15] Included under "Other districts."
[16] Exclusive of placer output, which is included under "Other districts."
[17] Exclusive of lode output, which is included under "Other districts."
[18] Includes following: Bishop Creek district in Inyo County; Daulton in Madera County; Bodie in Mono County; Rich Bar in Plumas County; Ivanpah in San Bernardino County; Figueroa Mountain in Santa Barbara County; Flat Creek, French Gulch (placer), and Redding (placer) in Shasta County; Brandy City and Downieville (lode) in Sierra County; Humbug (placer) in Siskiyou County; Knights Ferry in Stanislaus County; Coffee Creek (lode) and Trinity Center (placer) in Trinity County; and Yuba River in Yuba County.
[19] Includes 71,000 pounds from precipitates.

559250—43——19

AMADOR COUNTY

East Belt district.—The Belama Corporation worked the Belden mine in the Volcano section of the East Belt from January 1 until November 23, 1942. A lessee operated the Elk Horn mine from January 1 to May 1; 166 tons of gold ore containing 407 ounces of gold, 189 ounces of silver, and 2,621 pounds of copper were shipped to a smelter. Gold ore from the Fort Ann mine was amalgamated. The Garibaldi or Boardman property was operated by dragline and dry-land dredging; the dragline dredge recovered 775 ounces of gold and 102 ounces of silver from 172,200 cubic yards of gravel; and the dry-land dredge recovered 157 ounces of gold and 23 ounces of silver from 35,500 cubic yards of gravel.

Mother Lode district.—The Argonaut Mining Co., Ltd., suspended operations at the Argonaut mine March 31, 1942; gold ore was treated by amalgamation and flotation, and the concentrates were cyanided. The company also operated a 500-ton flotation plant at the Plymouth old tailings dump. While the Argonaut cyanide plant was in operation, the concentrates from the Plymouth old-tailings operation were cyanided but were shipped to a smelter later in the year. The Central Eureka Mining Co. operated the Old Eureka and Central Eureka mines from January 1 to October 1; ore was treated by amalgamation and flotation, and the sands and concentrates were cyanided. The Kennedy Mining & Milling Co. operated the Kennedy mine until War Production Board Order L–208 ended operations which had been continuous since 1886. Lorentz & Swingle and the Long Bar Gold Dredging Co. operated dragline dredges on the Lorentz property on Cosumnes River; the company recovered 1,140 ounces of gold and 138 ounces of silver from 200,000 cubic yards of gravel. The Long Bar company also operated a dragline dredge on the Pension mine from September 13 to 28; 14,000 cubic yards of gravel yielded 87 ounces of gold and 12 ounces of silver. J. C. Pantle operated a dry-land dredge on the Rupley ranch on Willow Creek 5 miles west of Drytown from January 1 until October 15; 230,000 cubic yards of gravel yielded 1,290 ounces of gold and 183 ounces of silver; gravel was delivered to the dry-land dredge by a dragline excavator equipped with a 1½-cubic yard bucket.

BUTTE COUNTY

Butte Creek district.—The Lancha Plana Gold Dredging Co. operated a connected-bucket dredge on Butte Creek from January 1 to October 12, 1942; the dredge was of the Yuba type and had 65 4½-cubic foot buckets.

Oroville district.—F. C. Peterson operated a nonfloating washing plant on the Amo mine during 1942; 60,000 cubic yards of gravel yielded 379 ounces of gold and 12 ounces of silver. Yuba Consolidated Gold Fields, Butte Unit, operated four connected-bucket dredges on land adjoining Feather River from January 1 to October 15; all dredges were of the Yuba type and used electric power. The dredge-bucket equipment per boat was: 84 9-cubic foot, 89 9-cubic foot, 87 9-cubic foot, and 71 6-cubic foot buckets. The Golden Feather Dredging Co. operated a dragline dredge on the Feather River channel at Oroville throughout 1942. Because this operation cleared the channel of the river and stacked tailings along the levees, the company was permitted to continue operations after War Production Board

Order L–208 became effective. The Placer Exploration Co. and Sunmar Dredging Co. operated dragline dredges on the Gianella property for short periods. The Placer Exploration Co. also carried on dragline dredging on the Innis property. In addition to the Gianella operation, the Sunmar Dredging Co. worked the Peter property. The Morris Ravine Mining Co. washed 850 cubic yards of gravel from which 658 ounces of gold and 65 ounces of silver were recovered; the gravel was recovered by drift mining.

Yankee Hill district.—Hoefling Bros. operated the Surcease mine from January 1 to November 15, 1942; 27,480 tons of gold ore were treated in a 125-ton flotation-cyanidation mill; 713 ounces of gold and 89 ounces of silver were recovered by amalgamation of high-grade jig concentrates, and 6,630 ounces of gold and 15,907 ounces of silver were recovered by cyanidation of sands, slimes, and reground concentrates. Hoefling Bros. explored the nearby Big Bend prospect and, when War Production Board Order L–208 went into effect, intended to utilize the company organization and mill to develop the Big Bend zinc-copper ores.

CALAVERAS COUNTY

Camanche district.—The Cat Camp Placers and Burson Mining Co. operated the Cat Camp mine during 1942; 71,818 cubic yards of gravel treated in nonfloating washing plants yielded 483 ounces of gold and 32 ounces of silver. E. A. Bacon recovered 286 ounces of gold and 14 ounces of silver from 10,000 cubic yards of gravel near Wallace; hydraulicking and a mechanical excavator were used.

Copperopolis district.—The Keystone Copper Co. unwatered and reopened the north shaft of the Keystone mine and started production in October 1942; 12,208 tons of copper ore were treated by flotation in the redesigned gold mill at the nearby Mountain King mine, and 1,619 tons of copper concentrates were shipped; the concentrates contained 15 ounces of gold, 602 ounces of silver, and 542,380 pounds of copper.

Mother Lode district.—The Carson Hill Gold Mining Corporation treated 144,954 tons of gold ore at the Carson Hill mine between January 1 and May 31, 1942, and produced amalgamated bullion containing 4,173 ounces of gold and 404 ounces of silver; cyanidation bullion containing 5,242 ounces of gold and 2,400 ounces of silver; and 122 tons of gravity concentrates which, after partial extraction by amalgamation, contained 1,188 ounces of gold and 1,596 ounces of silver, when delivered to a smelter. On May 31 a fire destroyed the crushing, grinding, and flotation parts of the mill, and production was not resumed thereafter. According to the company printed annual report for the year ended September 30, 1942, the average recovery was $2.18 per ton as compared with $2.15 and $2.19 for the years ended September 30, 1941 and 1940, respectively. According to the company engineer's report as of June 1, 1942, ore reserves in the Morgan Melones mine are estimated at 940,500 tons of a grade equal to that milled during the last 6 months of operation and 1,984,000 tons in the Calaveras mine of a grade estimated at $5.76 per ton. W. Clark subleased the Val ranch and operated a stationary washing plant, to which gravel was delivered by power shovel and trucks, from May 7 to October 19; 6,245 cubic yards of gravel yielded 69 ounces of gold and 7 ounces of silver.

West Belt district.—E. A. Vogt carried on development work at the Collier mine during 1942 and shipped small lots of zinc and gold-silver ores. The property received a Reconstruction Finance Corporation Class B development loan October 12. In the same district the Mountain Copper Co., Ltd., and the Quail Hill Mining Co. conducted exploration campaigns at the Napoleon and Quail Hill mines, respectively. The ore bodies under development in the district contained zinc, copper, gold, and silver.

ELDORADO COUNTY

Mother Lode district.—Alhambra-Shumway Mines, Inc., worked the Alhambra mine from March 1 to November 1, 1942; 2,305 tons of ore treated in the company 25-ton amalgamation mill yielded bullion containing 505 ounces of gold and 74 ounces of silver and 6 tons of flotation concentrates containing 34 ounces of gold and 3 ounces of silver. G. W. Gray recovered 80 ounces of gold and 5 ounces of silver from 1,000 pounds of quartz removed from a pocket at the Guttenberger property near Diamond Springs. The Barker Corporation operated a dragline dredge on the Explorers property from January 1 to August 29; 95,000 cubic yards of gravel yielded 754 ounces of gold and 94 ounces of silver. At the Good Luck mine 23,000 cubic yards of gravel yielded 164 ounces of gold and 22 ounces of silver; 14,000 cubic yards of gravel washed at the Max & Junction mine yielded 110 ounces of gold and 15 ounces of silver; 77,500 cubic yards of gravel washed at the Setter property yielded 548 ounces of gold and 70 ounces of silver.

West Belt district.—C. D. Jones operated the Boulder mine in the Rescue section of the West Belt from March to October 15, 1942; 280 tons of gold ore treated by amalgamation yielded 122 ounces of gold and 13 ounces of silver. The Big Canyon Dredge operated a dragline dredge from January 1 to July 31; 1,269 ounces of gold and 137 ounces of silver were recovered from 250,000 cubic yards of gravel; the dragline excavator was equipped with a 3-cubic yard bucket.

FRESNO COUNTY

Friant district.—Griffith Co. and Bent Co., which supplied gravel for the Friant Dam in 1942, recovered 205 ounces of gold and 29 ounces of silver in preparing 121,700 cubic yards of sand and gravel. The Twin Bar Mining Corporation operated a dredge on the Grant Pacific Rock and V. Roulard properties from March to October 23. Hopkins & Becker operated a suction dredge on San Joaquin River near Friant. The Grant-Service Rock Co. recovered 114 ounces of gold and 16 ounces of silver in preparing 339,955 tons of sand and gravel for concrete aggregate.

IMPERIAL COUNTY

Mesquite Diggings (Glamis) district.—Van Derpoel & Murphy operated the Mary Lode mine from January 1 to July 15, 1942, when operations were suspended because of war conditions; 186 tons of ore treated in the company 25-ton amalgamation-cyanidation mill yielded 109 ounces of gold and 136 ounces of silver.

INYO COUNTY

Bishop Creek district.—The United States Vanadium Corporation produced by flotation a copper concentrate containing a substantial quantity of silver per ton as a byproduct of ore treated primarily for tungsten. This company was the leading copper producer in the State in 1942.

Cerro Gordo district.—Desert Miners shipped zinc-lead ore from the Leary mine in the Swansea section of the Cerro Gordo district during 1942.

Coso (Darwin) district.—The Imperial Metals, Inc., operated the Defiance, Independence, Essex, Thompson, Lucky Jim, Lane, Promontory, and Columbia mines as a unit during 1942; a newly constructed 150-ton gravity-concentration and flotation mill began operations June 20 and continued until November 23, when unsatisfactory metallurgical results and inability to hire experienced workmen forced suspension of milling. In addition, the company made shipments of crude ore, which were continued after mill operations were suspended. The milling of 11,415 tons of silver ore produced 790 tons of lead concentrates, containing 57 ounces of gold, 22,989 ounces of silver, and 612,000 pounds of lead; shipments of 2,823 tons of lead ore contained 117 ounces of gold, 26,887 ounces of silver, and 850,000 pounds of lead.

Modoc district.—The Combined Metals Reduction Co. operated the Colorado group throughout 1942; zinc sulfide ore was shipped to the company concentrating mill at Bauer, Utah.

Resting Springs district.—Shoshone Mines, Inc., shipped ore from the Columbia No. 2 mine throughout 1942 and was by far the largest producer of lead and third-largest producer of silver in the State; 24,999 tons of ore contained 4,770 ounces of gold, 210,503 ounces of silver, 14,710 pounds of copper, 8,425,760 pounds of lead, and 2,789,540 pounds of zinc.

Sherman district.—Burton Bros. (partnership) operated the Ruth mine and treated 19,961 tons of ore by crushing and cyanide leaching in 1942; 3,674 ounces of gold and 102 ounces of silver were recovered before operations were suspended November 1 because of War Production Board Order L–208.

Slate Range district.—L. E. Damon shipped lead ore from the Gold Bottom mine during 1942. C. O. Mittendorf, lessee, operated the Ophir mine through sublessees from January to September and shipped to a smelter 501 tons of lead ore containing 4 ounces of gold, 2,215 ounces of silver, and 246,440 pounds of lead.

South Park district.—The Southwest Lead & Zinc Co. operated the Honolulu mine from April 1 to December 31, 1942, and shipped zinc-lead and lead ores to a smelter.

KERN COUNTY

Cove district.—Kern Mines, Inc., operated the Big Blue mine from January 1 to July 1, 1942; 16,467 tons of ore yielded amalgamation bullion, containing 1,054 ounces of gold and 460 ounces of silver, and 346 tons of flotation concentrates, containing 1,271 ounces of gold, 4,180 ounces of silver, and 11,216 pounds of lead.

Mojave district.—The Cactus Mines Co. operated the Cactus Queen mine in the Middle Buttes section of the Mojave district from January

1 to November 20, 1942, and treated gold-silver ore in the company 125-ton cyanidation-flotation mill; the resulting concentrates were shipped to a smelter. This property was California's leading silver producer for the fifth successive year. Lessees shipped 950 tons of gold ore from the Elephant-Eagle mine to nearby custom cyanide mills; 612 ounces of gold and 71 ounces of silver were recovered. Lessees worked the Middle Butte mine; 125 tons of ore treated by amalgamation, 165 tons of ore shipped to a custom cyanide mill, and 175 tons of old tailings cyanided yielded amalgamation bullion containing 15 ounces of gold and 4 ounces of silver and cyanide bullion containing 68 ounces of gold. Burton Bros., Inc., operated the Tropico mine from January 1 to November 1; 18,044 tons of gold ore treated in the company 100-ton cyanide mill yielded 5,353 ounces of gold and 11,850 ounces of silver. In addition, the company treated over 4,783 tons of custom material from 65 shippers during 1942 compared with over 8,800 tons of custom material from 215 shippers in 1941. When the Burton Bros., Inc., mill ceased to accept custom ores, a number of mines within a radius of 100 or more miles of Rosamond were left without an economic market for their ores, as all other custom mills in the region had alread discontinued milling.

Randsburg district.—E. B. Atkinson shipped 357 tons of ore from the Earl & Matilda mine to a custom cyanide mill in 1942; 68 ounces of gold and 11 ounces of silver were recovered. S. D. Fraser and lessees operated the K. C. N. mine from January 1 to August 15; 234 tons of ore shipped to custom cyanide mills yielded 175 ounces of gold and 8 ounces of silver. King Solomon Mines Lease worked the King Solomon mine from January 1 to April 30; 285 tons of ore treated by amalgamation yielded 76 ounces of gold and 21 ounces of silver, and 150 tons of old tailings treated by cyanidation yielded 7 ounces of gold and 3 ounces of silver. The Anglo American Mining Corporation, Ltd.—largest operator in the Randsburg district—treated 300,755 tons of old tailings and recovered 6,075 ounces of gold and 2,691 ounces of silver from January 1 to October 23, when operation was suspended by War Production Board Order L–208. The Rand Gold Dredging Associates installed a connected-bucket-type dredge with 82 3-cubic foot buckets to work gravels at a property 1¼ miles northwest of Randsburg; the dredge was moved from Shasta County, where it had formerly been operated by the Roaring River Dredging Co. The dredge was reconstructed and jigs were added in order to recover scheelite as well as gold; operations started November 1. The Monarch Rand Mining Co. operated a dry-land dredge for the recovery of scheelite and gold intermittently over a 6-month period.

LOS ANGELES COUNTY

Cedar district.—The Governor Mine Co. turned over operation of the Governor and Red Rover mines to G. Moore February 16, 1942, and all work was suspended October 15; during the year 870 tons of ore were treated by amalgamation and flotation in the company 135-ton mill; 78 ounces of gold and 15 ounces of silver were recovered in bullion, and 14 tons of concentrates shipped to a smelter contained 39 ounces of gold and 24 ounces of silver.

MADERA COUNTY

Daulton district.—The West Lode Reduction Co. pumped copper-bearing water from the Daulton mine, which was percolated through old dumps at the property and the copper precipitated on scrap iron during 1942; the cement copper was shipped to a manufacturer of copper sulfate. Copper ore from the Jessie Bell mine was shipped to a copper smelter.

Potter Ridge district.—G. E. Noble & Sons operated a suction dredge on the J. T. Pierce ranch from January 1 to December 12, 1942; 7,790 cubic yards of gravel yielded 118 ounces of gold and 35 ounces of silver. Suction-dredge operations on the Polk ranch recovered 148 ounces of gold and 32 ounces of silver from 9,000 cubic yards of gravel.

MARIPOSA COUNTY

East Belt district.—R. J. Wilson operated the Feliciana mine throughout 1942; 3,211 tons of gold ore treated by amalgamation and concentration in a 25-ton mill yielded amalgamation bullion containing 1,535 ounces of gold and 236 ounces of silver and 49 tons of flotation concentrates containing 403 ounces of gold and 78 ounces of silver; the concentrates were shipped to a smelter. Schroeder, Odgers & Schroeder worked the Schroeder mine in the Colorado section of the East Belt throughout the year; 39 tons of gold ore treated in a 20-ton Huntington mill yielded 716 ounces of gold and 88 ounces of silver. The Whitlock mine was active.

Hunter Valley district.—E. L. Buerki operated the Ruth Pierce mine throughout 1942 and treated 1,620 tons of old tailings, which yielded 94 ounces of gold and 59 ounces of silver; the old tailings were given a 96-hour leach in a 15-ton plant. Thurman & Wright operated a dragline dredge on Burns Creek from January 1 to August 20; the dragline-excavator equipment included 4½- and 6-cubic foot buckets. The Trebor Corporation, which suspended operations at the Gaskill property on Corbett Creek 8 miles west of Mariposa December 30, 1941, shipped 68 ounces of gold and 12 ounces of silver from the final clean-up of the operation; the dragline excavator was equipped with a 2-cubic yard bucket. The Barker Corporation operated a dragline dredge on the Kehoe, J. Lord, and Trabucco properties between January 1 and July 1, 1942; 22,000 cubic yards of gravel washed at the Kehoe property yielded 112 ounces of gold and 32 ounces of silver; 109,000 cubic yards of gravel at the J. Lord property yielded 833 ounces of gold and 229 ounces of silver; and 163,500 cubic yards of gravel at the Trabucco property yielded 1,016 ounces of gold and 280 ounces of silver.

Mother Lode district.—The Mount Gaines Mining Co. worked the Mount Gaines mine throughout 1942; 11,263 tons of gold ore yielded amalgamation bullion containing 3,664 ounces of gold and 1,134 ounces of silver and 337 tons of flotation concentrates containing 3,281 ounces of gold, 1,117 ounces of silver, 2,027 pounds of copper, and 583 pounds of lead; the concentrates were shipped to a smelter. The Pacific Mining Co. worked the Pine Tree and Josephine mines; 50,697 tons of ore yielded amalgamation bullion containing 233 ounces of gold and 52 ounces of silver and 959 tons of flotation concentrates containing 6,056 ounces of gold, 1,450 ounces

of silver, and 1,213 pounds of copper. The Trebor Corporation operated the C. C. Pierce property on Corbett Creek for 3½ months in 1942; 100,000 cubic yards of gravel yielded 289 ounces of gold and 57 ounces of silver; the equipment was the same as that used on another section of Corbett Creek in the Hunter Valley district.

MERCED COUNTY

Snelling district.—The Merced Dredging Co. operated a connected-bucket dredge with 60 9½-cubic foot buckets on Merced River ¾ of a mile southeast of Snelling from January 1 to October 13, 1942. The San Joaquin Mining Co. operated a connected-bucket dredge in the Merced River Valley 3 miles southwest of Snelling from January 1 to October 14; the dredge was equipped with 64 9½-cubic foot buckets. The Snelling Gold Dredging Co. began 1942 with two dredges operating on Merced River between Snelling and Merced Falls; dredge No. 1 with 66 7-cubic foot buckets was closed down March 31, and dredge No. 2 with 72 7-cubic foot buckets suspended operations October 15 because of War Production Board Order L–208.

MONO COUNTY

Blind Springs district.—Conversion of the Mineral Reduction Co. cyanide-flotation custom mill from the treatment of gold and silver ores to tungsten ores early in 1942 left many of the mines in the Blind Springs district and surrounding territory without a market for their ores.

NEVADA COUNTY

Grass Valley-Nevada City district.—The Empire Star Mines Co., Ltd., operated the Empire, North Star, and Pennsylvania mines at Grass Valley in Nevada County and the Pennsylvania and Dannebrog at Browns Valley in Yuba County during 1942; in addition, work on a tailings-disposal adit from the South Fork of Yuba River near Omega to the Zeibright mine was carried on during the early months of the year. Ore mined in the Empire-North Star-Pennsylvania group was treated in the company amalgamation-cyanidation-flotation mill; all productive operations were suspended by War Production Board Order L–208, but a crew of over 100 men was retained for maintenance purposes. The Idaho Maryland Mines Corporation operated the Idaho Maryland-Brunswick group from January 1 to October 15; according to the company printed annual report for the year ended December 31, 1942, 144,639 tons of ore yielded 53,342 ounces of gold and 14,700 ounces of silver. Of the year's total tonnage, 17.4 percent was derived from development or exploration and the remainder from stoping. The Brunswick mill was closed April 30, and one of the two units of the Idaho mill was operated part time. During the year the new Brunswick steel head frame, crusher plant, hoist, and compressor buildings were completed; this equipment was designed to handle 2,000 tons a day from depths of 5,000 feet. Increasing labor shortages curtailed production. When War Production Board Order L–208 went into effect, 245 men were employed compared with a daily average of 1,000 men in 1940; after the order the crew was reduced to 125 men for mine and plant maintenance. The Lava Cap Gold Mining Corporation operated the Lava Cap

mine throughout 1942; 137,194 tons of ore were treated by amalgamation, flotation, and cyanidation in the company 400-ton flotation plant, 25-ton concentrate- and middling-cyanide plant, and 350-ton tailings-cyanide plant. Cyanidation of sands, slimes, and middlings yielded 2,245 ounces of gold and 15,558 ounces of silver; amalgamation of high-grade ore yielded 113 ounces of gold and 29 ounces of silver; 4,912 tons of flotation concentrates shipped to a smelter contained 30,804 ounces of gold, 233,130 ounces of silver, 21,048 pounds of copper, and 13,600 pounds of lead.

North Bloomfield district.—A. B. Innis operated a dragline dredge at the Malakoff mine during 1942; 146,000 cubic yards of gravel yielded 694 ounces of gold and 64 ounces of silver.

Washington district.—The Omega Co. and lessees operated the Omega mine from January 17 to July 7, 1942; 818,175 cubic yards of gravel yielded 1,749 ounces of gold and 54 ounces of silver.

ORANGE COUNTY

Santa Rosa district.—The Blue Light Silver Mines Co. worked the Silverado or Blue Light mine in Silverado Canyon from January to June 1942; 100 tons of silver ore treated by flotation yielded 5 tons of lead concentrates containing 2 ounces of gold, 470 ounces of silver, 2,538 pounds of lead, and 1,517 pounds of zinc, and 7 tons of zinc concentrates containing 80 ounces of silver and 7,596 pounds of zinc; the concentrates were shipped to smelters. In addition, 18 tons of silver ore, containing 3 ounces of gold and 2,195 ounces of silver, were shipped to a smelter. The Ortega Mining Co. shipped argentiferous lead ore from the district.

PLACER COUNTY

Auburn district.—G. M. Trent shipped to a smelter 43 tons of gold-silver ore containing 9 ounces of gold, 150 ounces of silver, 776 pounds of copper, and 670 pounds of lead while developing the Valley View mine during 1942.

Ophir district.—The Alabama California Gold Mines Co. operated the Alabama mine from January to August 1942; ore was treated by amalgamation and flotation, and the resulting concentrates were shipped to a smelter; amalgamation bullion contained 8,391 ounces of gold and 2,575 ounces of silver, and 496 tons of flotation concentrates contained 2,149 ounces of gold, 25,919 ounces of silver, 5,442 pounds of copper, and 25,927 pounds of lead. Exploration and development continued at the Ophir mine from January 1 until September 1; test runs were made by amalgamation, cyanidation, concentration, and direct smelting on small tonnages of ore; in all, 184 tons of ore yielded 86 ounces of gold, 196 ounces of silver, and 3,288 pounds of copper. The Oro Fino Consolidated Mines operated the Oro Fino mine from January 1 to October 8; 9,058 tons of ore treated in the company 200-ton amalgamation-flotation mill yielded amalgamation bullion containing 3,535 ounces of gold and 1,423 ounces of silver; and 125 tons of concentrates, which were cyanided in the custom cyanide plant, yielded 522 ounces of gold and 224 ounces of silver.

PLUMAS COUNTY

Greenville (Crescent Mills) district.—Cherokee Mine operated the Cherokee property from January 1 to July 15, 1942, when the property was abandoned; 13,392 tons of ore treated by cyanidation yielded 2,331 ounces of gold and 59 ounces of silver.

SACRAMENTO COUNTY

Cosumnes River district.—The Cosumnes Gold Dredging Co. operated a connected-bucket dredge 7 miles southwest of Sloughhouse from January 1 to October 20, 1942; the dredge used electric power and was equipped with 63 12-cubic foot buckets. Hoosier Gulch Placers operated two dragline dredges in the Cosumnes River district during 1942. The Humphreys Gold Corporation operated a dragline dredge on Cosumnes River from January 1 to April 6; the floating washing plant was served by four dragline excavators, each equipped with a 2½-cubic yard bucket, which stripped overburden as well as delivered auriferous gravel to the plant.

Folsom district.—The Capital Dredging Co. operated two electric connected-bucket dredges on its property 5 miles south of Folsom from January 1 to October 15, 1942; one dredge had 88 and the other 100 18-cubic foot buckets. The General Dredging Co. operated three dragline dredges, one near Folsom, the second near Natoma, and the third near Fair Oaks. Cutter & Mueller and the Pacific Coast Aggregates, Inc., recovered gold as a byproduct in the operation of a commercial sand and gravel plant at Fair Oaks; Cutter & Mueller recovered 183 ounces of gold and 15 ounces of silver from 40,320 cubic yards of gravel, and Pacific Coast Aggregates, Inc., recovered 111 ounces of gold and 11 ounces of silver. The Lancha Plana Gold Dredging Co. operated a dragline dredge at Sailor's Bar on American River from January 1 to November 11, 1942. The Natomas Co. operated a fleet of seven electric connected-bucket dredges at and near Natoma from January 1 to October 15. The number and size of buckets per dredge were: No. 1, 62 16-cubic foot; No. 4, 67 15-cubic foot; No. 5, 105 12-cubic foot; No. 6, 106 11-cubic foot; No. 7, 98 9-cubic foot; No. 8, 105 12-cubic foot; and No. 10, 83 15-cubic foot.

SAN BERNARDINO COUNTY

Buckeye district.—The Bagdad-Chase, Ltd., operated the Bagdad-Chase mine from January 1 to December 31, 1942; gold ore, containing a substantial quantity of silver and copper, was shipped to a smelter.

Calico district.—M. La Jeunesse operated a cyanide-leaching plant on wind-blown tailings from the Calico tailings dump from January 1 to May 15, 1942; 370 tons of old tailings yielded 1,084 ounces of silver. L. Coke shipped silver ore from the Zenda mine.

Dale district.—L. A. Wilson operated the Glad-Stone, Gold-Stone, and Desert-Gold mining claims from January 1 to June 2, 1942; 243 tons of ore, shipped to custom cyanide mills, yielded 371 ounces of gold and 125 ounces of silver.

Ivanpah district.—W. F. Huston operated the Carbonate King mine from January 1 to December 31, 1942; 749 tons of oxidized zinc

ore, containing 1 ounce of gold, 543 ounces of silver, 16,745 pounds of lead, and 567,163 pounds of zinc, were shipped to smelters.

New York Mountains district.—The California Sulphur Co. carried on development work at the Sagamore mine (Alpha claims) from June until December 31, 1942; 114 tons of lead ore, containing 1 ounce of gold, 682 ounces of silver, 3,481 pounds of copper, and 14,597 pounds of lead, were shipped to smelters.

SAN JOAQUIN COUNTY

Camanche district.—The Gold Hill Dredging Co. operated two electric connected-bucket dredges on the California Lands, Inc., Central Bank of Calaveras, Thorne, and Putnam properties during 1942; one dredge had 66 7¾-cubic foot buckets and the other 87 8½-cubic foot buckets. Both dredges ceased operations October 14, but one resumed work December 20 and continued until December 31. The Lobicasa Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on the Foster ranch from January 1 to May 14, when the property was worked out and abandoned. The Gold Valley Dredging Co. operated a dry-land washing plant, to which gravel was delivered by a gasoline dragline excavator with a ½-cubic yard bucket, at the Murdoch ranch from February 25 to May 24; 9,316 cubic yards of gravel yielded 83 ounces of gold and 6 ounces of silver.

Jenny Lind (Bellota, Linden) district.—Smith-Notterman Co. operated a dragline dredge with a dragline excavator having a 1¾-cubic yard bucket on the Elmer Cady ranch from January to March 26, 1942; 93,105 cubic yards of gravel yielded 344 ounces of gold and 14 ounces of silver.

SHASTA COUNTY

Flat Creek district.—The Mountain Copper Co., Ltd., largest mineral producer in Shasta County, worked the Iron Mountain mine throughout 1942; oxidized ore was treated in the company 700-ton cyanide plant until plant operation was suspended in February. Mining of copper-bearing sulfide ores was begun in May, and shipments to a smelter continued during the rest of the year; in addition, the company was engaged in opening a large zinc-copper ore body and constructing a flotation mill for its treatment. A small quantity of gold, silver, and copper was recovered from smelting cinder derived from burning pyrites in a sulfuric acid plant; the pyrites was produced by the Mountain Copper Co., Ltd., at the Hornet mine.

Igo district.—B. H. K. Mines operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on the R. C. Connely and R. Litsch properties on Clear Creek from January 1 to May 15, 1942; 120,000 cubic yards of gravel yielded 760 ounces of gold and 104 ounces of silver. The Lincoln Gold Dredging Co. operated a dragline dredge with a dragline excavator having a 2½-cubic yard bucket on the Brady property; 37,234 cubic yards of gravel yielded 162 ounces of gold and 26 ounces of silver. The Clear Creek Dredging Co. operated a dragline dredge on Clear Creek. The Crow Creek Dredging Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on Cottonwood Creek from January 1 to April 13, 1942; 100,000 cubic yards of gravel

yielded 580 ounces of gold and 20 ounces of silver. The Dobbin Gulch Dredging Co. operated a dragline dredge with a dragline excavator having a 1¼-cubic yard bucket on Roaring River from March 3 to June 2; 70,500 cubic yards of gravel yielded 169 ounces of gold and 11 ounces of silver. The Thurman Gold Dredging Co. operated a Yuba electric connected-bucket dredge, equipped with 72 9-cubic foot buckets, on Clear Creek from January 1 to October 14, 1942.

SIERRA COUNTY

Alleghany district.—The Original Sixteen to One Mine, Inc., operated its Original Sixteen to One mine throughout 1942; in addition to underground work, a lessee treated old tailings at the property. J. Sweeney operated the Snow Drift mine from March to September; 111 tons of ore yielded 145 ounces of gold and 23 ounces of silver.

Downieville district.—Wm. Richter & Sons operated a dragline dredge on Pacific Gas & Electric Co. property from January 1 to April 30; 58,000 cubic yards of gravel yielded 243 ounces of gold and 29 ounces of silver.

Pike (Slate Range) district.—H. L. Sorensen operated the Alaska mine from January 1 to October 10 and treated 388 tons of ore by amalgamation, which yielded 547 ounces of gold and 185 ounces of silver; during the year development was shifted from the Alaska to the Grizzly vein. W. C. Ennis operated the Bowman mine from January 1 to December 31; 3,140 tons of ore yielded 480 ounces of gold and 85 ounces of silver.

Poker Flat (Port Wine, Table Rock) district.—A. J. Just carried on hydraulicking at the Pioneer Project mine at Grass Flat for 10 days during 1942; 17,000 cubic yards of gravel yielded 71 ounces of gold and 4 ounces of silver. C. S. Poor worked the Tennessee Manxman drift mine throughout the year; 1,200 cubic yards of gravel yielded 142 ounces of gold and 16 ounces of silver.

SISKIYOU COUNTY

Callahan district.—The Okoro Mines, Inc., operated a dragline dredge on the Hayden property from January 1 to 31, 1942; 60,000 cubic yards of gravel yielded 103 ounces of gold and 10 ounces of silver.

Greenhorn district.—The Lincoln Gold Dredging Co. operated a dragline dredge on the City of Yreka, General Dredge, Marlow, Nunes, and Rose properties from January 1 to July 21, 1942; the dragline excavator was equipped with a 2½-cubic yard bucket. The following data on yardages washed and precious metal recovered were reported: City of Yreka property, 43,029 cubic yards of gravel yielded 304 ounces of gold and 44 ounces of silver; General Dredge property, 272,423 cubic yards of gravel, 1,844 ounces of gold and 263 ounces of silver; and Nunes property, 31,128 cubic yards of gravel, 259 ounces of gold and 37 ounces of silver.

Klamath River district.—The Gray Eagle Copper Co. reopened the Dakin copper mine near Happy Camp and constructed a 550-ton flotation mill during 1942; no shipments of ore or concentrates were made. The William von der Hellen Mining Co. operated a dragline dredge, using a dragline excavator with a 3-cubic yard bucket, on

McConnell Bar from January 1 to September 27; 596,800 cubic yards of gravel yielded 3,594 ounces of gold and 554 ounces of silver.

Liberty district.—N. Marvin worked the Hansen mine during 1942. A. Markon operated the Surprise mine on Eddys Gulch from March 2 to November 28, 1942; 148 tons of ore treated by amalgamation yielded 78 ounces of gold and 15 ounces of silver. F. R. Jackson worked the J. F. Judge hydraulic mine from January 1 to July 1; 22,000 cubic yards of gravel yielded 238 ounces of gold and 33 ounces of silver.

STANISLAUS COUNTY

Knights Ferry district.—Placer Properties Co. operated a dragline dredge on Stanislaus River from January 1 to October 15 and from November 15 to December 31, 1942; two dragline excavators, one with a 6-cubic yard bucket and the other with a 2 ½-cubic yard bucket, were used.

TRINITY COUNTY

Crow Creek district.—C. L. Kalbaugh operated a suction dredge and tractor on the Thursday No. 1 mine on Crow Creek from May 1 to September 15, 1942; 103 ounces of gold were recovered from 1,000 cubic yards of gravel.

Junction City district.—Junction City Mining Co. operated an electric connected-bucket dredge with 72 9-cubic foot buckets from January 1 to October 28, 1942; 2,077,000 cubic yards of gravel yielded 7,878 ounces of gold and 735 ounces of silver.

Lewiston district.—The Lincoln Gold Dredging Co. operated a dragline dredge, using a dragline excavator with a 2½-cubic yard bucket, on the Costa property on Rush Creek from January 1 to September 12, 1942; 271,744 cubic yards of gravel yielded 1,406 ounces of gold and 95 ounces of silver. Lewiston Placers hydraulicked at the Lewiston Placers mine from January 1 to June 30; 75,000 cubic yards of gravel yielded 188 ounces of gold and 24 ounces of silver.

Weaverville district.—The La Grange Placer Mines, Ltd., hydraulicked 250,000 cubic yards of gravel, which yielded 548 ounces of gold and 52 ounces of silver, at the La Grange Placers mine from January 1 to July 1, 1942. The Dobbin Gulch Dredging Co. operated a dragline dredge, which had a dragline excavator with a 1¼-cubic yard bucket, at the Sunshine and M. A. Brady properties from January 3 to October 19, 1942; at the Sunshine mine 107,300 cubic yards of gravel yielded 348 ounces of gold and 33 ounces of silver.

TULARE COUNTY

White River district.—The Thanksgiving Mining Co. operated the Thanksgiving mine from January 1 to September 1, 1942; 315 tons of ore treated by amalgamation and flotation yielded bullion containing 61 ounces of gold and 22 ounces of silver and concentrates (shipped to a smelter) containing 69 ounces of gold and 28 ounces of silver.

TUOLUMNE COUNTY

Mother Lode district.—Miller & Clemson operated the Eagle-Shawmut mine from January 1 to December 31, 1942; 143,866 tons of ore treated in a 500-ton flotation mill yielded bullion containing 607

ounces of gold and 164 ounces of silver and 3, 865 tons of concentrates containing 10,687 ounces of gold, 3,270 ounces of silver, and 7,483 pounds of copper; the concentrates were shipped to a smelter. E. A. Kent operated a dragline dredge with a dragline excavator having a 2½-cubic yard bucket on the Lyons and Rosasco ranches from January 2 to February 19, 1942; 224 ounces of gold and 15 ounces of silver were recovered from 53,000 cubic yards of gravel at the Lyons ranch, and 308 ounces of gold and 21 ounces of silver were recovered from 52,500 cubic yards of gravel at the Rosasco ranch.

YUBA COUNTY

Smartville district.—The Williams Bar Dredging Co. operated a connected-bucket dredge equipped with 84 6-cubic foot buckets in the bed of Yuba River near Smartville throughout 1942; 2,872,327 cubic yards of gravel yielded 6,354 ounces of gold and 447 ounces of silver.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES

(MINE REPORT)

By A. J. MARTIN

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SUMMARY

The mine production of recoverable silver, copper, and zinc in the Central States decreased in 1942 compared with 1941, but that of lead increased. No output of gold was reported in either year, and the silver produced was derived from base-metal ores. The increase in lead output resulted from capacity operation of the large lead mines in Southeastern Missouri. The decreases in copper and zinc, despite intensified activity in mining, can be attributed to several factors. The developed high- and medium-grade ore reserves were drawn upon heavily in 1940 and 1941 to help meet quickly the expanding requirements of metal for armaments. Operating margins under the controlled and ceiling metal prices prevailing after September 23, 1940, generally were insufficient to meet the increases in operating costs and also provide for extensive new development and prospecting. The full potential effect of the premium-price plan and other measures taken by Federal agencies to get production from marginal and submarginal ores was not reflected in output during the year, owing to the length of time required to reopen and reequip old properties and bring newly found ore bodies to the productive stage. Labor shortages and delay in getting delivery of some materials, such as steel products and electrical equipment, reduced output at some mines.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.

[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.

[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.

[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in the Central States, 1938–42, in terms of recovered metals

Year	Mines producing	Ore and old tailings (short tons)	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
1938	229	19,037,105			386,210	$249,671
1939	251	22,972,151	[1] 4	$140	315,953	214,465
1940	416	25,532,085	[1] 5	175	353,737	251,546
1941	447	28,959,189			448,824	319,164
1942	502	30,726,994			130,884	93,073

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
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
1941	95,680,000	11,290,240	209,362	23,867,268	276,006	41,400,900	76,877,572
1942	93,958,000	11,368,918	235,229	31,520,686	258,181	48,021,666	91,004,343

[1] From placer prospecting.

Silver.—Silver output in the Central States in 1942 comprised 69,106 ounces derived from refining lead bullion, slags, and skimmings recovered from Southeastern Missouri lead ores; 61,674 ounces from Michigan copper ore; and 104 ounces from galena concentrates recovered in milling Illinois zinc-lead ore and fluorspar. Output of silver-bearing lead concentrates from Southeastern Missouri increased in 1942 and their average silver content per ton (about 1.5 ounces) was approximately the same as in other years, but the bulk of the silver was not recovered in the smelter production of chemical (undesilverized) lead and was therefore not included in the production figures for recoverable silver.

Copper.—Copper mines in Michigan yielded 97 percent of the Central States total output of recoverable copper in both 1941 and 1942. The State output was 91,358,000 pounds of refined copper in 1942, and the average recovery per ton of combined rock and sands treated was 20.9 pounds compared with 92,880,000 and 21.7 pounds, respectively, in 1941. The huge war demand for copper and the payment of the Government premium for copper produced in excess of quotas stimulated exploration and development work at Michigan mines. No copper ore was produced in any of the other Central States in 1942. The Missouri production of copper (2,600,000 pounds) was derived from treatment of residues from the smelting of lead concentrates from Southeastern Missouri.

Lead.—Of the 235,229 tons of recoverable lead produced by mines in the Central States in 1942, 197,291 tons (84 percent) came from Southeastern Missouri. The large mines of the St. Joseph Lead Co. in this region contained appreciable reserves of developed ore, which were drawn upon to prevent a shortage of lead for war purposes. The Tri-State region (Kansas, Oklahoma, and Southwestern Missouri) yielded 34,341 tons of lead during the year and Arkansas, Central Missouri, Illinois, Kentucky, and Wisconsin together 3,597 tons. The output from Southeastern Missouri increased 32,949 tons over

1941, but the combined output of the other regions decreased 7,082 tons.

Zinc.—Although activity in zinc and zinc-lead mining in the Central States continued to expand during 1942 and many old mines were reopened, the output of recoverable zinc dropped 6 percent below that in 1941; the largest decrease in quantity was 20,901 tons (8 percent) in the Tri-State region, which yielded 92 percent of the total in 1942, 94 percent in 1941, 95 percent in 1940, and 97 percent in 1939. In 1942 Oklahoma contributed 62 percent and Kansas 23 percent of the Tri-State output compared with 64 and 28 percent, respectively, in 1941. A general review of mining and milling in the Tri-State region is given in the pages of this chapter devoted to Southwestern Missouri. Production of zinc in Illinois increased from 9,198 tons in 1941 to 9,389 tons in 1942 and that in Wisconsin from 6,238 to 9,426 tons; in Southeastern and Central Missouri the combined output decreased from 1,100 to 842 tons; in Kentucky the output decreased from 427 to 407 tons and in Arkansas from 206 to 181 tons.

MINE PRODUCTION BY STATES AND REGIONS

Mine production of silver, copper, lead, and zinc in the Central States in 1942, by States, in terms of recovered metals

State	Mines producing	Ore and old tailings (short tons)	Silver	
			Fine ounces	Value
Arkansas	33	4,595		
Illinois	19	[1] 86,796	104	$74
Kansas	81	3,872,052		
Kentucky	7	[1] 2,056		
Michigan	9	4,362,640	61,674	43,857
Missouri	118	9,298,758	69,106	49,142
Oklahoma	141	12,798,423		
Wisconsin	94	301,674		
Total, 1941	502	30,726,994	130,884	93,073
	447	28,959,189	448,824	319,164

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Arkansas			2	$268	181	$33,666	$33,934
Illinois			2,344	314,096	9,389	1,746,354	2,060,524
Kansas			9,419	1,262,146	55,874	10,392,564	11,654,710
Kentucky			335	44,890	407	75,702	120,592
Michigan	91,358,000	$11,054,318					11,098,175
Missouri	2,600,000	314,600	199,548	26,739,432	36,394	6,769,284	33,872,458
Oklahoma			22,806	3,056,004	146,510	27,250,860	30,306,864
Wisconsin			775	103,850	9,426	1,753,236	1,857,086
Total, 1941	93,958,000	11,368,918	235,229	31,520,686	258,181	48,021,666	91,004,343
	95,680,000	11,290,240	209,362	23,867,268	276,006	41,400,900	76,877,572

[1] Excludes lead-bearing material mined with fluorspar and from which some lead was recovered as a byproduct of the mining and milling of the fluorspar.

Of the seven lead- and zinc-producing regions in the Central States, three are not limited to a single State. The Central Missouri region yielded a small output, which is combined with that of Southeastern Missouri. The Arbuckle Mountain region of Southern Oklahoma has had no production since 1918. The output by regions in 1942 is given in the following table.

Mine production of lead and zinc in the Central States in 1942, by regions

Region	Lead [1]		Zinc [2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin or Tri-State	44,857	$4,456,782	443,847	$30,905,327	$35,362,109
Southeastern Missouri [3]	277,255	19,426,540	[4] 1,739	41,913	19,468,453
Upper Mississippi Valley [5]	1,289	119,026	20,601	1,207,275	1,326,301
Kentucky-Southern Illinois	4,059	262,984	14,637	852,617	1,115,601
Northern Arkansas	3	177	518	27,431	27,608
Total, 1941	327,463	24,265,509	481,342	33,034,563	57,300,072
	287,948	19,342,323	513,511	25,495,005	44,837,328
Recoverable metal:					
Joplin or Tri-State	34,341	4,601,694	237,936	44,256,096	48,857,790
Southeastern Missouri [6]	[7] 197,432	26,455,888	[8] 842	156,612	26,612,500
Upper Mississippi Valley [5]	908	121,672	11,126	2,069,436	2,191,108
Kentucky-Southern Illinois	2,546	341,164	8,096	1,505,856	1,847,020
Northern Arkansas	2	268	181	33,666	33,934
Total, 1941	235,229	31,520,686	258,181	48,021,666	79,542,352
	209,362	23,867,268	276,006	41,400,900	65,268,168

[1] Includes galena and small quantity of lead carbonate concentrates.
[2] Includes sphalerite and relatively small quantity of zinc carbonate and silicate concentrates.
[3] Includes 180 tons of lead concentrates and 468 tons of zinc concentrates from Central Missouri.
[4] Includes 1,260 tons of zinc-lead carbonate averaging 19.52 percent zinc and 2.46 percent lead.
[5] Region includes Iowa, Northern Illinois, and Wisconsin; no production in Iowa from 1918 to 1942, inclusive.
[6] Includes 141 tons of lead and 179 tons of zinc from Central Missouri.
[7] Includes 28 tons contained in zinc-lead carbonate.
[8] Includes 450 tons recovered in fuming slag from byproduct copper-lead-zinc matte produced in smelting lead concentrates.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in some [1] Central States, 1940–42, by States

State	1940		1941		1942	
	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	3,153,800	2.40	3,696,247	2.55	3,872,052	1.85
Michigan	4,438,219	1.02	4,282,448	1.08	4,362,640	1.05
Missouri	6,457,400	2.94	6,792,594	2.85	9,298,758	2.63
Oklahoma	11,250,400	1.80	13,883,989	1.52	12,798,423	1.45
Wisconsin	190,326	3.61	211,973	3.86	301,674	3.74
	25,490,145	----------	28,867,251	----------	30,633,547	----------

[1] Only small-scale intermittent mining done in Arkansas from 1918 to 1942; 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

Most of the ore mined in the Central States is concentrated by the companies producing it, but that mined by some of the large producing companies in the Tri-State and Upper Mississippi Valley regions is sent to custom 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. The bulk of the ore is treated by gravity concentration, supplemented by flotation. Since 1939 a large tonnage of ore has been treated by the differential-density

(or sink-and-float) process in the Central mill of the Eagle-Picher Mining & Smelting Co. at Cardin, Okla.; the enriched product resulting from treatment by this process is concentrated further by jigging and flotation. The concentrates produced in the Central States generally have an established market. In 1942 copper concentrates from Michigan were smelted in 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 or pigment plants at Galena and Coffeyville, Kans., Alton and Hillsboro, Ill., Herculaneum, Mo., and Omaha, Nebr. Zinc concentrates from the Tri-State district moved to plants at Bartlesville and Henryetta, Okla.; Coffeyville and Galena, Kans.; Fort Smith and Van Buren, Ark.; Danville, East St. Louis (Fairmont), Hillsboro, and La Salle, Ill.; Donora and Josephtown, Pa.; and Moundsville, W. Va. Most of the lead and zinc concentrates from Wisconsin, Illinois, and other scattered districts in the Central States were shipped to plants that treated the concentrates from the Southeastern Missouri and Tri-State districts. Small tonnages of zinc carbonate from Arkansas and Missouri were shipped to chemical plants at Collinsville, Ill., and Newcastle, Pa.

REVIEW BY STATES

ARKANSAS

The small output of lead and zinc in Arkansas in 1942 came from 33 mines and prospects in Boone, Izard, Lawrence, Marion, Newton, and Searcy Counties. None of the mines was a steady producer, and only 4 shipped as much as a carload of concentrates. The total shipments comprised 485 tons of carbonate and mixed carbonate, silicate, and sulfide averaging 39.50 percent zinc, 33 tons of sulfides averaging 57.10 percent zinc, and 3 tons of lead concentrates averaging 63.33 percent lead. Most of the carbonate produced from January to October was sold in small lots to the Manda Industrial Corporation at Harrison, which shipped it in carlots to the Chemical & Pigment Co. at Collinsville, Ill. The rest of the zinc concentrates were shipped to smelters at Fort Smith and Van Buren, Ark. Small tonnages of concentrates were produced in mills at the Gloria-Alma-Jackpot group near Zinc, Boone County; the Edith, Leader Hollow, and McIntosh near Rush, Marion County; the Bald Hill, Newton County; and the Excelsior and Lone Star, Searcy County. The Silver Hollow group near Rush and the Big Hurricane in Searcy County were reopened for examination through preliminary R. F. C. loans. The Bureau of Mines did 3,368 feet of diamond drilling in the Rush Creek district to explore strata below mining done in the past.

ILLINOIS

Northern Illinois (*see section on Wisconsin for output data*).—All the lead and zinc ores shipped from mines in Northern Illinois in 1942 were sold to the Vinegar Hill Zinc Co. custom mill near Cuba City, Wis. Gill Bros. continued to work the old Hughlet and Gray mine near the Illinois-Wisconsin State line and also worked the adjacent North Unity from July through December and the South Unity throughout October. The Hughlet and Gray was shut down February

4, 1943, but the North Unity, on which a 132-foot shaft was sunk in 1942, continued producing good ore. Individuals shipped a few truckloads of ore from Scales Mound and Galena. The Bureau of Mines approved an exploratory drilling project on the Gray property south of Galena and had three churn drills running under contract early in 1943.

Southern Illinois.—From 1939 through 1942 the zinc-lead fluorspar mines of the Mahoning Mining Co. near Cave in Rock, Hardin County, contributed most of the zinc and lead output from Southern Illinois. In 1942 the company operated the W. L. Davis-Deardorff, Green No. 1, and Anna L. Davis mines. The ore is composed chiefly of fluorspar, sphalerite, and galena, which are recovered as separate products in the company 200-ton selective flotation mill at Rosiclare. The fluorspar concentrates produced in 1942 were mostly of acid grade; the sphalerite averaged 62.87 percent zinc, and the galena 63.88 percent lead. A small part of the mill feed was custom ore from other properties in Southern Illinois and Kentucky, mostly fluorspar mines yielding zinc and lead as byproducts. During the year the company sank a 363-foot shaft on the Green No. 1 mine and began sinking another shaft on the Green No. 2; at the end of the year it had six drills at work in a greater effort to discover and extend ore bodies and was installing additional machinery to expand the capacity of the mill. Hillside Fluor Spar Mines continued to ship byproduct lead concentrates. The total output of lead concentrates in Southern Illinois in 1942 was 3,566 tons averaging 63.83 percent lead and about 5.14 ounces of silver to the ton, and that of zinc concentrates was 13,590 tons averaging 62.87 percent zinc. Production (in terms of recovered metals) amounted to 2,211 tons of lead, 104 ounces of silver, and 7,689 tons of zinc, compared with 2,256 tons of lead, 20,340 ounces of silver, and 7,480 tons of zinc in 1941.

KANSAS

The Kansas lead and zinc mines are in the Tri-State (Joplin) mining region, embracing parts of Cherokee County, Kans., and Ottawa County, Okla., and about 12 counties in Southwestern Missouri. General details of the Tri-State mining industry are given in following pages devoted to Southwestern Missouri.

The total output of zinc from Kansas ores and old tailings decreased 22 percent and lead 35 percent in 1942 from 1941. The Baxter Springs-Blue Mound-Treece area extending northward from the Oklahoma-Kansas State line has been the principal producing area since 1918; it yielded 96,856 tons of zinc concentrates and 12,183 tons of lead concentrates in 1942 compared with 122,582 and 18,835 tons, respectively, in 1941 (revised figures), and an annual average of 122,024 and 18,973 tons from 1918 through 1940. In 1942 the output of both zinc and lead from the Eagle-Picher Mining & Smelting Co. Westside-Barr and Webber mines was less than in 1941, and the total output of the Big John, Black Eagle, Chubb, Mid-Continent, Wilbur, and Robob mines shipping to the Central mill at Cardin, Okla., decreased. The Webber mill was closed in October, and the ore from the Webber lease was diverted to the Central mill. Two shafts on the lease north and northwest, respectively, of the Webber mill shaft were reopened, and spur tracks connecting them with the railroad to the Central mill were built. A shaft on the Foley land was reopened

to facilitate mining of the Westside ore, and the old Westside mill shaft was being converted for double-skip hoisting in conjunction with the erection of a 1,000-ton hopper. Other new Eagle-Picher operations in Kansas included reopening of the Lucky Jew Parmenter and Velie Leopard properties. In November the company also began preparing to reopen the Paxson mine and 2,400-ton mill as agent for the Metals Reserve Co. This mine began producing in April 1943.

The 1,800-ton Ballard central mill of the St. Louis Smelting & Refining Co. was operated at approximate capacity throughout 1942 on company ore from the Ballard, Bailey, Clark, English "O", Keith, Shanks, Slaughter, and Walter H. mines; the output of zinc concentrates was less than in 1941, but that of lead concentrates was approximately the same in both years. The Bilharz Mining Co. operated the Bilharz-Brewster mine throughout 1942, treating the ore in the company mill which also handled crude ore from the L. D. Brewster and Huttig mines in Oklahoma from January to July. The Madison mill was run steadily on ores from the Peru-Banning group and Craig and Brugger leases. The Wade custom mill treated 20,817 tons of mine dirt from the Discard, Commonwealth, and other small mines in Kansas and Oklahoma. From September through December the Mineral Products Co. shipped crude ore from a shaft on the Swalley property to the Mission mill in Oklahoma. The Pilot mill was shut down in March and remained idle the rest of the year. The Oldham Mining Co. shipped ore to custom mills. The Dines Mining Co. continued to run its mill on company and custom ores, mostly from the Southern, Harris, and Hartley No. 1 mines. The Beck No. 3 mill at Baxter Springs was reconditioned to treat company and custom ores and was put in operation in January 1943; part of the ore treated came from the McArthur mine, on which two shafts were sunk in 1942. The Muncie mill of the Federal Mining & Smelting Co. was closed in April, and the ore from the Muncie-Tar Creek-Semple group was then sent to the company Gordon central mill in Oklahoma, which also treated other Kansas ore from the Federal Jarrett mine. The north shaft on the Muncie was reopened and reequipped for additional development. The Muncie mill and the remaining part of the old Jarrett mill were dismantled and salvaged. The Harris Mining Co. continued to work the Robinson mine and in October began mining ore from a new shaft on the Silver Fox lease. The ore from these two mines and that from the leased Evans-Wallower No. 24 was concentrated in the Youngman mill. The Opperman mine, operated by the Lula Bell Mining Co., was closed in August. The New Blue Mound Mining Co. operated one section of its mill on crude ore from the Blue Mound mine, and the Worley Mining Co. operated the other section on new tailings from the Blue Mound ore and old tailings hauled from scattered piles in the vicinity. The Captain and Early Bird tailing mills were run steadily, and their output of zinc concentrates was larger than in 1941.

The Kansas part of the Waco district yielded 5,113 tons of zinc concentrates and 5 tons of galena in 1942 compared with 8,361 and 15 tons, respectively, in 1941. The St. Louis Smelting & Refining Co. operated its No. 9 mill (capacity 800 tons in 16 hours) throughout 1942. More than half the ore treated came from the company Olsen and High Five leases in the Missouri part of the Waco district; the

rest came from the company Grasselli and J. M. Bennett leases, the Stotts City Mining Co. J. M. Bennett lease, and the Beck Mining Co. Hurlbut lease. The F. W. Evans mill treated ore from the O'Neill land (partly in Kansas and partly in Missouri), the St. Louis Smelting & Refining Co. land, and the Blue Rock mine in Missouri. In the Galena area, formerly (1876–1917) the principal zinc- and lead-producing area in Kansas, the Eagle-Picher Mining & Smelting Co. continued churn drilling, sank two new shafts and reopened several old shafts, and did underground development work and pumping. Ore shipments to the company Bird Dog mill in Oklahoma began in March 1943. The Galena Mining Co. shipped crude ore from the Southside mine to the Central mill.

Mine shipments of lead and zinc in Kansas, 1938–42

Year	Mines producing	Lead concentrates		Zinc concentrates		Metal content[1]			
						Lead		Zinc	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	58	18,888	1,264,147	131,406	6,595,506	14,538	1,657,332	71,403	10,710,450
1942	81	12,253	1,167,302	103,247	6,926,745	9,419	1,262,146	55,874	10,392,564

[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, 1941–42

	1941		1942	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled.....short tons	2,446,207	1,250,040	2,170,121	1,701,931
Total concentrates produced:				
Galena.....do	18,886	2	12,253	----------
Sphalerite.....do	123,000	8,406	92,540	10,707
Ratio of concentrates to ore, etc.:				
Lead.....percent	0.77	----------	0.56	----------
Zinc.....do	5.03	0.67	4.26	0.63
Metal content of ore, etc.:[1]				
Lead.....do	.61	----------	.44	----------
Zinc.....do	3.04	.40	2.57	.36
Average lead content of galena concentrates.....do	78.54	50.0	78.44	----------
Average zinc content of sphalerite concentrates.....do	60.48	58.9	60.38	57.96
Average value per ton:				
Galena concentrates	$66.93	$56.00	$95.27	----------
Sphalerite concentrates	50.32	48.38	65.55	$80.42

[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.

KENTUCKY

Part of the Kentucky output of zinc and most of the lead in 1942 were byproducts of fluorspar mining. The United States Coal & Coke Co. Fluorspar Division, operating the Lafayette mine near Mexico, was the principal shipper of byproduct zinc concentrates and also shipped lead concentrates. The largest shipper of lead con-

centrates was the Kentucky Fluor Spar Co., which recovered the concentrates in milling fluorspar from the Babb mine. The Cumberland Fluorspar Co., Delhi Foundry Sand Co., and Summers Fluorspar Mine shipped zinc-lead fluorspar ore to the Mahoning mill at Rosiclare, Ill. The Cumberland Fluorspar Co. also shipped 530 tons of carbonate ore averaging 30.62 percent zinc to oxide plants. During November and December the Eagle-Picher Mining & Smelting Co. shipped 1,220 tons of crude zinc-lead sulfide ore from its Nunn mine 6 miles east of Marion to the company Central mill at Cardin, Okla. The total State output of recoverable zinc was 407 tons and that of lead 335 tons compared with 427 and 282 tons, respectively, in 1941. The Twin Valley Mining Co. continued developing the Gratz mine in Owen County and installed additional equipment in the mill, increasing its capacity (formerly 50 tons daily) to 100 tons. Mining and milling of ore were begun in February 1943.

MICHIGAN

Although the output of refined copper in Michigan decreased 2 percent in 1942 from 1941, there was a material expansion in 1942 in the scope of mining and development operations by the mining companies. Special arrangements with Federal procurement agencies in the latter part of 1941, whereby the copper produced from certain "high-cost" mines would be paid for on a cost-plus basis, and the premium-price plan placed in effect in February 1942 enabled the companies to make preparations to mine and mill copper-bearing rock not commercial under the ceiling copper price of 12 cents a pound. The average grade of the crude ore mined was 10 percent lower than in 1941, and that of old tailings (sands) treated at reclamation plants was slightly lower. The total crude ore treated increased from 1,741,961 tons in 1941 to 1,952,781 tons in 1942; tailings decreased from 2,540,487 to 2,409,859 tons. The tailings yielded 34 percent of the total copper in 1942 and 36 percent in 1941.

The concentrate ("mineral") produced at mills in Michigan in 1942 was smelted at plants of the Calumet and Hecla Consolidated Copper Co. at Hubbell and the Copper Range Co. at Houghton. Some of the copper bullion was cast into anodes and shipped to the electrolytic refinery at Laurel Hill, N. Y., where silver was recovered. Silver was also recovered by hand-picking at the mine and from some of the concentrates.

Mine production of silver and copper in Michigan, 1938–42 [1]

Year	Silver (fine ounces)	Copper [2]			Concentrate ("mineral") [3]		Ore ("rock") (short tons) [4]
		Pounds	Yield		Pounds	Yield (percent copper)	
			Pounds per ton of ore ("rock")	Percent			
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
1941	60,796	92,880,000	21.7	1.08	141,100,268	65.8	4,282,448
1942	61,674	91,358,000	20.9	1.05	141,372,582	64.6	4,362,640

[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.

Value of silver and copper produced in Michigan mines, 1938–42

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of ore ("rock") and sands				Total	Per ton of ore ("rock") and sands	
1938	$60,531	$9,161,628	$2.44	$9,222,159	1941	$43,233	$10,959,840	$2.56	$11,003,073
1939	69,154	9,148,880	1.99	9,218,034	1942	43,857	11,054,318	2.53	11,098,175
1940	63,045	10,214,748	2.30	10,277,793					

The Calumet and Hecla Consolidated Copper Co. continued to be the largest producer of copper in Michigan. After June 1, 1942, when the company purchased all the physical assets of the Wolverine Tube Co. (manufacturer of seamless nonferrous tube) at Detroit, the mining, smelting, and other company operations in Northern Michigan were operated as the Calumet Division, and the newly acquired enterprise became the Wolverine Tube Division. The producing company mines in 1942 were the Ahmeek, Peninsula, Douglass, and No. 4 North Kearsarge groups. The ore from all four groups was treated in the 6,800-ton Ahmeek stamp mill by gravity concentration followed by flotation of the fines. The details of operations at the mines that follow were extracted from the annual company report to stockholders. Operations at the Ahmeek mine were confined largely to stoping. Exploration of the Peninsula area was continued throughout the year. A heavy program of dead work, consisting of the extension of No. 4 shaft, reopening of three old levels, and unwatering old Seneca workings, resulted in high costs for the copper produced. No important new ore shoots were discovered, but the extension of two known ore shoots was determined. At the Douglass group a total of 6,228 feet of openings was driven from No. 2 and No. 3 Ahmeek shafts. A large portion of the openings was in low-grade vein, but a reasonable percentage was in ground of probable commercial value. The No. 4 North Kearsarge mine was reopened and operated under a contract with the Metals Reserve Co. During February and March the surface plant and underground openings were rehabilitated; production started in April at a moderate rate and increased gradually throughout the year. On the Iroquois property a surface plant was constructed, an exploratory inclined shaft was sunk to a depth of about 700 feet, and 196 feet of drifting was done at the 600-foot level. At the Central property underground workings were unwatered, the surface plant was repaired, diamond drilling was done, the shaft was sunk 128 feet below the 200-foot level, and crosscutting to the mineralized area was begun.

Both the Lake Linden and the Tamarack dredges operated in the older, richer parts of the respective deposits adjacent to the original shore lines. At Lake Linden the conglomerate tailings above the water line will have disappeared before the end of the coming summer, and operations thereafter will be spotty and irregular until reserves are exhausted. The profitable life of this asset is short. At Tamarack there is some promise of an extended life on amygdaloid tailings if a suitable price can be obtained for the copper produced.

Copper output from the Champion and Globe mines of the Copper Range Co. increased in 1942. The ore from both mines was treated

in the company mill at Freda. Copper recovered from 355,630 tons of mine ore and 223,859 tons of sands treated in the tailings-recovery plant totaled 18,441,607 pounds. The average yield of fine copper per ton of mine rock was 49.97 pounds compared with 52.38 pounds in 1941. Mine workings include two 70° shafts about 5,000 feet deep and one subshaft about 400 feet deep. Development work done during the year totaled 198 feet of shaft, 12,086 feet of drifts and crosscuts, and 12,571 feet of diamond drilling. The concentrates were smelted in the company smelter, which also handled custom concentrates from the mills of the Isle Royale Copper Co. and the Quincy Mining Co.

The Isle Royale Copper Co. mine and 2,000-ton stamp mill were run continuously in 1942. Crude ore produced totaled 315,142 tons compared with 316,598 in 1941. The yield of fine copper per ton of rock averaged 20.16 pounds in 1942 and 21.223 in 1941. The 1942 annual company report to stockholders stated that mining costs were gradually increasing and that notice had been received in February 1943 of an increase in wages awarded by the Nonferrous Metals Commission; the notice indicated that some increase in the copper price would be necessary to enable the company to pay the wage increase.

The Quincy Mining Co. operated its mine and mill continuously in 1942. Both the tonnage of rock treated and the yield of copper per ton were slightly lower than in 1941. In 1942 the company obtained a loan of $1,150,000 from the Metals Reserve Co. to be expended in constructing a 4,000-ton plant for re-treating the Quincy Mining Co. tailing deposit at Mason, on Torch Lake. The loan is to be retired by payment of 4 cents per pound of copper produced. The plant will be constructed by the Calumet and Hecla Consolidated Copper Co. which will furnish much of the machinery from dismantled structures no longer needed by that company. After completion, the plant will be operated by the Quincy Mining Co. All the copper produced will be sold to the Metals Reserve Co. for 17 cents a pound.

From January through December 1942 Arcadian Mines (incorporated May 2, 1942) drove 1,250 feet of development drifts and 150 feet of crosscuts on the company property on the south side of Ripley Hill. The Ripley adit, through which the property is being developed, was 2,050 feet long at the end of the year. About 250 tons of ore removed in drifting were stored for a mill test, and nearly a ton of native ("mass") copper was sent to the Copper Range smelter.

MISSOURI

In 1942 Missouri maintained by a wide margin the rank it has held for 35 years as the chief lead-producing State. Under the stimulus of heavy demand and higher prices brought on by the war, the output of zinc increased 73 percent in 1941 over 1940 and 66 percent in 1942 over 1941. Lead production increased 20 percent in 1942 over 1941. The lead comes largely from the Southeastern Missouri region and the zinc mostly from Southwestern Missouri. In 1942 silver, copper, and zinc were recovered in relatively small quantities as byproducts in smelting and refining lead concentrates from Southeastern Missouri. The Central district of Missouri produced 141 tons of recoverable lead and 179 tons of zinc in 1942; these figures are combined with those of Southeastern Missouri in the table that follows.

Mine production of lead and zinc in Southeastern and Central Missouri, 1938–42

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
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
1941	228,572	15,404,226	[4] 5,192	73,202	164,388	18,740,232	1,100	165,000
1942	277,255	19,426,540	[5] 1,739	41,913	197,432	26,455,888	[6] 842	156,612

[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.

[4] Includes 4,720 tons of zinc-lead carbonate concentrates containing 893 tons of recoverable zinc and 172 tons of lead.

[5] Includes 1,271 tons of zinc and zinc-lead carbonate concentrates containing 213 tons of recoverable zinc and 28 tons of lead.

[6] Includes 450 tons recovered in fuming slag from byproduct copper-lead-zinc matte produced in smelting lead concentrates.

Tenor of lead ore and concentrates in Southeastern Missouri disseminated-lead district, 1938–42

	1938	1939	1940	1941	1942
Total lead ore, short tons	3,668,400	5,127,000	5,837,400	5,737,230	7,107,191
Galena concentrates in ore, percent	4.45	4.11	3.99	3.98	3.90
Zinc content of ore, do	[1]	[1]	[1]	[1]	[1]
Average lead content of galena concentrates, do	74.8	74.4	74.45	73.31	72.65
Average value per ton of galena concentrates	$55.29	$58.61	$61.28	$67.39	$70.04

[1] Figures not available.

Mine production of lead and zinc in Southwestern Missouri, 1938–42

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
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
1941	2,084	125,730	90	4,379	38,513	1,923,472	1,277	14,355	1,521	173,394	20,832	3,124,800
1942	2,790	303,331	20	864	66,881	4,791,020	1,510	23,940	2,116	283,544	35,552	6,612,672

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Southwestern Missouri, 1941–42

	1941		1942	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled ..... short tons	777,351	252,603	1,404,731	751,252
Total concentrates produced:				
Lead ..... do	2,147	27	2,773	37
Zinc ..... do	37,594	2,196	59,909	8,482
Ratio of concentrates to ore, etc.:				
Lead ..... percent	0.28	0.01	0.20	0.004
Zinc ..... do	4.84	.87	4.26	1.13
Metal content of ores, etc.: [1]				
Lead ..... do	.20	.006	.15	----------
Zinc ..... do	2.83	.47	2.48	.63
Average lead content of galena concentrates ..... do	72.8	51.9	77.1	64.9
Average lead content of lead carbonate ..... do	52.22	----------	50.0	----------
Average zinc content of sphalerite concentrates ..... do	59.74	53.82	58.12	55.52
Average zinc content of silicates and carbonates ..... percent	22.47	----------	23.25	----------
Average value per ton:				
Galena concentrates	$60.62	$38.52	$108.30	$105.19
Lead carbonate concentrates	48.66	----------	43.20	----------
Sphalerite concentrates	50.34	43.45	69.79	74.73
Zinc silicates and carbonates	11.24	----------	15.85	----------

[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.

Southeastern and Central Missouri.—The disseminated-lead district of Southeastern Missouri yielded 197,291 tons of recoverable lead in 1942—an increase of 32,949 tons (20 percent) over 1941. The bulk of production in 1942, as in the past, came from St. Francois County, where the St. Joseph Lead Co. operated continuously its four groups of mines and four mills, comprising the Bonne Terre, Leadwood, Desloge, and Federal Divisions. The mines were operated two 8-hour shifts per working day and the mills three 8-hour shifts, and all worked 6 days a week. Ore hoisted per day averaged 21,100 tons, which kept the mills operating at capacity. One ore-hoisting shaft is at each mill; in addition, there were 11 operating shafts equipped for handling men, supplies, and poor rock. The average depth of the four ore-hoisting shafts is 440 feet. The ore occurs in extensive, flat-lying deposits in limestone and is mined from open stopes supported by pillars. Electric-powered mechanical loaders and locomotives are used for loading and underground haulage. Mine development and drilling done in 1942—77,143 feet of drifts, a 716-foot raise, 9,564 feet of churn drilling, and 2,305,272 feet of diamond drilling—were nearly double the total in 1941. New equipment purchased included 6 diamond core drills, 12 underground mechanical loaders, 100 mine cars, and 24 underground trolley locomotives. The annual company report to stockholders for 1942 stated that although the mines were still being worked beyond their economic capacity the development work during the year was very satisfactory, and the tonnage of proved ore was greater than it had ever been. In Madison County production of lead from the Mine La Motte mine of the Mine La Motte Corporation (50-percent owned by the St. Joseph Lead Co.) also increased. The 1,000-ton mill was enlarged during the latter part of 1942 to provide 500 tons additional daily capacity to treat the chat tailings from old operations. Mine development and drill prospecting done totaled 3,451 feet of drifts and 41,026 feet of churn

drilling. The Fredericktown Lead Co., which had purchased the mining leases on the Catherine and Fleming tracts and the 400-ton Clark and Hallock mill, installed a new Diesel power plant, surface buildings, and mining equipment and in March began treating ore from the reopened Catherine mine. During the rest of the year 96,763 tons of ore were treated, yielding 2,470 tons of 76-percent lead concentrates. Of the 277,075 tons of lead concentrates made in 1942 in Southeastern Missouri, about 129,560 tons were flotation concentrates. The St. Louis Smelting & Refining Co. carried on prospect drilling and mine-development work at its own property and the adjoining leased property of the Missouri Cobalt Co. at Fredericktown; the commercial metals in the ore are lead, copper, nickel, and cobalt. The ore was tested in the Bureau of Mines laboratory at Rolla to develop a suitable treatment process.

The zinc ore and concentrates shipped from Southeastern Missouri in 1942 were carbonates, mostly from old dumps on the Valle Mining Co. properties in Jefferson and St. Francois Counties and the Frumet mine on the Tausig estate west of DeSoto. Shipments totaled 1,271 tons, averaging 19.76 percent zinc and 2.44 percent lead.

In Central Missouri the Wemhaner Mining Corporation continued to mine zinc, lead, and coal from its leased open-pit mine on the Monarch Coal & Mineral Co. land in Moniteau County. In treatment, the coal and some waste are removed by screens and coal jigs, and the ore rock is then concentrated further in ore jigs. Otis and E. M. Sullens worked the Lowery mine near Enon on a small scale and shipped 150 tons of galena averaging 80 percent lead. A 2-ton lot of lead ore was shipped from Lynn Creek.

Southwestern Missouri.—The method of marketing the mine output in the Tri-State or Joplin lead and zinc region (Southwestern Missouri, Kansas, and Oklahoma) is explained in the reports of this series for 1940 and 1941.

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. Under the ceiling price of 8.25 cents a pound for slab zinc at East St. Louis, the quoted price for zinc concentrates at Joplin remained at $55.28 a ton throughout 1942. The quoted price for galena opened in January at $68.64 a ton on a metal contract basis; on January 13 it was raised to $76.75, which held until March 28 when the price was reduced slightly to $76.54; it remained at that level the rest of the year.

Effective February 1, 1942, the Metals Reserve Co. paid premiums of $28.05 a ton for 60-percent zinc concentrates and $39.60 for 80-percent galena for production from individual mines in excess of quotas fixed jointly by the War Production Board and the Office of Price Administration. On December 1 the premiums were increased slightly to $29.70 a ton for zinc concentrates and $41.80 for galena following a revision of the formula used in determining the recoverable-metal content of the concentrates; the recovery factor for zinc was raised from 85 to 90 percent and that for lead from 90 to 95 percent.

Early in 1943 the scope of the premium-payment program was broadened to afford an additional premium for lead (called "B"-level quota) and an additional premium or premiums for zinc (called "B" and "C" level) at operations where such additional premiums were considered essential to insure maximum necessary mine pro-

duction. The premium payments on the "B"-level quota were twice those on the original or "A" level, and the payment on the "C" level (zinc only) was three times that on the "A" level. The maximum combined commercial price and premiums obtainable for standard-grade zinc concentrates was therefore $144.38 a ton and for lead concentrates $160.14.

All Government premium payments for zinc and lead produced from restricted Indian lands in 1942 were subject to royalties, at rates (usually 10 percent) specified in the leases, for money received from sales at market prices. Lessees on other lands with one or two exceptions also paid part of the premium moneys received as royalty. In April 1943 the Office of Price Administration issued Maximum Price Regulation 356 freezing royalties on April 1 at rates in effect December 31, 1942. Under this regulation, "B"- and "C"-level premiums are not subject to royalties.

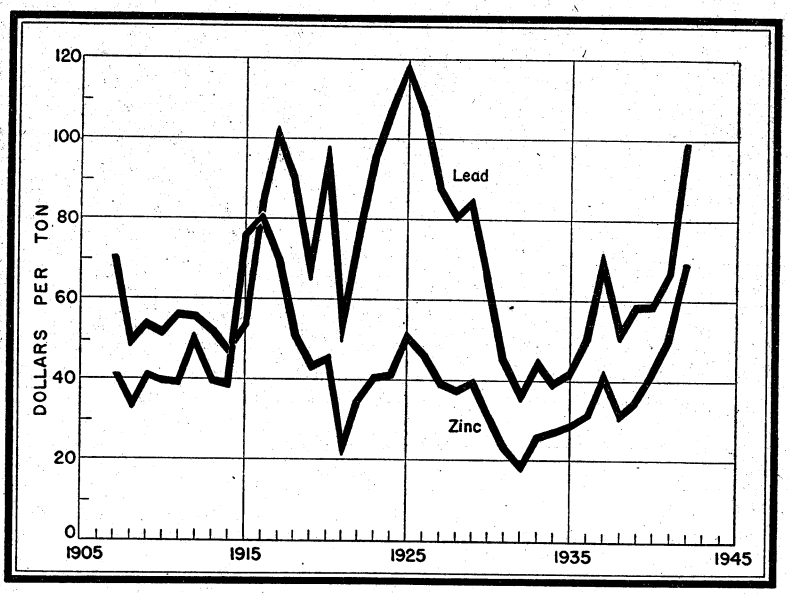

FIGURE 1.—Average prices received by sellers per ton of concentrates in the Tri-State district, 1907–42.

Local mining companies did much prospect drilling and other exploration and development work in 1942. The total number of drill rigs in operation rose from 67 on March 31 to 99 on June 30 and 100 on November 1. About 21 new shafts (averaging 190 feet deep) were sunk during the year, and at least 43 old shafts were reopened; reopenings, however, were partly offset by closings. Progress was made in mechanizing underground loading, and by the end of the year about 50 drags and more than 100 other types of mechanical loaders were being used in the district. Labor shortages, which became acute for some operators during the summer and early fall, were somewhat ameliorated later in the year. In general, established mines and mills were able to obtain needed supplies and replacement equipment under assigned priority ratings, although there was delay at times in getting

delivery of steel products, lumber, and electrical equipment. The Reconstruction Finance Corporation granted loans for development and mining on about 15 Tri-State properties, and the Bureau of Mines investigated 34 properties and did churn drilling on the Townsite mine at Cardin, Okla.

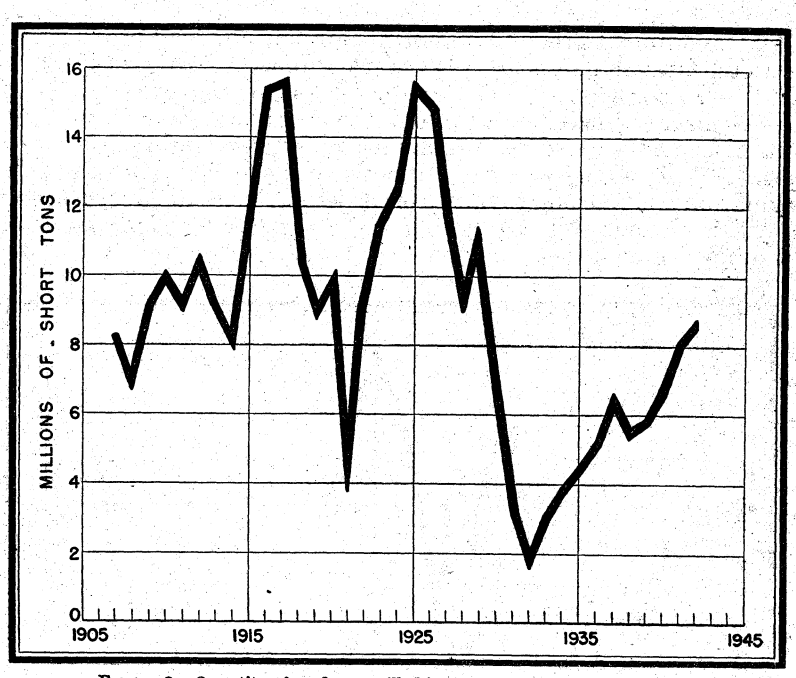

FIGURE 2.—Quantity of crude ore milled in the Tri-State district, 1907–42.

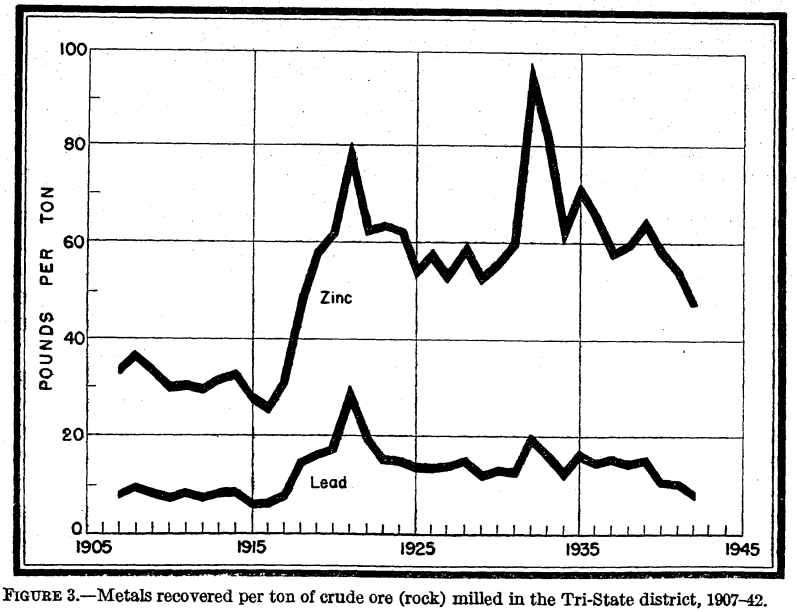

FIGURE 3.—Metals recovered per ton of crude ore (rock) milled in the Tri-State district, 1907–42.

Production of zinc in Southwestern Missouri again increased in 1942 and was the highest annual since 1918. The Oronogo Circle open-pit mine at Oronogo continued to be the largest producer. The ore is mined by the Oronogo Mutual Mining Co. and milled by the Eagle-Picher Mining & Smelting Co. Under a program undertaken in July to expand production, the rate of ore extraction was stepped up beyond the capacity of the mill on the property, and part of the crude ore was diverted to other Eagle-Picher mills in Oklahoma and Missouri. The rock milled totaled 287,680 tons; in addition, 295,520 tons of waste rock and overburden were removed from the pit, which was 230 feet deep at the end of 1942. The Fenix & Martin Mining Co. continued to operate the La Tosca mine and 200-ton mill, and Fenix & Sons shipped crude ore from a shaft on the Oronogo Mutual property to the Central mill in Oklahoma. Kansas Explorations, Inc., operated its Snapp mine and 600-ton mill near Oronogo throughout the year; the company also reopened the old A. W. C. property near Joplin and equipped it with a 1,000-ton mill, which was put in operation in October. The Eagle-Picher mines served by the Navy Bean mill near Wentworth made a large output in 1942. The Federal Mining & Smelting Co. operated six shafts (average depth 170 feet) on its Granby-American property, treating the ore in the company 1,200-ton mill; the company also developed its Granby-Davis lease, which began producing in September, and nearly completed a large mill at its Duenweg mine. The new mill and the Duenweg mine were placed in operation about April 1, 1943. The American Zinc, Lead & Smelting Co. drilled out a good ore body on the Henckle and Smith lands near Duenweg in 1942 and began developing it by sinking three shafts; the mine was put in operation late in March 1943, and the ore produced was treated on a contract basis in the new Federal mill at Duenweg. The company also struck good ore at Aurora while drilling on the McLain-Jones land and began constructing a mill on the property in March 1943.

The principal producer near Joplin was the Missouri Mining Co. 1,200-ton tailing mill at Chitwood. The High Grade Mining Co. reopened its mine and mill in May and operated until November; the property was then idle until March 1943, when it was put in operation by the Southside Mining Co. The Northside Mining Co., which had its ore milled in the High Grade mill in 1942, built a mill on the Northside property and began milling in January 1943. The St. Louis Mining & Milling Co. operated its custom mill at Thoms Station steadily, affording milling facilities for small mines operating nearby. At Waco the St. Louis Smelting & Refining Co. worked its High Five and Olsen leased mines and sent the ore to the company No. 9 mill across the State line in Kansas. F. W. Evans Mines operated the O'Neill and Blue Rock mines and treated the ore in the company mill in Kansas. C. C. Playter ran his mill (capacity, 12½ tons an hour) continuously on ore from his Reynolds lease at Waco and other ores from small mines near Carl Junction, Joplin, Neck City, and Pleasant Valley and from Galena, Kans. At Webb City the Sciota Milling Co. mill ran steadily on tailings from the Connor Investment Co. land and other properties. Early in 1943 Cooley Bros. began stripping operations with draglines and bulldozers on the F. W. Evans land in Sucker Flat. At Stotts City the Capital Mining Co. continued to operate its Capital mine and in July purchased the adjacent Stotts

City Mining Co. property; the ore from both mines was treated in the Capital mill. The Harris Mining Co. mill north of Aurora was run intermittently. Near Ozark, Christian County, the Mary Arnold mine and mill were operated from January through October, and the Monark Mining Co. property was under development and made a small output early in the year. The Wentworth Mining & Milling Co. operated the Kline mine and mill after July. The Southwest Mining Co. began developing its property at Stark City and nearly completed a 250-ton mill before the year ended. Eleven small mills in the Alba-Neck City, Carthage, Duenweg, Granby, Joplin, and Webb City areas produced some concentrates in 1942, mostly from tailings. Zinc carbonate and silicate shipped from scattered mines and dumps in Southwestern Missouri in 1942 (including low-grade zinc-lead concentrates from Granby dump material treated in the Goade mill) totaled 1,510 tons averaging 23.25 percent zinc and 3.58 percent lead.

OKLAHOMA

General details of mining and milling in the Tri-State region—which includes northeastern Oklahoma—are given in the preceding pages on Southwestern Missouri. Although Oklahoma continued to yield much the largest part of the total Tri-State production of both zinc and lead, the State output of recoverable lead decreased 9 percent and zinc 12 percent in 1942 from 1941. The total value of the zinc and lead concentrates, however, increased 26 percent owing to the advance in average market prices and the payment by the Government of premiums for over-quota production. About 141 mines produced during the year and 26 mills were operating at the end of the year compared with 120 and 27, respectively, in 1941.

Mine shipments of lead and zinc in Oklahoma, 1938–42

Year	Lead concentrates		Zinc concentrates		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	32,628	2,202,876	307,207	15,427,235	25,021	2,852,394	166,602	24,990,300
1942	29,794	2,985,285	272,209	19,163,622	22,806	3,056,004	146,510	27,250,860

[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, 1941–42

	1941		1942	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled.....short tons	4,868,021	9,015,968	5,012,485	7,785,938
Total concentrates produced:				
Galena.....do	32,296	332	29,371	423
Sphalerite.....do	243,773	63,434	226,302	45,907
Ratio of concentrates to ore, etc.:				
Lead.....percent	0.66	0.004	0.59	0.005
Zinc.....do	5.01	.70	4.51	.59
Metal content of ore, etc.: [1]				
Lead.....do	.52	.002	.46	.003
Zinc.....do	3.03	.41	2.71	.34
Average lead content of galena concentrates.....do	78.53	51.51	78.43	55.08
Average zinc content of sphalerite concentrates.....percent	60.59	58.97	60.11	58.25
Average value per ton:				
Galena concentrates	$67.75	$44.79	$100.52	$77.86
Sphalerite concentrates	50.55	48.94	68.54	79.59

[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.

In 1942 the Eagle-Picher Mining & Smelting Co. was again by far the largest producer of both lead and zinc in Oklahoma and in the Tri-State region. The company 13,000-ton Central mill at Cardin treated a total of 3,599,087 rock tons of company and custom ore, of which 2,905,220 tons (81 percent) came from Oklahoma mines, compared with 3,311,144 tons in 1941, of which 2,711,212 tons (82 percent) came from Oklahoma. The concentrating equipment of the mill includes, besides the usual jigs, flotation machines, and tables, a large primary heavy-density (or sink-and-float) cone unit and a smaller secondary cone which provide preliminary stages of concentration at coarse sizes for a large portion of the mill feed. Company-operated mines in Oklahoma shipping to the mill in 1942 were the Blue Goose Nos. 1, 2, and 3, Crawford, Crystal No. 1, Crystal-Central, Eagle-Picher Gordon Nos. 1 and 2, Grace Walker Nos. 1 and 2, Goodeagle Nos. 1 and 3, Hum-bah-wat-tah Nos. 1, 2, and 3 (includes Jaybird), John Beaver Nos. 1 and 2, Little Greenback, Mehunka, Netta, Niday No. 1, See Sah, Southside Nos. 1 and 2, Stanley, and Wesah Greenback. The Crawford, Goodeagle Nos. 1 and 3, Mehunka, Niday No. 1, Netta, and Southside Nos. 1 and 2 (closed in May 1941) were reopened during the year. The Crawford and Gordon No. 1 were shut down in October and July, respectively, owing to exhaustion of ore; the John Beaver No. 1 was shut down in May because the property was too low-grade to work. New shafts were sunk on the Beck Robinson, Goodeagle No. 3, and Niday No. 1 properties. The Eagle-Picher 2,400-ton Bird Dog mill was not run in 1942 but was reopened in March 1943 and began treating ores from Oronogo, Mo., and Galena, Kans.

The principal shippers of Oklahoma custom ore to the Central mill in 1942 were the American Development Co. (Hunt mine), Baird Mining Co. (American-Douthat), Cameron & Henderson (Admiralty), Cortez-Childress (Jeff City), Davis-Big Chief Mining Co. (Eudora-Whitebird, Imbeau, and Skelton), F. W. Evans (Shorthorn, Tom L.), Lula Bell Mining Co. (Anna Beaver), Mahuska Mining Co. (Acme),

M. & M. Mining Co. (LaSalle, Piokee, Swift, Whitebird), and Mutual Mining & Development Co. (Slim Jim).

The Federal Mining & Smelting Co. operated its 1,700-ton Gordon central mill throughout 1942 on company ore from the Gordon, Howe, Lucky Bill, Lucky Syndicate, and Quapaw-Davenport mines in Oklahoma and the Federal Jarrett and Muncie groups in Kansas; the mill, built in 1937, operated until March 7, 1943, when it was destroyed by fire. The mines served by the mill were closed, and no announcement was made immediately regarding their future operation. The Rialto Mining Corporation operated its No. 3 mine and mill continuously; the No. 2 mill, handling tailings since 1938, was remodeled early in 1942 to treat mine ore from the reopened No. 2 mine and was run as a mine mill until it burned on February 12, 1943. The corporation reopened its No. 4 mine (old L. & G.) about September 1942 and concentrated the ore in the No. 2 mill. Soon after this mill burned the No. 3 mill began operating three shifts daily and handled ore from other company mines in addition to that from the No. 3 mine.

The Jane E. Mining Co. reopened its Scott mill January 1, 1942, and resumed the milling of Scott mine ore; the crude ore mined from this property in 1941 was sent to the Central mill. Development work done at the Scott mine in 1942 included sinking a 275-foot shaft and 1,945 feet of churn drilling. Evans-Wallower Zinc, Inc., ran its No. 7 mine and mill continuously in 1942, and its No. 4 mine and mill from January 1 through February 26 when operations were suspended pending conversion of the No. 4 mill into a tailing plant to re-treat old tailings from the old Golden Rod property on which the company had obtained a lease. Milling of the tailings and some mine ore was begun in June and continued the rest of the year. The Weidman Mining Co. ran the Woodchuck and Townsite mines, treating the ore, as well as some custom ore, in the Woodchuck mill. The United Zinc Smelting Corporation continued to operate its Royal mine and mill; the mill also handled custom ore, mostly from the Dixie R. mine. The Mission mill of the Mission Mining & Royalty Co. treated both company and custom ore. Other mine mills operating steadily during the year were the Kansas Exploration (Ritz), Lawyers, Lula Bell (Farmington), and St. Louis No. 4. The Hudson Goodeagle, Roan Bull, Romo, and Smoky Hill mine mills were operated part of the year on a small scale. The M. & W. Mining Co. continued to work the Federal Brewster mine and reopened and operated the adjoining Huttig; the ore was shipped to custom mills. During the year the company obtained a lease on the Ninety-Six Brewster and sank a shaft into new ore bodies, which were brought into production early in 1943. The Beck Mining Co. mill was run steadily in 1942 on company and custom ore from various mines in Oklahoma and Kansas. Tailing mills in Oklahoma that were active in 1941 and continued running in 1942 were the Atlas, Big Chief, Britt & Britt, Cardin Nos. 2 and 3, Semple (Martin), Tri-State Zinc (Ottawa and Sooner), and Western. Tri-State Zinc, Inc., experimented with the H. H. sink-and-float process in the treatment of Tri-State tailings in a commercial-size plant built during the year adjacent to the Sooner mill; the plant was shut down in the latter part of the year. The C. G. & C. Co. leased tailing piles on the Skelton property and acquired the old Skelton mine mill, which was converted into a tailing plant with a capacity of 75 tons an hour; the mill was placed in operation in June and ran the

rest of the year except for a temporary shut-down for repairs and improvements.

WISCONSIN

Government premium payments for over-quota production of lead and zinc resulted in a sizable increase in zinc production from old mines and dumps in the Wisconsin and Northern Illinois parts of the Upper Mississippi Valley region in 1942, but the mines in the Iowa part remained idle. The principal producer of finished (smelting-grade) concentrates in the region continued to be the Vinegar Hill Zinc Co., which operated its custom mill near Cuba City on crude ore and zinc-iron-lead rougher jig concentrates purchased from operators throughout the active areas. Plant alterations and installation of additional equipment to increase the capacity of the mill were begun under a Defense Plant Corporation agreement late in 1942 and completed February 22, 1943. The enlarged mill has a capacity of 400 to 500 tons daily, and the equipment includes crushing and sampling units, rougher jigs, two separate ball-mill grinding and selective flotation units, tables, thickeners, and filters. The lead and zinc concentrates produced in 1942 were shipped to smelters outside the State, and the iron concentrates were used to make sulfuric acid in the company plant adjoining the mill. Besides the 79,539 tons of ore and bulk concentrates treated during the year, the company bought for the account of the Metals Reserve Co. about 22,000 tons of crude ore, which was stock-piled pending completion of the mill expansion program. The stock-piled ore is not included in the production for 1942 shown in the tables of this chapter but will be credited to that for the year (probably 1943) in which the ore is reduced to concentrates of smelting grade. This step is necessary before the quantity of metal actually recovered from the ore can be determined.

Shipments to the mill from Northern Illinois in 1942 (comprising the total output from that area) amounted to 22,402 tons of crude ore averaging 11.86 percent zinc and 0.53 percent lead, of which 16,537 tons were reduced to finished concentrates during the year and yielded 1,700 tons of recoverable zinc and 133 tons of lead. Shipments from Wisconsin included both crude ore and rougher jig concentrates. Shippers of jig-mill concentrates comprised the Big Jack Mining Co. (operating the Liberty mine), the C. F. & H. Mining Co. (Mulcahy mine), Coughlin Mining Co., Four S. & B. Mining Co., Little Benny Mining Co. (Monroe mine), and Wm. Blair Baggaley (Kittoe tailing dump). Principal shippers of Wisconsin crude ore, in order of rank, were the Cuba Mining Co., B. A. T. mine; Meloy & Baker, Martin mine; Gill Bros., James and Cleveland mines; R. J. Teske, McCabe mine; Depp Mining Co.; Mathey Mining Co., DeRocher mine; Francis B. Piquette, Trego mine; and Carter & Meloy, Leadmine mine.

The Dodgeville Mining Co. continuously operated its leased group of Dodgeville city lots and 150-ton jig- and flotation-concentration mill. Ore treated totaled 54,774 tons, yielding 2,451 tons of zinc concentrates averaging 61.20 percent zinc and 412 tons of lead concentrates averaging 74.02 percent lead. W. E. Faithorn erected a 600-ton tailing mill equipped with jigs and flotation machines on the Champion property at New Diggings; the mill was operated from July to December and produced 781 tons of 58.5-percent zinc concentrates.

At the Field property near Shullsburg the Chestnut Hill Zinc Co. did construction work on a flotation- and table-concentration mill, which was completed and put in operation on tailings in April 1943. During the latter part of 1942 Bureau of Mines engineers examined 45 zinc and lead mines on 14 separate properties in Wisconsin and approved an exploratory drilling project near Hazel Green, on which drilling began early in 1943.

Mine production of lead and zinc in Wisconsin, 1938–42

Year	Lead concentrates		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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	[3] 10,875	[3] 447,396	445	44,500	5,770	727,020
1941	1,639	111,014	[3] 11,685	[3] 594,323	1,225	139,650	6,238	935,700
1942	1,092	104,896	[3] 17,449	[4] 1,028,828	775	103,850	9,426	1,753,236

[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] Most of the ore mined in Wisconsin from 1939–42 was first treated in gravity-concentration mills producing bulk concentrates which were re-treated by flotation.

[4] The bulk of the finished zinc concentrates and part of the lead concentrates produced in Wisconsin in 1942 came from a custom mill treating purchased crude ores and low-grade bulk concentrates on which premium payments had been made previously to mine operators; therefore, the value of these concentrates is calculated at market prices. Premium payments not reflected in the value of the finished concentrates amounted to about $399,000 for zinc and $18,500 for lead; part of these payments, however, were for ore which was stock-piled and will not be treated until 1943.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Wisconsin, 1941–42

	1941		1942	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore, etc., milled—short tons	211,973		208,032	93,642
Total concentrates produced: [1]				
Lead—do	1,639		1,092	
Zinc—do	11,685		16,543	906
Ratio of concentrates to ore, etc.: [2]				
Lead—percent	0.77		0.52	
Zinc—do	5.51		7.95	0.97
Metal content of ore, etc.: [3]				
Lead—do	.59		.39	
Zinc—do	3.27		4.78	.57
Average lead content of galena concentrates—do	76.27		74.27	
Average zinc content of sphalerite concentrates—do	59.77		60.12	58.83
Average value per ton: [4]				
Galena concentrates	$67.73		$96.06	
Sphalerite concentrates	51.39		58.07	$75.22

[1] Most of the ore mined in Wisconsin in 1941–42 was first treated in gravity-concentration mills producing bulk concentrates which were re-treated by flotation.

[2] Percentage represents finished flotation concentrates.

[3] Percentages represent metal content of the ore insofar as it is recovered in the concentrates.

[4] The bulk of the finished zinc concentrates and part of the lead concentrates produced in Wisconsin in 1942 came from a custom mill treating purchased crude ores and low-grade bulk concentrates on which premium payments had been made previously to mine operators; therefore, the value of these concentrates is calculated at market prices.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY OUTLINE

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SUMMARY

Colorado mines yielded gold, silver, copper, lead, and zinc valued, in terms of recovered metals, at $19,896,623 in 1942 compared with $23,877,597 in 1941. (See fig. 1.) Gold and silver together represented 58 percent of the total value in 1942 and 77 percent in 1941. Gold production decreased 29 percent in 1942 from 1941. The quantity of silver and copper produced decreased 58 and 84 percent, respectively, lead increased 21 percent, and zinc 105 percent. The number of producing lode mines decreased from 579 in 1941 to 311 in 1942; the number of placer mines decreased from 324 to 68.

The Government, through its agency the Metals Reserve Company, announced that effective February 1, 1942, premiums of 5 cents per pound for copper and 2¾ cents per pound for both lead and zinc would be paid for these metals produced in excess of fixed basic quotas. The ceiling prices for these metals at that date and as of July 1943 were: Copper, electrolytic, 11.775 cents per pound f. o. b. Atlantic seaboard refineries; lead 6.50 cents (New York); and zinc 8.25 cents (St. Louis). The quota for each mine or mining company was based on 1941 production. On December 1, 1942, arrangements for additional premium payments for overquota metal production were announced by the Metals Reserve Company. Operators who could argue their inability to maintain present rate of production without loss of money or who could assure additional output were eligible for these additional Government subsidies for copper, in several steps of 5 cents a pound for each step; for lead and zinc, steps of 2¾ cents a pound.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Company for over-quota production but excludes value of foreign copper delivered to Metals Reserve Company for domestic consumption.
[4] 1938-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Company for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Annual figures for the 5 years ended with 1942 and total production from 1858 are given in the table that follows. To the end of 1941 Colorado had produced more silver than any other State, but the decreased output in 1942 allowed Montana to pass it.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1938–42, and total, 1858–1942, 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
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
1941	579	324	2,222,786	380,029	13,301,015	7,301,697	5,192,318
1942	311	68	1,797,386	268,627	9,401,945	3,096,211	2,201,750
1858–1942			(1)	38,565,382	843,665,334	721,046,775	560,682,926

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	13,496,000	1,592,528	25,148,000	1,433,436	31,444,000	2,358,300	23,877,597
1942	2,204,000	266,684	30,362,000	2,034,254	64,430,000	5,991,990	19,896,623
1858–1942	[2] 245,396	64,765,883	[2] 2,392,072	226,729,967	[2] 1,183,229	167,578,686	1,863,422,796

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Colorado, 1938–42, 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
1938	2,285	433	1,362	279	10,201	2,020	3,166	279	1,027	239	18,041	3,250
1939	2,535	498	15	1	10,631	2,436	1,950	178	4,688	1,012	19,819	4,125
1940	1,822	360			10,203	2,210			4,975	1,068	17,000	3,638
1941	1,886	402			13,052	2,580	4,817	553	10,622	2,152	30,377	5,687
1942	1,802	335			119	9	6,173	945	14,523	2,913	22,617	4,202

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

Gold.—The output of recoverable gold from lode mines in Colorado decreased from 349,652 fine ounces in 1941 to 246,010 fine ounces in 1942; the production of gold from placer mines decreased 7,760 fine ounces.

Silver.—Mine production of recoverable silver in Colorado was 3,096,211 fine ounces in 1942, compared with 7,301,697 fine ounces in 1941. Dry and siliceous ores yielded 69 percent of the total silver; zinc and zinc-lead ores, 29 percent; and other types of ores, with a very small quantity of silver from placer mines, 2 percent.

Copper.—The output of recoverable copper from mines in Colorado in 1942 was 2,204,000 pounds compared with 13,496,000 pounds in

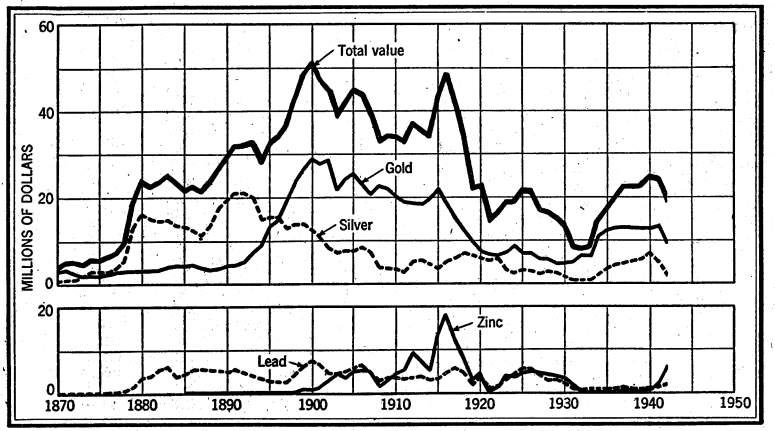

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc in Colorado, 1870–1942. The value of copper has been less than $2,000,000 annually, except in a few years.

1941. Eagle County produced 29 percent of the State total in 1942 compared with 83 percent in 1941.

Lead.—The mine production of recoverable lead in Colorado was 30,362,000 pounds in 1942 compared with 25,148,000 pounds in 1941. Zinc-lead ore yielded 67 percent of the total lead; dry and siliceous ores 28 percent; and lead, copper, zinc, and lead-copper ores together, 5 percent.

Zinc.—The output of recoverable zinc from mines in Colorado increased 105 percent in quantity in 1942 over 1941. Largely responsible for this increase was the New Jersey Zinc Co. Empire Zinc Division Eagle mine at Gilman, Eagle County, which resumed mining and milling zinc-lead ore in June 1941 and continued throughout 1942. Other principal zinc-producing districts in 1942 were: California (Leadville), Lake County; Pioneer (Rico), Dolores County; Ten Mile, Summit County; and Buckskin, Park County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1942, 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		1	274	$9,590	45	$32
Boulder	43		15,920	557,200	26,900	19,129
Chaffee	3	4	268	9,380	1,274	906
Clear Creek	45		18,105	633,675	207,139	147,299
Costilla		2	7	245		
Custer	4				384	273
Dolores	2		119	4,165	110,918	78,875
Eagle	2		2,040	71,400	395,252	281,068
Fremont	1				66	47
Garfield	1				56	40
Gilpin	24	13	5,390	188,650	15,179	10,794
Grand	2				540	384
Gunnison	8		1,322	46,270	9,132	6,494
Hinsdale	3		26	910	6,798	4,834
Jefferson		7	432	15,120	73	52
Lake	29	3	27,235	953,225	243,474	173,137
La Plata	3		390	13,650	377	268
Larimer	1		8	280	3	2
Mesa	2				59	42
Mineral	6		644	22,540	805,202	572,588
Montezuma	2		218	7,630	741	527
Montrose	1	5	15	525	2,762	1,964
Ouray	19		6,782	237,370	141,411	100,559
Park	10	20	37,370	1,307,950	26,830	19,079
Pitkin	5		1	35	286,131	203,471
Rio Grande	1	1	5,499	192,465	7,186	5,110
Routt	1				28	20
Saguache	9		60	2,100	41,313	29,378
San Juan	16	1	17,094	598,290	394,657	280,645
San Miguel	9		23,451	820,785	315,820	224,583
Summit	17	11	1,502	52,570	40,801	29,014
Teller	42		104,455	3,655,925	15,660	11,136
Total, 1941	311	68	268,627	9,401,945	3,096,211	2,201,750
	579	324	380,029	13,301,015	7,301,697	5,192,318

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$9,622
Boulder	39,900	$4,828	147,700	$9,896	5,700	$530	591,583
Chaffee	800	97	12,000	804	8,200	763	11,950
Clear Creek	72,300	8,748	1,023,700	68,588	462,000	42,966	901,276
Costilla							245
Custer			7,000	469			742
Dolores	70,100	8,482	4,564,100	305,795	5,528,800	514,178	911,495
Eagle	645,700	78,130	4,480,700	300,207	45,760,400	4,255,717	4,986,522
Fremont	600	73			14,300	1,330	1,450
Garfield			400	27	2,900	270	337
Gilpin	122,300	14,798	112,300	7,524			221,766
Grand			1,000	67			451
Gunnison	3,600	436	186,200	12,475	117,300	10,909	76,584
Hinsdale	6,000	726	295,600	19,805			26,275
Jefferson							15,172
Lake	130,300	15,766	6,703,700	449,148	6,688,000	621,984	2,213,260
La Plata							13,918
Larimer							282
Mesa	2,100	254					296
Mineral	77,600	9,390	1,051,600	70,457			674,975
Montezuma							8,157
Montrose	16,600	2,009					4,498
Ouray	141,300	17,097	799,300	53,553	708,600	65,900	474,479
Park	78,400	9,486	543,600	36,421	912,000	84,816	1,457,752
Pitkin	1,000	121	629,800	42,197	284,000	26,412	272,236
Rio Grande	93,400	11,301	800	54			208,930
Routt			700	47	4,800	446	513
Saguache	36,400	4,404	878,900	58,886	663,600	61,715	156,483
San Juan	575,000	69,575	4,297,000	287,899	784,000	72,912	1,309,321
San Miguel	78,800	9,535	3,436,700	230,259	780,000	72,540	1,357,702
Summit	11,800	1,428	1,189,200	79,676	1,705,400	158,602	321,290
Teller							3,667,061
Total, 1941	2,204,000	266,684	30,362,000	2,034,254	64,430,000	5,991,990	19,896,623
	13,496,000	1,592,528	25,148,000	1,433,436	31,444,000	2,358,300	23,877,597

Ore sold or treated and gold and silver produced at lode mines in Colorado in 1942, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Boulder	37,207	15,920	26,900
Chaffee	143	73	1,246
Clear Creek	114,140	18,105	207,139
Custer	24	----	384
Dolores	35,371	119	110,918
Eagle	243,689	2,040	395,252
Fremont	34	----	66
Garfield	10	----	56
Gilpin	16,135	5,120	15,127
Grand	4	----	540
Gunnison	7,622	1,322	9,132
Hinsdale	3,685	26	6,798
Lake	365,033	27,204	243,464
La Plata	66	390	377
Larimer	7	8	3
Mesa	11	----	59
Mineral	39,243	644	805,202
Montezuma	1,619	218	741
Montrose	138	1	2,759
Ouray	38,605	6,782	141,411
Park	93,284	17,189	23,154
Pitkin	16,842	1	286,131
Rio Grande	14,970	5,497	7,186
Routt	19	----	28
Saguache	4,794	60	41,313
San Juan	197,404	17,093	394,657
San Miguel	179,003	23,451	315,820
Summit	10,289	292	40,486
Teller	377,995	104,455	15,660
Total, 1941	1,797,386	246,010	3,092,009
	2,222,786	349,652	7,296,010

Gold and silver produced at placer mines in Colorado in 1942, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dredges						Total	
			Dry-land [1]		Dragline floating		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Adams	274	45	----	----	----	----	----	----	274	45
Chaffee	195	28	----	----	----	----	----	----	195	28
Costilla	7	----	----	----	----	----	----	----	7	----
Gilpin	270	52	----	----	----	----	----	----	270	52
Jefferson	432	73	----	----	----	----	----	----	432	73
Lake	31	10	----	----	----	----	----	----	31	10
Montrose	14	3	----	----	----	----	----	----	14	3
Park	484	99	119	9	6,173	945	13,405	2,623	20,181	3,676
Rio Grande	2	----	----	----	----	----	----	----	2	----
San Juan	1	----	----	----	----	----	----	----	1	----
Summit	92	25	----	----	----	----	1,118	290	1,210	315
Total, 1941	1,802	335	119	9	6,173	945	14,523	2,913	22,617	4,202
	1,886	402	13,052	2,580	4,817	553	10,622	2,152	30,377	5,687

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The variation and complexity of Colorado ores allowed mines to meet the shifting and complexing Government orders, as well as changes in the prices for metal. Except for the Cripple Creek district, virtually all the ores in Colorado districts—although chiefly valuable for gold and silver—contain some zinc, often discarded. A change in selection of ore and in metallurgy converted many mines

into producers of zinc concentrates or products containing recoverable zinc. This change is shown clearly by a comparison of the county and district tables for 1939 and 1942.

Effective March 2, 1942, the War Production Board issued an amendment to Order P–56, placing the mining industry on a par with manufacturers of war materials. Among other instructions, this amendment provided that mines at which the value of gold, silver, or both produced exceeded 30 percent of the value of the total metal output would no longer be entitled to priority ratings assigned under Order P–56. This amendment deprived virtually all gold mines in Colorado of essential equipment and supplies and forced many operators to close long before the Gold Mining Limitation Order of October 8, 1942. Later, upon appeal, this amendment to Order P–56 was voided.

Dredging operations ceased immediately upon the date set for closing by Order L–208—called the Gold Mining Limitation Order (see Gold and Silver chapter for text of order). Cripple Creek lode district, upon appeal, was given a reprieve until June 8, 1943, but the exodus of miners that had begun in March greatly increased. Split-check lessees, indigenous to that district (and the producers of 80 percent of the ore), who had generally kept at work, began drifting away after the issuance of Order L–208 and continued to do so in 1943, with the result that several of the largest mines ceased operations in March.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Colorado in 1942, 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	932,145	188,682	293,231	597,574	2,138,734	735,874
Dry and siliceous gold-silver ore	192,709	25,077	399,586	122,738	4,012,497	780,000
Dry and siliceous silver ore	88,132	2,407	1,428,333	716,619	2,477,385	284,000
	1,212,986	216,166	2,121,150	1,436,931	8,628,616	1,799,874
Copper ore	208	44	3,189	26,286	865	----------
Lead ore	6,418	1,451	61,717	26,513	1,442,554	----------
Lead-copper ore	22	24	493	2,192	3,483	----------
Zinc ore	590	6	2,514	2,200	40,822	429,899
Zinc-lead ore	577,162	28,319	902,946	709,878	20,245,660	62,200,227
	584,400	29,844	970,859	767,069	21,733,384	62,630,126
Total, lode mines	1,797,386	246,010	3,092,009	2,204,000	30,362,000	64,430,000
Total, placers	----------	22,617	4,202	----------	----------	----------
	1,797,386	268,627	3,096,211	2,204,000	30,362,000	64,430,000
Total, 1941	2,222,786	380,029	7,301,697	13,496,000	25,148,000	31,444,000

METALLURGIC INDUSTRY

The total ore sold or treated in Colorado was 1,797,386 tons in 1942 compared with 2,222,786 tons in 1941. The quantity of zinc-lead ores sold or treated increased from 434,200 tons in 1941 to 577,162 tons in 1942, most of the increase coming from Eagle County; dry and siliceous ores decreased from 1,572,763 tons to 1,212,986; copper ore decreased from 207,678 tons to 208, owing almost entirely to conversion to zinc-lead mining and milling at the New Jersey Zinc Co. Empire Zinc Division Eagle mine at Gilman, Eagle County; lead ore decreased from 7,917 tons to 6,418; and zinc ore increased from 224 tons to 590.

Direct smelting ore comprised 3 percent of the State total output of ore in 1942 as compared with 11 percent in 1941. 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 ores and concentrates from Lake and Saguache Counties to Coffeyville, Kans.; zinc concentrates from Clear Creek, Dolores, Ouray, Park, Pitkin, San Juan, San Miguel, and Summit Counties to Amarillo, Tex.; and silver-gold-copper-lead ore from Eagle County, gold-silver-copper ores and concentrates from Gilpin, Mesa, Montrose, Ouray, Rio Grande, and San Juan Counties, and zinc-lead-copper-silver-gold ores and concentrates from Garfield, Lake, Ouray, Saguache, and San Juan Counties to Utah smelters.

The quantity of gravel handled in 1942 by two floating connected-bucket dredges, one dragline floating dredge, and one dry-land dredge was approximately 2,919,406 cubic yards. Specific data on yardage handled at small-scale placer operations are not obtainable because the operators do not know the quantity of gravel sluiced.

Mine production of metals in Colorado in 1942, by methods of recovery, in terms of recovered metals

	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore and concentrates amalgamated [1]	717,716	60,233	15,906			
Ore, old tailings, concentrates, sands, and slimes cyanided [2]	[3] 272,889	86,132	13,202			
Concentrates smelted	140,590	91,219	2,446,104	1,467,753	27,800,925	63,874,212
Ore smelted	48,173	8,426	616,797	736,247	2,561,075	555,788
Placer [1]		22,617	4,202			
Total, 1942		268,627	3,096,211	2,204,000	30,362,000	64,430,000
Total, 1941		380,029	7,301,697	13,496,000	25,148,000	31,444,000

[1] Quicksilver used by amalgamation mills was 3,429 pounds. Placer mines used approximately 115 pounds.
[2] Cyanide (in terms of 96- to 98-percent NaCN) used was 529,747 pounds.
[3] Comprises 253,551 tons of sands and slimes from ore and iron concentrates first roasted and amalgamated and 19,338 tons of combined flotation concentrates and crude ore cyanided direct.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1942, 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	30,576	9,997	1,892	1,736	3,043	8,595	13,281	113,477	
Chaffee	10	16	5						
Clear Creek	68,378	10,204	1,221	2,424	3,725	17,976	17,677	224,226	
Eagle	(1)	11	45						
Gilpin	3,587	240	55	322	763	3,661	14,766	19,859	
Gunnison	6,270	584	366	94	191	2,141		7,696	
Lake	259,162	9,423	3,203	7,948	6,105	80,201	124,973	729,528	196,174
Larimer	7	8	3						
Montezuma	1,600	134	49	16	42	672			
Ouray	33,562	4,518	1,370	2,449	2,039	105,826	130,400	618,134	539,700
Park	(1)	39	8						
Rio Grande	14,970	1,969	1,548	975	3,528	5,638	93,400	800	
San Miguel	146,301	6,465	4,815	14,556	14,368	199,530		2,399,166	780,000
Teller	362,486	102,757	14,528						
	926,909	146,365	29,108	30,520	33,804	424,240	394,497	4,112,886	1,515,874
Total, 1941	1,244,184	203,191	53,614	33,027	48,450	596,758	469,407	3,483,823	

[1] Less than ½ ton.

Mine production of metals from concentrating mills in Colorado in 1942, in terms of recovered metals

BY COUNTIES

	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	5,890	288	1,642	14,897	7,585	32,885	5,700
Chaffee	40	17	18	343	387	5,109	8,200
Clear Creek	45,544	3,743	4,108	177,796	52,069	761,449	462,000
Dolores	35,371	9,824	119	110,918	70,100	4,564,100	5,528,800
Eagle	227,248	57,257	363	142,786	20,534	4,342,087	45,760,400
Fremont	34	10		66	600		14,300
Gilpin	12,324	2,014	2,715	9,905	95,130	81,156	
Gunnison	1,136	271	265	3,737	3,400	114,069	117,300
Hinsdale	3,680	274	26	6,608	5,800	295,600	
Lake	92,718	12,279	9,967	109,260	1,704	4,697,856	6,395,419
Mineral	34,119	2,361	576	595,798	74,041	856,335	
Ouray	4,904	536	193	26,775	9,793	162,369	168,900
Park	92,104	5,723	15,831	18,063	58,803	497,418	912,000
Pitkin	9,000	819		252,295	1,000	488,155	284,000
Routt	19	5		28		700	4,800
Saguache	3,320	1,030	26	17,930	12,208	465,854	531,499
San Juan	197,063	7,110	17,038	392,277	571,835	4,277,864	781,620
San Miguel	32,683	3,307	2,613	110,558	78,800	1,033,634	
Summit	9,598	2,500	217	30,692	9,467	1,011,399	1,383,400
Teller	15,509	702	1,698	1,132			
	822,304	110,070	57,415	2,021,864	1,073,256	23,688,039	62,358,338
Total, 1941	730,982	73,097	62,748	1,807,373	1,641,587	16,716,067	31,404,929

BY CLASSES OF ORE TREATED

Dry and siliceous gold	147,538	9,157	24,534	37,341	163,869	464,888	
Dry and siliceous gold-silver	42,898	4,313	3,871	179,875	117,302	1,370,014	
Dry and siliceous silver	56,260	4,004	663	910,318	86,154	1,941,127	284,000
Lead	910	139	41	3,141	750	85,417	
Zinc	34	10		66	600		14,300
Zinc-lead	574,664	92,447	28,306	891,123	704,581	19,826,593	62,060,038
	822,304	110,070	57,415	2,021,864	1,073,256	23,688,039	62,358,338

Gross metal content of concentrates produced from ores mined in Colorado in 1942, 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	11,387	18,452	79,656	259,216	607,019	111,319
Dry gold-silver	197	128	5,023	4,783	56,872	1,608
Copper	1,856	3,015	8,424	129,532	9,706	13,835
Lead	47,403	58,248	1,918,157	502,753	26,796,399	4,045,318
Lead-copper	3,175	8,001	229,152	586,691	1,742,692	385,519
Total to copper and lead plants	64,018	87,844	2,240,412	1,482,975	29,212,688	4,557,599
Zinc	73,180	1,515	123,823	133,993	1,065,515	70,901,370
Zinc-lead	3,392	2,341	122,408	189,592	742,740	1,191,376
Total to zinc plants	76,572	3,856	246,231	323,585	1,808,255	72,092,746
Total, 1941	140,590	91,700	2,486,643	1,806,560	31,020,943	76,650,345
	106,124	111,321	2,425,238	2,580,943	22,542,261	41,495,808

Mine production of metals from Colorado concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	2,024	4,685	23,492	20,866	146,362	5,700
Chaffee	17	18	343	387	5,109	8,200
Clear Creek	6,167	7,833	195,772	69,746	985,675	462,000
Dolores	9,824	119	110,918	70,100	4,564,100	5,528,800
Eagle	57,257	363	142,786	20,534	4,342,087	45,760,400
Fremont	10		66	600		14,300
Gilpin	2,336	3,478	13,566	109,896	101,015	
Gunnison	365	456	5,878	3,400	121,765	117,300
Hinsdale	274	26	6,608	5,800	295,600	
Lake	20,227	16,072	189,461	126,677	5,427,384	6,591,593
Mineral	2,361	576	595,798	74,041	856,335	
Montezuma	16	42	672			
Ouray	2,985	2,232	132,601	140,193	780,503	708,600
Park	5,723	15,831	18,063	58,803	497,418	912,000
Pitkin	819		252,295	1,000	488,155	284,000
Rio Grande	975	3,528	5,638	93,400	800	
Routt	5		28		700	4,800
Saguache	1,030	26	17,930	12,208	465,854	531,499
San Juan	7,110	17,038	392,277	571,835	4,277,864	781,620
San Miguel	17,863	16,981	310,088	78,800	3,432,800	780,000
Summit	2,500	217	30,692	9,467	1,011,399	1,383,400
Teller	702	1,698	1,132			
Total, 1941	140,590	91,219	2,446,104	1,467,753	27,800,925	63,874,212
	106,124	111,198	2,404,131	2,110,994	20,199,890	31,404,929

BY CLASSES OF CONCENTRATES SMELTED

Dry gold	11,387	18,452	79,656	222,080	546,068	
Dry gold-silver	197	128	5,023	3,827	51,185	
Copper	1,856	3,015	8,424	103,626	8,736	
Lead	47,403	58,248	1,918,147	398,877	24,220,390	
Lead-copper	3,175	8,001	229,152	469,317	1,568,422	
Total to copper and lead plants	64,018	87,844	2,240,402	1,197,727	26,394,801	
Zinc	73,180	1,034	83,294	108,914	693,048	63,123,495
Zinc-lead	3,392	2,341	122,408	161,112	713,076	750,717
Total to zinc plants	76,572	3,375	205,702	270,026	1,406,124	63,874,212
	140,590	91,219	2,446,104	1,467,753	27,800,925	63,874,212

Gross metal content of Colorado crude ore shipped to smelters in 1942, 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	5,235	4,776	11,368	51,614	10,869	
Dry and siliceous gold-silver	2,274	409	10,885	4,357	215,494	1,357
Dry and siliceous silver	31,872	1,744	518,015	689,406	631,836	245,790
Copper	208	44	3,189	28,567	961	
Lead	5,508	1,410	58,576	33,108	1,502,245	74,109
Lead-copper	22	24	493	2,742	3,916	
Total to copper and lead plants	45,119	8,407	602,526	809,794	2,364,821	321,256
Zinc	556	6	2,715	1,833	55,863	476,005
Zinc-lead	2,498	13	11,823	6,529	462,993	199,045
Total to zinc plants	3,054	19	14,538	8,362	518,856	675,050
Total, 1941	48,173	8,426	617,064	818,156	2,883,677	996,306
	247,620	35,263	4,838,265	11,705,347	6,424,479	4,270,163

Mine production of metals from Colorado crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	741	1,238	1,516	19,034	1,338	
Chaffee	93	39	898	413	6,891	
Clear Creek	218	68	10,146	2,554	38,025	
Custer	24		384		7,000	
Eagle	16,441	1,666	252,421	625,166	138,613	
Garfield	10		56		400	2,900
Gilpin	224	1,402	1,506	12,404	11,285	
Grand	4		540		1,000	
Gunnison	216	282	2,888	200	64,435	
Hinsdale	5		190	200		
Lake	13,153	1,709	50,800	3,623	1,276,316	96,407
La Plata	66	390	377			
Mesa	11		59	2,100		
Mineral	5,124	68	209,404	3,559	195,265	
Montezuma	19	42	20			
Montrose	138	1	2,759	16,600		
Ouray	139	32	7,440	1,107	18,797	
Park	1,180	1,319	5,083	19,597	46,182	
Pitkin	7,842	1	33,836		141,645	
Saguache	1,474	34	23,383	24,192	413,046	132,101
San Juan	341	55	2,380	3,165	19,136	2,380
San Miguel	19	5	917		3,900	
Summit	691	75	9,794	2,333	177,801	322,000
Total, 1941	48,173	8,426	616,797	736,247	2,561,075	555,788
	247,620	35,263	4,838,265	11,385,006	4,948,110	39,071

BY CLASSES OF ORE

Dry and siliceous gold	5,235	4,776	11,368	41,476	9,576	
Dry and siliceous gold-silver	2,274	409	10,885	3,168	193,867	
Dry and siliceous silver	31,872	1,744	518,015	630,465	536,258	
Copper	208	44	3,189	26,286	865	
Lead	5,508	1,410	58,576	25,763	1,357,137	
Lead-copper	22	24	493	2,192	3,483	
Total to copper and lead plants	45,119	8,407	602,526	729,350	2,101,186	
Zinc	556	6	2,448	1,600	40,822	415,599
Zinc-lead	2,498	13	11,823	5,297	419,067	140,189
Total to zinc plants	3,054	19	14,271	6,897	459,889	555,788
	48,173	8,426	616,797	736,247	2,561,075	555,788

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1942, 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		1			274	274		45	45				$9,622
Boulder County:													
Central	6		2,918	1,606		1,606	360		360	400	4,100		56,789
Gold Hill	15		24,020	8,156		8,156	9,461		9,461	10,600	118,300	5,700	301,927
Grand Island	4		4,474	1,227		1,227	13,836		13,836	2,100	19,700		54,358
Magnolia	4		444	612		612	3		3				21,422
Sugar Loaf	11		3,280	2,644		2,644	1,253		1,253		1,000		93,498
Ward	3		2,071	1,675		1,675	1,987		1,987	26,800	4,600		63,589
Chaffee County:													
Chalk Creek	1		50	39		39	415		415	600	7,400	8,200	2,992
Granite	1	4	11	21	195	216	7	28	35				7,585
Monarch	1		82	13		13	824		824	200	4,600		1,373
Clear Creek County:													
Alice	2		1,129	400		400	699		699	800	16,000		15,666
Argentine	1		506				14,732		14,732		12,700		11,327
Empire	4		29,986	7,893		7,893	724		724	4,700	2,300		277,493
Griffith	4		9,700	51		51	133,314		133,314	5,100	417,000	462,000	168,108
Idaho Springs [1]	24		39,504	6,171		6,171	30,611		30,611	56,100	193,300		257,492
Montana	4		6,161	53		53	22,164		22,164	3,300	247,100		34,571
Trail Creek	6		27,154	3,537		3,537	4,895		4,895	2,300	135,300		136,619
Costilla County		2			7	7							245
Custer County:													
Hardscrabble	3		18				384		384		4,000		541
Ilse	1		6								3,000		201
Dolores County: Pioneer (Rico)	2		35,371	119		119	110,918		110,918	70,100	4,564,100	5,528,800	911,495
Eagle County: Red Cliff	2		243,689	2,040		2,040	395,252		395,252	645,700	4,480,700	45,760,400	4,986,522
Fremont County	1		34				66		66	600		14,300	1,450
Garfield County: Rifle Creek	1		10				56		56		400	2,900	337
Gilpin County:													
Southern	21	13	15,281	4,968	270	5,238	14,546	52	14,598	115,900	112,300		215,259
Northern	3		854	152		152	581		581	6,400			6,507
Grand County	2		4				540		540		1,000		451
Gunnison County:													
Gold Brick	4		7,109	1,317		1,317	3,492		3,492	600	19,700		49,971
Taylor Park	2		133	2		2	3,774		3,774	2,000	66,300	8,400	8,219
Tomichi	2		380	3		3	1,866		1,866	1,000	100,200	108,900	18,394
Hinsdale County:													
Galena	2		3,680	26		26	6,608		6,608	5,800	295,600		26,116
Lake	1		5				190		190	200			159
Jefferson County		7			432	432		73	73				15,172

See footnote at end of table.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1942, 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				
Lake County:													
California (Leadville)	25	1	364,641	27,114	1	27,115	241,301		241,301	130,300	6,696,400	6,688,000	$2,207,026
Other districts [2]	4	2	392	90	30	120	2,163	10	2,173		7,300		6,234
La Plata County: California	3		66	390		390	377		377				13,918
Larimer County: Masonville	1		7	8		8	3		3				282
Mesa County: Sinbad	2		11				59		59	2,100			296
Mineral County: Creede	6		39,243	644		644	805,202		805,202	77,600	1,051,600		674,975
Montezuma County	2		1,619	218		218	741		741				8,157
Montrose County:													
La Sal	1		138	1		1	2,759		2,759	16,600			4,006
San Miguel River (Naturita)		5			14	14		3	3				492
Ouray County:													
Red Mountain	7		1,447	54		54	3,119		3,119	4,900	88,000	168,900	26,305
Sneffels	4		33,789	6,569		6,569	110,295		110,295	130,400	625,600	539,700	416,232
Uncompahgre	8		3,369	159		159	27,997		27,997	6,000	85,700		31,942
Park County:													
Alma Placers		2			413	413		83	83				14,514
Beaver Creek		4			1,936	1,936		422	422				68,060
Buckskin	2	1	5,741	1,445	2	1,447	9,696		9,696	27,800	118,200	906,600	153,137
Consolidated Montgomery	2		885	735		735	4,306		4,306	18,400	1,800		31,134
Fairplay		11			13,853	13,853		2,738	2,738				486,802
Mosquito	6		86,658	15,009		15,009	9,152		9,152	32,200	423,600	5,400	564,602
Tarryall		2			3,977	3,977		433	433				139,503
Pitkin County: Roaring Fork	5		16,842	1		1	286,131		286,131	1,000	629,800	284,000	272,236
Rio Grande County: Summitville	1	1	14,970	5,497	2	5,499	7,186		7,186	93,400	800		208,930
Routt County	1		19				28		28		700	4,800	513
Saguache County:													
Kerber Creek	8		4,793	60		60	41,292		41,292	36,400	878,600	663,600	156,448
Myers Creek	1		1				21		21		300		35
San Juan County:													
Animas	12	1	197,048	17,077	1	17,078	391,794		391,794	572,900	4,248,000	757,000	1,300,677
Eureka	3		288	8		8	2,039		2,039	1,400	39,200	23,400	6,701
Ice Lake Basin	1		68	8		8	824		824	700	9,800	3,600	1,943
San Miguel County:													
Iron Springs	2		19	5		5	917		917		3,900		1,088
Upper San Miguel	7		178,984	23,446		23,446	314,903		314,903	78,800	3,432,800	780,000	1,356,614
Summit County:													
Breckenridge	5	11	82	66	1,210	1,276	235	315	550	100	400		45,090
Green Mountain	1		387	6		6	2,392		2,392	1,600	7,600	322,000	32,560
Montezuma	9		1,127	20		20	7,768		7,768	1,800	195,600	96,600	28,531
Ten Mile	2		8,693	200		200	30,091		30,091	8,300	985,600	1,286,800	215,109
Teller County: Cripple Creek	42		377,995	104,455		104,455	15,660		15,660				3,667,061
Total Colorado	311	68	1,797,386	246,010	22,617	268,627	3,092,009	4,202	3,096,211	2,204,000	30,362,000	64,430,000	19,896,623

[1] Includes Cascade and Ute Creek district.

[2] Includes St. Kevin and Twin Lakes districts.

ADAMS COUNTY

Sand and gravel handled in the washing plant of the Brannan Sand & Gravel Co. on Clear Creek, north of Denver, yielded gold as a byproduct.

BOULDER COUNTY

Central (Jamestown) district.—The Wano mine was again, as in 1941, the largest producer of gold in the Central district; it was operated by the owners, who shipped crude ore to the Golden Cycle mill at Colorado Springs. Mining of gold ores ceased in May for the duration of the war, but the operator began experiments in milling fluorspar from the property and from the Emmett mine. A lessee at the Smuggler group shipped gold ore to the Golden Cycle mill until operations were suspended November 12 by the Gold Mining Limitation Order. The General Chemical Co. entered the district in 1942 to mine fluorspar and incidentally shipped gold ore to the Golden Cycle mill during the latter part of the year from surface dumps on the Invincible claim. Other producers of gold in the Central district were the Black Rose group, the Emmett, and the John Jay mine. In milling fluorspar ore, 24 tons of lead-silver concentrates were made and shipped from the Emmett mine to the smelter at Leadville.

Gold Hill district.—Slide Mines, Inc., was the leading producer of gold, silver, copper, and lead in the Gold Hill district. The company operated its Slide-Klondyke-Twin group of mines and 70-ton gravity- and flotation-concentration mill continuously until August, when a change-over of most of the crew and equipment was made to operate the company tungsten mines in the Sugar Loaf district. Gold concentrates caught on burlap tables between the classifier and Wilfley tables were amalgamated, and the remainder—containing gold, silver, copper, and lead—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. Other sizable producers, in order of gold output, were the Ingram group, Gardner, Nil Desperandum, Sunshine, and the Emancipation group. Zinc-lead ore containing 7,803 pounds of zinc, 8,319 pounds of lead, 281 ounces of silver, and 14.80 ounces of gold were shipped from the Home Sweet Home to the Midvale (Utah) custom concentrator, in addition to the shipment of 1,206 tons of gold ore to the Golden Cycle mill.

Grand Island district (Nederland).—The Donora Mining Co. operated the Boulder County mine and 70-ton jig- and flotation-concentration mill at Cardinal under lease until June. About 100 tons of gold-silver-lead concentrates were produced and shipped to the Leadville smelter. The other producing mines in the district were the Enterprise group, the Blue Bird, and the Golden Reward.

Magnolia district.—The producing mines in the Magnolia district in 1942, in order of gold output, were the Cash-Rebecca, Keystone, India, and Hereafter. All ore was shipped to the Golden Cycle mill.

Sugar Loaf district.—Most of the ore produced from mines and dumps in the Sugar Loaf district in 1942 was shipped to the Golden Cycle mill. The Poorman group, worked continuously by lessees until October, was again the largest producer of gold in the district; it was followed by the Livingston, Alpine Horn, Nancy, Empress, and Herold. The silver output of the district came chiefly from the Nancy.

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Ward district.—The Boston and Utica mines were operated throughout 1942 by the Ward United Mines Co. and were the leading producers of copper in the Ward district and in Boulder County. Low-grade ore concentrated at the company 25-ton concentration-flotation mill and crude smelting ore shipped to the smelter at Leadville contained (in smelting ore and concentrates combined) 1,586 ounces of gold, 1,450 ounces of silver, and 29,112 pounds of copper. Small tonnages of concentrates were also shipped to the Leadville smelter from the Columbia and Black Jack mines at Ward.

CHAFFEE COUNTY

Chalk Creek district.—Lessees continued to operate the Mary Murphy mine in 1942 and shipped 40 tons of gold-silver-lead-copper-zinc ore to the Midvale (Utah) custom milling plant and 10 tons to the Leadville smelter. The ore contained 41.68 ounces of gold, 447 ounces of silver, 897 pounds of copper, 8,043 pounds of lead, and 16,293 pounds of zinc.

Granite district.—Ernest Dial operated the Marion Bell lode from June until September and shipped 1 ton of gold-silver ore to the Leadville smelter and retort and amalgam grains to the Denver Mint. The Marion Bell was the only lode operation in the Granite district in 1942. Len Savage operated his Gold Basin placer until September, using a power shovel and screening-sluicing plant. Intermittent operations on the Channel, Lost Canyon, and Independent placers produced small lots of gold, which were shipped to the Denver Mint.

Monarch district.—Production from the Monarch district comprised 82 tons of gold-silver-lead-copper ore, which was shipped by a lessee from the Madonna group to the Leadville smelter.

CLEAR CREEK COUNTY

Alice district (*Yankee, Lincoln*).—New Lombard Mines, Inc., operated the Lombard mine until August 1942 and milled the ore in the Lombard mill; the product was gold bullion shipped to the Denver Mint and 148 tons of lead-silver-gold concentrates shipped to the Leadville smelter. The Gold King mine yielded 29 tons of gold ore, which were shipped to the Golden Cycle mill at Colorado Springs.

Argentine district.—The only output from the Argentine district in 1942 was from Buckley Bros. operations on the Hamill tunnel group; 506 tons of silver ore containing some silver and lead were produced, of which 375 tons were concentrated in a local custom mill and 131 tons shipped crude to the Leadville smelter.

Empire district.—In 1942 Minnesota Mines, Inc., operated continuously its Crown Prince group of mines and 250-ton (daily) flotation-cyanidation mill and was again the largest producer of gold in the county, producing over one-third of the county total. (See Minerals Yearbook, 1941, for method of ore treatment.) Copper Cone, Inc., produced 559 tons of gold-silver-copper ore from the Upper Union-Gold Fissure group; the ore was treated in the Clear Creek-Gilpin Co. mill at Idaho Springs, and the concentrates were shipped to the Leadville smelter. Other small producers included the Empire tunnel, Gold Dirt, and Omaha properties.

Griffith district.—The Smuggler mine, largest producer of lead and zinc in the county, was worked throughout the year by the Mile High Mining Co. Zinc and lead concentrates were produced in the Silver

Leaf mill at Silver Plume and shipped to the Amarillo (Tex.) and Leadville smelters. Fargo Mines, operators at the Fargo mines, and Wallace K. Howard at the Mendota group of mines made several small shipments of ore to the Midvale (Utah) custom concentrator. The Burleigh tunnel was rehabilitated to the Phillips vein, and sampling was also done in the district by the Federal Bureau of Mines during the latter half of the year. Several shipments of dump ore were made from the Dives-Pelican group in 1942 to the Proctor Milliken mill, east of Idaho Springs, by the Silver Plume Mines, Inc.

Idaho Springs district.—The Alma-Lincoln Mining Co. continued to operate its Lincoln-South Lincoln-Elliott Barber group and 150-ton flotation mill throughout 1942 and treated 16,624 tons of ore (mill was operated 6 days a week, one shift a day), compared with 25,019 tons in 1941. The company also leased and operated the Cardigan group until April 16, 1942, and treated the ore at the Alma-Lincoln mill. Inter-Mountain Mines, Inc., operated the Dona Juanita-Maude Monroe group of mines from January 1 until May 1 and mined about 6,000 tons of ore, which were milled at the Silver Spruce mill. The Williams Mining Co. operated the Williams mine in 1942 and treated the ore at its Missouri Lake mill in Gilpin County. Until October LeRoy Giles & Co. continued to ship gold-silver ore from the Dixie No. 4 to the Ruth custom mill. Other sizable producers of gold-silver-lead-copper ores were the Shafter, Freighter's Friend, Idaho Bride, and Specie Payment group. Custom mills operating intermittently in the Idaho Springs district included the Clear Creek-Gilpin Co., Ruth, Chicago Creek, Proctor Milliken, and Silver Spruce.

Montana district.—Virtually all production of ore from the Montana district in 1942 comprised 3,511 tons of lead-silver-gold ore from the Joe Reynolds and 2,595 tons from the Red Elephant group. Other small producers in 1942 were the Columbine and the Golden Calf.

Trail Creek district.—Lamartine Mines, Inc., operated the Lamartine-Falcon group of mines throughout the year and was the second-largest producer of gold in Clear Creek County. About 26,060 tons of ore were 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 1,436 fine ounces of gold and 372 fine ounces of silver; and concentrates shipped to the Leadville smelter contained 1,908 ounces of gold, 3,682 ounces of silver, 140,347 pounds of lead, 65,606 pounds of zinc, and some copper. Other sizable producers in the Trail Creek district were the Wheatland, Lone Tree, and Phoenix mines.

CUSTER COUNTY

Hardscrabble district.—The output from the Hardscrabble district in 1942 comprised 16 tons of lead ore from the Passiflora mine and 1 ton each from the Four Aces and High Kicker-Wild Girl group.

DOLORES COUNTY

Pioneer district (Rico).—The Rico Argentine Mining Co. operated its group of mines and 135-ton selective-flotation mill continuously in 1942 and milled 34,735 tons of zinc-lead-silver-gold-copper ore,

compared with 35,666 tons in 1941. The products of the mill were lead-silver concentrates (carrying some copper, zinc, 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. The zinc concentrates averaged 48.9 percent zinc, and the lead concentrates averaged 67.8 percent lead. Markey Bros. operated the Yellow Jacket group under lease and shipped crude zinc-lead ore (carrying some silver, copper, and a little gold) to custom mills in Utah.

EAGLE COUNTY

Red Cliff district (*Battle Mountain*).—In 1942 the Red Cliff district ranked first among Colorado districts in output of copper and zinc. The New Jersey Zinc Co. Empire Zinc Division Eagle mine and mill at Gilman were operated continuously in 1942; its 600-ton zinc-lead mill was operated only from June through December in 1941. The company mined and shipped very much less copper-iron-silver-gold sulfide smelting ore in 1942 than in 1941. A lessee on the Cora claim at Belden shipped 55 tons of gold-silver smelting ore in 1942.

EL PASO COUNTY

GOLDEN CYCLE MILL

The Golden Cycle custom mill at Colorado Springs recovered 48 percent of the total Colorado output of gold from lode mines in 1942. It treated 378,434 tons of ore averaging 0.308 ounce of gold to the ton compared with 532,127 tons of ore averaging 0.3038 ounce in 1941. Of the total ore treated in 1942, 362,460 tons were gold-[silver]-sulfotelluride ores from the Cripple Creek district (Teller County), and 15,974 tons comprised miscellaneous gold and gold-silver ores from other districts, mainly in Boulder, Clear Creek, and Gilpin Counties. As ores purchased vary in character and grade, the metallurgy is not always the same. Essential features of ore treatment are described in this section, Minerals Yearbook, 1941.

Milling at Colorado Springs was curtailed in October by the provisions of the Gold Mining Limitation Order. A reprieve was granted to December 8, 1942, and another reprieve on that date (in response to an appeal filed with the War Production Board) permitted the mill to operate for 6 months, or until June 8, 1943, during which time equipment should be added to treat zinc-lead ores. Under the terms of this reprieve the mill was allowed to continue to treat Cripple Creek ores, with a provision also to be allowed to continue to treat siliceous gold-bearing ores to serve as a lighter-weight product to mix with iron concentrates (containing gold and silver) from the zinc-lead-iron ores. Conversion and enlargement of the flotation-mill unit within the amalgamation-cyanidation plant were begun in late December 1942 and completed in February 1943. The capacity of the flotation mill (changed from bulk concentration to selective) was increased from 300 to 500 tons per day. Between February and May 1943, 4,000 tons of zinc-lead ore from Saguache, Lake, Fremont, and Clear Creek Counties were treated in the flotation unit of the plant. A further reprieve was granted June 8, 1943, permitting operations until August 8. Zinc-lead bulk concentrates from the 1,000-ton Ore & Chemical Co. "sink-and-float" mill at Leadville

(to be completed in July or August 1943) will be shipped to the Golden Cycle mill for selective concentration.

FREMONT COUNTY

The Monarch Galena Co. operated the Cotopaxi mine in the Cotopaxi district the last 6 months of 1942 and shipped 34 tons of zinc-copper-silver ore to the United States Smelting, Refining & Mining Co. custom concentrator at Midvale, Utah.

GILPIN COUNTY

Southern districts (Blackhawk, Central City, Nevadaville, Russell Gulch).—Twenty-one lode and 13 placer mines were productive in the Southern districts in 1942, as compared with 43 lode and 76 placer mines in 1941. The output of gold, silver, and copper decreased sharply in 1942, but an increase was noted in the production of lead. The Pittsburg-Notaway group of mines and 100-ton flotation mill were operated continuously under lease in 1942 by Kingmill Mines, Inc. This group yielded nearly two-thirds of the total output of gold from lode mines in the Southern districts and was the largest producer of silver and copper in Gilpin County in 1942. The gold-silver-copper concentrates were shipped to the Leadville smelter. The Queen Mineral Ranch, operated by Cole Godsey and associates, produced over half of the year's output of lead from Gilpin County. The California-Hidden Treasure Mines Co. worked the Monmouth-Kansas mine throughout the year through the Argo tunnel, sending the ore produced to the Clear Creek-Gilpin mill at Idaho Springs (Clear Creek County) for treatment. The recovery in bullion shipped to the Denver Mint and the content of concentrates sold to the Leadville smelter totaled 703 ounces of gold, 3,103 ounces of silver, 12,772 pounds of copper, and 8,883 pounds of lead. Lessees operated the New Brunswick mine and 15-ton stamp amalgamation-table concentration mill until February, when work stopped because of the high cost of labor and materials. Ore was also shipped to custom mills in Clear Creek County from the Anchor, Justice, West Notaway, Pyrenees, Rocky Mountain, and other mines and dumps in the Southern districts.

Small-scale placers working with power shovels or draglines and screening and sluicing plants in 1942 included the MacElwee, Peerless, Morgan, and Russell Gulch placers.

Northern districts.—The Perigo group was worked on a small scale by lessees during part of 1942. Most of the ore was concentrated in the Monarch 75-ton flotation mill on the property, and the gold-silver concentrates were shipped to the Leadville smelter. Other producing mines in the district were the Champion and Evergreen.

GRAND COUNTY

Small lots of silver-lead ore were shipped to the Leadville smelter in 1942 from the Bobtail claim in La Plata district and the Ready Cash mine near Jones Pass.

GUNNISON COUNTY

Gold Brick district.—The Carter Mines Co. continued to operate its mine and mill on Gold Creek until October 15, 1942, when production ceased in compliance with the Gold Mining Limitation Order. The ore was treated by amalgamation and by flotation and gravity concentration. Burleson Mines, Inc., operated the Raymond group and 75-ton flotation mill from January 1 to June 25, 1942; the mill recovered 46 tons of bulk lead-gold-silver concentrates, which were sold to the Leadville smelter. Crude smelting ore was shipped from the Chicago and Gold Links properties.

Taylor Park district.—In 1942 the Star and Thunderbird mines shipped 88 and 45 tons, respectively, of ore containing zinc, lead, copper, silver, and gold to the Midvale (Utah) custom mill.

Tomichi district.—The Callahan Zinc-Lead Co., Inc., operated the Akron mine throughout 1942; operations before September were confined to development only. Zinc-lead-silver ore (286 tons) was shipped to the Midvale (Utah) custom mill.

HINSDALE COUNTY

Galena district.—Davis Gold Mines shipped 11 tons of lead-silver-gold concentrates, milled in 1941 from Eldorado mine ore, to the Leadville smelter in 1942. The Base Metal Corporation operated under lease the Ute and Ulay group and flotation mill and produced 263 tons of lead-silver-gold concentrates.

JEFFERSON COUNTY

Placer gold and silver were the only metals produced in Jefferson County in 1942. The greatest part of the placer gold produced during the year was recovered by W. B. Kerkling from the Bertrand gravel pit and the Tresize placer. The American Smelting & Refining Co. explored the Malachite mine, near Starbuck, by diamond drilling but did not exercise its option.

LAKE COUNTY

LEADVILLE DISTRICT

The American Smelting & Refining Co. operated its Arkansas Valley lead bullion-leady copper matte smelter continuously (one furnace) in 1942 on ores and concentrates purchased from operators in virtually every active mining district in Colorado. Receipts of ore and concentrates totaled 94,659 tons compared with 121,297 tons in 1941.

The largest mining enterprise in the Leadville district in 1942 was that of the Resurrection Mining Co., which operated the Resurrection mine and 300-ton selective-flotation mill throughout 1942. In 1941 the company purchased the Yak tunnel and the mining claims of the Yak Mining, Milling & Tunnel Co. Construction was begun on a modern 250- to 300-ton flotation mill at the portal of the Yak tunnel in California Gulch; this mill was completed and production of concentrates from mine ore hauled through the Yak tunnel was started in January 1942. Total ore treated in the mill in 1942 amounted to 91,642 tons, of which 17,165 tons were dump ore from the Resurrec-

tion dump, milled for the American Smelting & Refining Co. Zinc-lead-gold-silver concentrates produced totaled 12,009 tons, containing 10,100 ounces of gold, 116,775 ounces of silver, 5,181,323 pounds of lead, and 7,011,312 pounds of zinc. Lead concentrates were shipped to the Leadville smelter; zinc concentrates were shipped to Amarillo, Tex. Development in 1942 consisted of 30 feet of shaft, 8,664 feet of drift, 1,181 feet of raises, and 2,753 feet of diamond drilling. To attract workers to this operation the management purchased and remodeled two large buildings in Leadville to make apartments for mine personnel. Work was commenced on a second milling unit designed to double the capacity of the 1942 milling operation; the new unit is expected to be completed and in operation in July 1943.

The California Gulch Mining & Milling Co. operated its two gravity- and flotation-concentration and amalgamation mills—one 75- to 125-ton capacity and one 450-ton capacity—during most of the year on ores from the Wolftone dump, Ibex dump, Valley lease, and Fortune lode. The Gold Mining Limitation Order of October 1942 forced the company to convert its small mill to the recovery of zinc and lead to remain in operation. Conversion of the larger mill to selective flotation was in progress in the early part of 1943. The John Hamm Mining & Milling, Ltd., operated its 300-ton amalgamation-gravity concentration-flotation mill the entire year on ore from the Ibex and Maid of Erin dumps. Addition of a jig plant to handle dump ores carrying zinc and lead was in progress at the close of the year. Andy Caine & Co. treated ore from the Fanny Rawlings mine by table concentration and amalgamation in the leased Norton mill. Gold-silver bullion recovered was sold to the Denver Mint; 90 tons of concentrates containing 36 ounces of gold, 537 ounces of silver, 8,632 pounds of lead, and a little copper were shipped to the Leadville smelter. The principal shippers of smelter ore to the Leadville smelter and smelters in Utah (in approximate order of tonnage) were the Breece dump, Galligher dump, Ibex, Rock Hill, New Monarch-Treasure Vault, Dolly B, Tucson, Little Jonny, Galligher lease, Fortune, Little Ellen, Golden Eagle, St. Louis tunnel, Breece, and "Lillian."

The Ore & Chemical Co. early in 1942 sampled dumps and determined 365,000 tons of mill-grade dump ore averaging 5 percent zinc and 3 percent lead; in November 1942 it began construction of a 1,000-ton "sink-and-float" mill southwest of Leadville near the Arkansas Valley smelter. The mill is scheduled for completion in July or August 1943; production of 125 tons of bulk zinc-lead concentrates (containing 15 percent zinc and 8 percent lead) a day is anticipated. The concentrates produced will be shipped to the Golden Cycle mill for selective flotation. Wartime demands for increased production of zinc and lead prompted the Federal Bureau of Mines to initiate two projects in the Leadville area designed to make available more ore for the production of these metals. The sampling of several old mine dumps in the fall and winter of 1942 proved 370,000 tons of dump ore. If funds are made available, the Bureau of Mines will drive a 2.55-mile tunnel to unwater the mines of Carbonate Hill, Evans Gulch, and Fryer Hill areas north and east of Leadville and the Downtown area within the city. Bureau of Mines engineers began planning and design studies of this project in September 1942. It is anticipated that this tunnel will drain 65 to 90 percent of the mine water of the Leadville area above the 9,950-foot or

9,970-foot altitude, whichever level of the portal is chosen. An appropriation of $1,500,000 has been approved by the Bureau of the Budget to cover costs of driving.

OTHER DISTRICTS

Slightly less than 400 tons of ore (mostly dry and siliceous gold, gold-silver, and silver and one small lot of lead-silver) were shipped in 1942 from mines in Lake County outside the Leadville district. Producing lode properties comprised the Amity, Dinero, and Dinero dump in the St. Kevin-Sugar Loaf district; and the Gordon-Bengal Tiger in the Twin Lakes district. Sluicing on the Derry Ranch placer in the Box Creek district recovered some gold.

LA PLATA COUNTY

California (or La Plata) district (Hesperus, La Plata).—Very small quantities of gold-silver ore were shipped by truck to the Leadville smelter in 1942 from the Bessie G and Nonpareil lodes. A lessee on the Mountain Lilly group shipped 19 tons of gold-silver ore to the Midvale (Utah) custom mill.

MINERAL COUNTY

Creede district.—The Emperius Mining Co., which in 1942 controlled nearly all mining properties in the Creede district, operated a group of mines and its 100-ton flotation mill at near capacity throughout 1942. Owing to a shortage of manpower, an average of 120 men was employed at the operation as compared with 160 in 1941. Lead-silver-gold concentrates produced were shipped to the Leadville smelter. Mines shipping to the mill comprised the Amethyst group, Commodore, New York-Last Chance-Pittsburg, Equinox, Ochre, and Happy Thought. From all the above producing properties except the Happy Thought, high-grade lead-silver-gold ore was shipped direct to the Leadville smelter.

MONTEZUMA COUNTY

The Red Arrow Gold Corporation operated its Red Arrow mine and 25-ton amalgamation-concentration mill from January to November 17, 1942. Gold-silver bullion recovered was sold to the Denver Mint. Gold-silver-copper concentrates produced by jigging and blanket-tabling were shipped to the Leadville smelter. The Outwest Mining Co. shipped 19 tons of gold-silver ore from the Outwest property adjoining the Red Arrow.

MONTROSE COUNTY

La Sal district.—Lessees at the Cashin group shipped 138 tons of copper-silver ore to the Tooele (Utah) copper plant.

OURAY COUNTY

Red Mountain district.—Several carloads of zinc-lead-silver ore were shipped in 1942 to the Midvale (Utah) custom mill from the Beaver, Micky Breen, Barstow dump, Rico, and Ida L in the Red Mountain district. Wm. McCullough and G. A. Franz leased the Mountain

King dump in August and began trucking ore on September 1 to the Franz mill for treatment; 1,200 tons were milled, yielding 158 tons of concentrates, which were shipped to the Midvale (Utah) custom mill for further concentration.

Sneffels district.—King Lease, Inc., operated the Camp Bird mine and the King Lease 100- to 125-ton amalgamation-flotation mill continuously in 1942. (See Minerals Yearbook, 1941, for methods of ore treatment.) A lessee on the Trust-Ruby claim shipped 5 tons of lead-silver-gold concentrates recovered from 191 tons of ore milled in the Franz custom mill. Zinc-lead-silver ore totaling 36 tons was shipped to the Midvale (Utah) custom mill from the Atlas and Mountain Top claims.

Uncompahgre district.—G. A. Franz, Inc., operated its 120-ton flotation mill 2 miles north of Ouray in 1942 on custom ores from the Mountain King dump in the Red Mountain district; Trust-Ruby in the Sneffels district; and the Bachelor, Senorita, Mineral Farm, and Wedge in the Uncompahgre district. During the year, 4,187 tons of ore were milled, averaging 0.02 ounce of gold and 6.5 ounces of silver to the ton, 0.6 percent copper, 4.1 percent lead, and 4.6 percent zinc. Lead-silver concentrates were shipped to the Leadville smelter and zinc concentrates to the Amarillo (Tex.) smelter and the Midvale (Utah) concentrator. The McCullough Lease shipped 840 tons of gold-silver-copper ore to the Midvale (Utah) smelter from the Wanakah group, in addition to shipping 28 tons of gold-silver ore to the Leadville smelter from the Wanakah and American Nettie groups. The J. R. Sonza lease on the Bachelor Consolidated group of claims completed hauling the remainder of the Wedge dump to the Franz mill in 1942. Lead concentrates produced, amounting to 140 tons, were shipped to the Leadville smelter. Small tonnages of smelting ore were also shipped from the Newsboy, Senorita, and U. S. mines.

PARK COUNTY

Alma Placers district.—Jack Richards was the principal producer on the Alma Placers in 1942 but ceased operations in September 1942. A lessee on the Gumaer placer operated from May 18 to June 22, 1942. At both operations the gravel was excavated from open pits by power shovels and trucked to central sluicing plants for treatment. The gold recovered was sold to the Denver Mint.

Beaver Creek district.—The Timberline Dredging Co. operated its electric floating connected-bucket dredge (dredge No. 1) on Beaver Creek 2 miles north of Fairplay from April 9 to October 15, 1942, when operations were stopped in deference to War Production Board Order L-208. The dredge, equipped with 84 7½-cubic foot buckets, handled 520,065 cubic yards of gravel in 1942, yielding 1,907 fine ounces of gold and 415 fine ounces of silver. Sluicing at other placers on Beaver Creek by Ray Wood and H. D. Myers recovered some gold, which was sold to the Denver Mint.

Buckskin district.—The Buckskin Joe Mines, Ltd., operated the Phillips group of mines in Buckskin Gulch and the Alma-Betts 50-ton selective-flotation mill in Mosquito Gulch throughout 1942. The mill treated 5,652 tons of ore, yielding 1,560 tons of concentrates containing 1,469 ounces of gold, 9,965 ounces of silver, 33,467 pounds of copper, 133,043 pounds of lead, and 988,205 pounds of zinc. Lead concentrates carrying some gold, silver, copper, and zinc were shipped

to the Leadville smelter; zinc concentrates carrying some gold, silver, copper, and lead were shipped to the Amarillo (Tex.) smelter. A lessee on the Gold Ridge mine shipped 66 tons of zinc-lead ore to the Midvale (Utah) custom mill and 23 tons of gold-silver-lead ore to the Leadville smelter. Sluicing in Buckskin Gulch recovered a small amount of gold.

Consolidated Montgomery district.—The Magnolia Gold Mining Co. worked the Lee Goss lode under lease throughout 1942 and produced 880 tons of gold-silver ore, containing a little copper, which was trucked to the Leadville smelter. The company 50-ton mill in Montgomery Gulch was not operated during the year. A small lot of lead-silver ore was shipped to the Leadville smelter from the Webber group.

Fairplay district.—The South Platte Dredging Co. continued to operate (until closed by Government order October 15, 1942) its steel floating connected-bucket dredge on bench ground along the Platte River 1½ miles southeast of Fairplay. The dredge is powered by electricity and is equipped with 108 12-cubic foot buckets. The Snowstorm placer 2 miles north of Fairplay yielded a substantial output during the year. Five operators, one of which (the Timberline Dredging Co.) used a dragline (8-cubic yard bucket) and floating Bodinson washing plant (called dredge No. 2), worked the gravels on the property. Small, intermittent sluicing operations were conducted at other placers on the Platte River near Fairplay.

Mosquito Creek district.—The London Mines & Milling Co. maintained production throughout 1942 from its consolidated group of mines on London Mountain and continued to be the principal metal producer in the Mosquito Creek district and in Park County. Dump and mine ore totaled 71,258 tons and was treated in the company 200-ton flotation- and gravity-concentration mill 7 miles west of Alma on South Mosquito Creek. Besides gold—the chief metal of value—the concentrates produced contained some silver, a little copper, and considerable lead and zinc and were sold to the Leadville smelter. James Redman operated his 150-ton Record mill from July 30 to August 5, 1942, and again for a few days in December on ore from the American mine. The London Butte Gold Mines Co. operated its Butte mine and 100-ton flotation mill 7 miles northwest of Alma throughout 1942 and treated 14,138 tons of ore, which made 618 tons of concentrates containing 2,720 ounces of gold, 1,685 ounces of silver, 95,004 pounds of lead, and a small amount of copper. The concentrates produced were shipped to the Leadville smelter. Several shipments of lead ore from the American, Ophir, and Hock Hocking claims were made to the Leadville smelter, and dump ore from the Orphan Boy mine was milled in the district. Reconstruction Finance Corporation granted Class A and Class B loans in 1942–3 totaling $80,000 to mines in the Mosquito Creek, Buckskin, and Consolidated Montgomery districts, all contingent on production of zinc-lead-[silver-gold] ore.

Tarryall district.—Cooley Bros. continued to operate the Peabody-Volz group of placers 2 miles north of Como under lease from April 4 to October 15, 1942, when operations were closed by the Gold Mining Limitation Order. The 3,000-cubic yard (per day) dragline floating dredge recovered 3,858 ounces of gold and 424 ounces of silver in 1942. The Sterling Mining Co. operated its 1½-cubic yard dragline and four-

bowl land dredge on the Little Mint-Storming Jordan placer on Tarryall Creek 7 miles below Como from May 20 to September 14, 1942.

PITKIN COUNTY

Roaring Fork district (*Aspen*).—The Midnight Mining Co. operated the Midnight mine and mill continuously 6 days a week in 1942. The mine produced 9,000 tons of ore, which was treated in the company 50-ton flotation mill. The products were lead-silver concentrates (sold to the Leadville smelter) and zinc concentrates (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 Spar lode, Aspen, and other groups under his management. Small tonnages of crude smelting ore were shipped to the Leadville smelter from the Dorothy Louise, Mt. Ranger, and Unexpected claims.

RIO GRANDE COUNTY

Summitville district.—Summitville Consolidated Mines, Inc., operated the consolidated group of mines and 150-ton mill at Summitville continuously until August 1, 1942, when it relinquished its lease on the property. On the same day the Gold Links Mine obtained a lease to continue operating the property and maintained production throughout the remainder of the year. Crude ore milled by both operators totaled 14,970 tons, from which—in addition to amalgamation bullion and cyanide precipitates—975 tons of dry gold concentrates were made containing 3,528 ounces of gold, 5,638 ounces of silver, and 96,983 pounds of copper. Ore treatment by the Summitville operation is described under the corresponding chapter and district, Minerals Yearbook, 1941. Until November 15 the Gold Links operation was entirely amalgamation; the crude ore was run through the stamps and over amalgamation plates to remove any free gold. Amalgamation tailings were tabled and concentrates filtered and shipped to the Leadville smelter. Amalgam bullion produced was shipped to the Denver Mint. On November 15, 1942, the gradual conversion to a straight flotation mill in place of the former cyanide and amalgamation treatment was completed, and production of flotation concentrates was commenced.

ROUTT COUNTY

Milbank Franz shipped to a custom mill in Utah 19 tons of zinc-lead ore containing 0.36 ounce of gold, 398 ounces of silver, 187 pounds of copper, 877 pounds of lead, and 6,407 pounds of zinc from the Greenville mine in the Hahns Peak area.

SAGUACHE COUNTY

Kerber Creek district (*Bonanza*).—The Pratt-Bonanza Mining & Milling Co. worked the St. Louis mine under lease throughout the year and shipped lead smelting ore to the Leadville smelter and the Tooele (Utah) slag-fuming plant, zinc-lead smelting ore to the Coffeyville (Kans.) pigment plant, and zinc-lead milling ore to the Combined Metals Reduction Co. custom mill at Bauer, Utah, and the custom concentrator at Midvale, Utah. A test run of 1,077 tons of St. Louis ore was made in the 50-ton flotation mill of the Flagstaff

Mining & Milling Co.; results were unsatisfactory. Regular shipments of zinc-lead ore were made to the custom mill at Bauer, Utah, and the custom concentrator at Midvale, Utah, from the Erie mine, operated throughout 1942 by Pickering and Olive Mines. Milling ore shipped averaged 12.6 ounces per ton of silver, 13.06 percent lead, 19.98 percent zinc, and a low content per ton of gold and copper. A substantial tonnage of lead ore containing 25.59 ounces per ton of silver, 19.15 percent lead, and minor quantities of gold and copper was shipped to the Leadville smelter. Lessees on the Rawley No. 1 mine and dump shipped some lead-silver-copper-gold ore to the Leadville smelter. Other shippers of crude smelting ore and milling ore included the Cora Group, Now What, and Minnie Lynch.

SAN JUAN COUNTY

Animas district.—The Shenandoah-Dives Mining Co. continued operations throughout 1942 at its consolidated group of claims on King Solomon Mountain and the Silver Lake group as a single unit, and its 750-ton selective-flotation mill on Animas River near Silverton. The mill treated 168,772 tons of ore from company mines and 2,920 tons of custom ore from other mines in San Juan County. Output from the mill totaled 4,509 tons of combined lead-copper, zinc, and iron (lead) concentrates containing in all 15,090 ounces of gold, 269,589 ounces of silver, 606,070 pounds of copper (wet assay), 2,406,020 pounds of lead (wet assay), and 961,168 pounds of zinc; the lead-copper and iron (lead) concentrates were shipped to the Leadville smelter, and the zinc concentrates (494 tons of 55.4-percent zinc content, with also gold, silver, lead, and minor copper content) to the Amarillo (Tex.) smelter. Custom ore came from the Little Fannie, Brewery tunnel, Little Nation, and Buffalo Boy mines in the Animas district; the Mountain Queen mine in the Eureka district; and the Bandora mine in the Ice Lake district. In 1942 the company entered into a 15-year contract to operate the American Smelting & Refining Co. Silver Lake unit. Ore milled in 1942 from the Silver Lake totaled 20,240 tons (included in the 168,772 tons above) assaying 0.086 ounce of gold and 1.56 ounces of silver per ton, 0.58 percent lead, 0.33 percent copper, and 0.49 percent zinc, from which 355 tons of concentrates (calculated on basis of mill recoveries) were produced. The calculated concentrates (combined lead, zinc, and iron) averaged 4.12 ounces of gold and 59.67 ounces of silver to the ton, 19.8 percent lead, 15.5 percent copper, and 15.0 percent zinc. Development in 1942 at the Silver Lake and Shenandoah-Dives groups consisted of 1,819 feet of drifts and crosscuts, 470 feet of raises, and 113 feet of diamond drilling. The Highland Mary mine and 70-ton flotation mill were operated from June 1 to November 28, 1942, when operations ceased for lack of water for the mill. The concentrates produced (containing gold, silver, copper, and lead) were shipped to the Leadville smelter. The Denver Equipment Co., agent for the Pride of the West Mining Co., operated the 100-ton Pride of the West selective-flotation mill at Howardsville continuously in 1942 on company lead-zinc-gold-silver-copper ore from the Pride of the West group. Lead concentrates (containing gold, silver, copper, and some zinc) were shipped to the Leadville smelter; zinc concentrates were shipped to the Amarillo (Tex.) smelter. Development in 1942 consisted of 1,041 feet of drifts; the capacity of the mill was increased from 70 tons to 100. Crude

lead ore was shipped to the Leadville smelter in 1942 from the Action, Austria tunnel, and Galena Champion claims; several carloads of dry gold smelting ore were shipped from the Golden Eagle property.

Eureka district.—Most of the ore produced from the mines in the Eureka district in 1942 came from the Mountain Queen claim 18 miles north of Silverton and was sold to the Shenandoah-Dives mill. About 1 car of zinc-lead ore was shipped from the Columbus property to the custom mill at Bauer, Utah. A small tonnage of zinc-lead ore recovered in development was shipped from the Mazeppa claim to the Midvale (Utah) custom mill.

Ice Lake Basin district.—The only output from the Ice Lake Basin district in 1942 was 49 tons of zinc-lead ore shipped to the Shenandoah-Dives mill and 19 tons of lead ore shipped to the Leadville smelter, all from the Bandora mine. The operators received a Reconstruction Finance Corporation Class A loan in 1942.

SAN MIGUEL COUNTY

Iron Springs district (Ophir).—All the output of the Iron Springs district in 1942 was contained in small tonnages of lead-silver ore shipped to the Leadville smelter from the Butterfly-Terrible-Silver Bell group and San Bernardo.

Upper San Miguel district (Telluride).—Telluride Mines, Inc., operated its 550-ton amalgamation and gravity- and flotation-concentration mill at Pandora 2½ miles east of Telluride and treated 146,211 tons in 1942 compared with 193,768 tons in 1941. The ore treated in 1942 was from the Smuggler Union, Pandora, Hermit, Montana, and Cimarron mines and the Adit and Marshall Basin dumps. Of the 14,556 tons of concentrates produced, 12,002 tons were lead concentrates shipped to the Leadville smelter; zinc concentrates were shipped to the Amarillo (Tex.) smelter. Gold bullion was also produced by amalgamation and shipped to the Denver Mint. Mine development in 1942 comprised 1,730 feet of drifts. Early in the year a unit of flotation cells was added to the mill circuit for the recovery of zinc. Alta Mines, Inc., operated the Alta-St. Louis group and 100-ton gravity- and flotation-concentration mill throughout 1942, but with some idleness due to lack of men, and produced 32,683 tons of ore yielding 3,307 tons of lead concentrates shipped to the Leadville smelter, containing 2,613 ounces of gold, 110,558 ounces of silver, 98,453 pounds of copper, 1,148,474 pounds of lead, and 435,966 pounds of zinc.

A war minerals study of the Black Bear mine by the Bureau of Mines resulted in the Metals Reserve Co. taking a 5-year lease on the property. The lease was signed June 11, 1943. The property will be opened by extension of the Treasury tunnel (Red Mountain, Ouray County).

SUMMIT COUNTY

Breckenridge district.—Small-scale operations only were carried on at lode mines in the Breckenridge district in 1942, and most of the ore produced was shipped direct to the Leadville smelter. Shippers included the Bemrose lode, Estella Agnes, Jumbo, Royal Tiger group, and Brooks-Snyder lode.

The Blue River Co. operated its floating connected-bucket dredge at Breckenridge from May to October 1942; later the dredge was

dismantled and equipment sold. The Bemrose-Bostwick in Hoosier Gulch and the John Jay group in French Gulch were worked by hydraulicking and sluicing. Testing of placer gravels in Nigger Gulch and on the Blue River and Little Pittsburg Creek recovered small amounts of gold, which were sold to the Denver Mint.

Green Mountain district.—Walter McDaniel continued producing zinc-silver-lead-gold-copper ore of very high zinc content from his Big Four mine on Green Mountain 17 miles south of Kremmling. Output for 1942 was 387 tons of ore (shipped to the Midvale (Utah) custom mill) containing 357,997 pounds of zinc, 2,659 ounces of silver, 8,570 pounds of lead, 6.44 ounces of gold, and 1,833 pounds of copper.

Montezuma district.—The Plymouth Milling Co. worked the New York, Waterloo, and Silver King mines and 125-ton electric-powered selective flotation mill part of 1942 and produced 47 tons of lead concentrates and 63 tons of zinc concentrates which were shipped, respectively, to the Leadville and Amarillo (Tex.) smelters. A lessee on the Fisherman group operated from January 2 until September 30 and shipped to the Midvale (Utah) custom mill 179 tons of zinc-lead ore containing 5 ounces of gold, 725 ounces of silver, 37,247 pounds of lead, and 56,721 pounds of zinc. Twenty tons of lead-silver smelting ore were shipped to the Leadville smelter. Small-scale operations on the Pinacle claim produced 73 tons of crude lead-silver-copper smelting ore, which were shipped to the Leadville smelter. A few lots of lead-silver smelting ore were also shipped from the Alvi No. 1, Quail, Erickson, Maid of Orleans, and Pennsylvania claims. Mining activities in this district in 1942 were encouraged by various loans totaling $94,000 from the Reconstruction Finance Corporation and examination of several properties by Federal Bureau of Mines engineers.

Ten Mile (Kokomo, Robinson) district.—The Wilfley Leasing Co. began production in November at its Wilfley mine and 75-ton selective flotation mill 1 mile west of Kokomo. The mill handled 799 tons of ore in 1942, composed largely of marmatite and pyrite, yielding 9 tons of lead concentrates and 128 tons of zinc concentrates which were shipped to the Leadville and Amarillo (Tex.) smelters. The opening of the property and the building of the mill were stimulated by the granting of a $71,000 loan from the Reconstruction Finance Corporation and the construction (by the Forest Service) of a 14-foot graded access road from Kokomo to the mill. L. J. Gould and A. R. Rhine operated the Washington and Hancock group (known as the Lucky Strike group) throughout 1942 and shipped 7,820 tons of zinc-lead-silver-copper-gold ore to the Midvale (Utah) custom concentrator. Crude lead-silver smelting ore shipped to the Leadville smelter totaled 74 tons.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

Except for several years, Cripple Creek has been annually the leading gold-producing district in Colorado, and its total output makes it rank first among gold-producing districts. From 1891, when gold was discovered in that area, through 1942 it has yielded a total of 18,420,744 fine ounces valued at $398,300,522, or 48 percent of the State total output of gold from 1858 to 1942, inclusive. In 1942 the district produced 104,455 ounces (39 percent of the State total) compared with

133,470 ounces (35 percent) in 1941 and 128,932 ounces (35 percent) in 1940. Several factors were responsible for the decreased output in 1942, namely: Government priority restrictions regarding materials essential to mines and mills became exceedingly severe early in 1942 and have grown steadily more complicated; Selective Service regulations and attractive salaries offered by war industries created a drastic shortage of able-bodied men; the cost of labor and of mining and milling supplies increased greatly in 1942, whereas the price of gold remained fixed; and War Production Board Gold Mining Limitation Order L–208, issued October 8, 1942, has caused many mines to close. The total output of ore from Cripple Creek mines and dumps in 1942 was 377,995 tons, of which 362,460 tons were shipped to the Golden Cycle mill (operations reviewed under El Paso County). The only ore milled locally was 15,509 tons treated in the flotation mill of the Cameron Gold Mines, Inc. 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 its annual report to stockholders for the year ended December 31, 1942 (dated March 20, 1943):

> During 1942 the Cripple Creek district shipped to the Golden Cycle mill 362,460 tons of ore with a gross [settlement] value of $3,607,744.94 and an average value of $9.95 per ton. This compares with 484,702 tons with a gross value of $4,640,419.99 and an average value of $9.57 per ton for 1941. This large drop in tonnage was due wholly to economic conditions brought on by the war.
>
> The United Gold Mines Co. was still the largest producer in the Cripple Creek district with the Cresson Consolidated Gold Mining & Milling Co. second and the Golden Cycle Mining Operations third. These three properties accounted for 72 percent of the ore shipped from the district and, as in previous years, lessees operating throughout the district accounted for more than 80 percent of the total tonnage to the mill.
>
> A large number of the company men and lessees throughout the district are older men or men who cannot get work in any other industry. The Cripple Creek district is about cleared out of younger men. The Army and Navy have received a large number of men from this district. Over forty are in the Army and Navy from the Cresson Mine alone. This labor condition affects lessees as well as the company with the result that tonnage to the mill will be greatly decreased until the war is over.
>
> *Ajax operation.*—The Ajax mine during 1942 shipped a total of 29,822 tons of ore with a gross [settlement] value of $505,557.09 and an average value of $16.95 per ton. The shaft was sunk an additional 105 feet to the 28th level in March. This makes the shaft 2,900 feet deep. It still has 260 feet to go to reach the level of the Carlton tunnel. The 27th and 28th level stations were cut and crosscuts started west for the various vein systems. Due to the shortage of labor, work on both of the crosscuts has been stopped and it is doubtful if much work on these levels can be done until after the war. Most of the work at the present time is being carried on the 23d, 24th and 26th levels. The following is a summary of the development work for 1942:

	Feet
Company	3,148
Lessees	2,037
Shaft sinking	105
Total	5,290

Anchoria Leland operations.—The Anchoria Leland shipped 8,358 tons of ore with a gross value of $65,170.42 and an average value of $7.80 per ton. Practically all work done on the property during the past year was by lessees. 1,203 feet of development work was accomplished during the past year.

Index operation.—No underground work was carried out on this property during the past year. Lessees shipped 3,345 tons of dump ore with an average value of $4.93 per ton.

Carlton tunnel operation.—The only work done by the Golden Cycle Corporation on the Carlton tunnel during the past year was maintenance and salvage work. It was necessary to replace some timber and repair some track in order to keep the tunnel open. The Portland shaft was connected to the tunnel level by the United Gold Mines Co. and a large station cut on the tunnel level. The skips in Portland No. 2 shaft now run directly to the tunnel level. No work is contemplated in the tunnel until after the war. The Cresson Consolidated Gold Mining & Milling Co. and the United Gold Mines Co. then plan on driving two laterals; one of about 4,000 feet to the Cresson shaft and one of 5,000 feet to the Vindicator shaft. The flow of water from the tunnel has held steadily to about 5,400 gallons per minute throughout the year. It is well to point out at this time that a large percentage of all mine ore being shipped to the mill from the Cripple Creek district at this time has been made available by the Carlton tunnel. Without the drainage afforded by the Carlton tunnel, there would be no ore coming from the Ajax and Portland and very little from the Cresson. It is even doubtful if these properties could operate at all under present conditions.

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, 1942 (dated February 15, 1943), gives the following details on operations at individual mines:

GENERAL MANAGER'S REPORT

Production by the company and lessees was 119,346 tons, with an average value of $8.44 per ton and a gross [settlement] value of $1,007,693. Of this amount the company accounted for 21,007 tons with an average value of $6.68 per ton and a gross value of $140,314, while the lessees accounted for 98,339 tons with an average value of $8.82 per ton and a gross value of $867,379.

The Portland No. 1 and No. 2 shafts, the Vindicator, and the Rose Nicol shafts were operated by the company, largely for the accommodation of split-check lessees.

The shortage of company men and lessees has steadily grown worse throughout the year. The big blow came with the War Production Board's order closing all gold mines in October 1942. While this order was later modified, nevertheless it caused a regular exodus from this district to various defense plants, base metal mines, and other industries of a like nature, until at the present time we are left with older men or men who are not capable of doing any work except leasing in this district. In January 1942 there were 489 men working on the various properties of the United Gold Mines Co.; January 1943 shows 100 men working on these same properties. This gives some idea how employment has dropped off in this district.

The Portland No. 2 shaft was completed to the [Carlton] tunnel level and a 50-foot sump sunk below this level during the year. A large station was cut in order to handle the muck from all future work at the Carlton tunnel level. Part of the equipment, which was located at the mouth of the tunnel, has now been moved onto this station in preparation for driving both the Cresson and Vindicator laterals of the tunnel when we have the available manpower and this will not be until after the war.

Both the Portland No. 1 and No. 2 shafts were operated on company account; No. 1 shaft for the accommodation of split-check lessees, and No. 2 shaft mainly for company work. A large amount of clean-up and repair work was carried out in the lower levels of No. 2 shaft. The 31st, or the old winze level, was connected through to the shaft and a station cut. Track and pipe have been installed on this level, in preparation to do some development work when the necessary manpower is available. Considerable development work was accomplished both by the company and lessees. The company opened several small chutes of ore on the 27th and 29th levels and these are being mined to a limited extent at the present time. A considerable tonnage of low-grade ore was hoisted from a large cave on the 27th level. In fact, more ore was shipped on company account from the Portland during 1942 than for a good many years past.

There are six sets of lessees working underground on the Portland and three sets of dump lessees. All of these made a fair production during the year.

The Vindicator-Cycle group.—The Vindicator shaft was operated by the company throughout the entire year. There are seven sets of lessees operating underground on this property at the present time. The Theresa and Hull City shafts were closed down about the middle of the year, due to a lack of lessees. During the year the Vindicator sold a total of 32,212 tons of crushed rock. This was the best year we have had as far as the crushed rock business is concerned in a number of years.

Rose Nicol.—The Rose Nicol shaft produced 13,316 tons with a gross value of $163,134. Of this amount the lessees produced 8,667 tons with a gross value of $136,154, and the company accounted for the balance of 4,649 tons with a gross value of $26,980.

In spite of the shortage of both company men and lessees, the company accomplished 1,100 feet of development work and the lessees accounted for 1,145 feet, making a total of 2,245 feet on the property for the year. Some good ore was opened which is now being mined. There are seven sets of lessees operating through the Rose Nicol shaft and one set through the Trail tunnel.

Shurtloff-Findley.—This property, which had been under lease to the Golden Conqueror Mines, Inc., for a number of years, was closed down in December, due chiefly to the labor shortage. In previous years a good production came from this mine.

The Wild Horse, Deadwood, and other miscellaneous properties are all idle and there is very little chance that any work can be done on them until after the war. The Tennessee Mines Co. is operating the Patti Rosa shaft and making some production. One set of lessees are also working on the Kalamazoo. There are not more than ten men working on all the miscellaneous United Gold Mines properties. Two years ago there were probably 250 men working on this same ground.

The Teller County Air Co., which the United Gold Mines Co. owns, has virtually lost all its business since its chief market for compressed air was the small scattered operations throughout the district.

Production of company ore by United Gold Mines Co. in 1942

Mine	Net tons	Gross value [1]	Company ore cash receipts	Average gross value per ton [1]
Vindicator	2,442	$11,399	$4,058	$4.67
Rose Nicol	4,649	26,980	11,939	5.80
Portland	6,944	71,435	43,006	10.29
No. 2 Plant	6,972	30,500	9,935	4.37
	21,007	140,314	68,938	6.68

[1] Settlement value.

Production of lessee ore of United Gold Mines Co. in 1942

Group	Net tons	Gross value [1]	Royalties received	Lessees' receipts	Average gross value per ton [1]
Vindicator	52,386	$342,364	$58,255	$108,831	$6.54
Rose Nicol	8,667	136,154	42,490	47,622	15.71
Portland	8,440	139,990	46,425	52,005	16.59
Theresa	4,254	35,077	10,208	9,437	8.25
Hull City	1,619	15,006	4,401	4,058	9.27
Bull Hill Group	22,973	198,788	14,917	83,764	8.65
	98,339	867,379	176,696	305,717	8.82

[1] Settlement value.

Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to December 31, 1942

	Net tons	Gross value[1]
Ore mined before consolidation	26,310	$456,806
Production under operation of United Gold Mines Co	2,339,411	24,382,719
Total to Dec. 31, 1942	2,365,721	24,839,525

[1] Settlement value.

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1942 (dated February 1, 1943) says—

PRESIDENT'S REPORT

Herewith is annual statement of The Cresson Consolidated Gold Mining & Milling Co. for the twelve months ended December 31, 1942.

Operating gain for 1942 was $55,754, compared to $122,903 in 1941, a decrease of $67,149. Many factors, chief of which are hereafter set out, caused the large decrease in gain for 1942 compared to 1941.

Company ore produced during 1942 had a gross value of $246,596 and an average per ton gross value of $6.18, compared to a total gross value of $363,821 in 1941, with an average per ton gross value of $6.84.

Ore produced by lessees operating under split-check and royalty leases for 1942 had a gross value of $765,573 and an average per ton value of $12.48, compared to 1941 with a total gross value of $973,659 and an average per ton gross value of $12.65.

Total gross value of all ores produced by both the company and lessees during 1942 was $1,012,169, compared to $1,337,480 in 1941, a decrease of $325,311.

Early in 1942 the priority restrictions insofar as securing materials necessary for gold mining became exceedingly severe and have grown steadily worse. On October 8, 1942, the Mining Branch of the War Production Board, Washington, D. C., issued an order closing down all "nonessential" gold mines in the United States, its territories, or possessions.

SUPERINTENDENT'S REPORT

The following is a summary of the development work for twelve months, ending December 31, 1942:

Development

	Feet	Feet
Drifts and crosscuts:		
Company	1,707	
Hart group	233	
Lessees	1,317	
		3,257
Raises and winzes:		
Company	363	
Lessees	1,171	
		1,534
		4,791

Shortage of men during the past year resulted in the smallest production from the mine in a number of years. From the beginning of the year, labor shortage became progressively worse, reaching its climax when the War Production Board issued the order closing all gold mines. The bottom then dropped out of our man power. While the order was modified early in December just before the date set for a complete close down, the damage had been done and we were left with a small number of older men and lessees; the cream of our man power having left for various other industries paying much higher wages than it is possible for us to pay. The armed forces have also taken over forty of our younger men.

During the past year, the nineteenth level, which was under water until the later part of 1941, was cleaned up. Track and pipe lines were installed and some development work accomplished. Two bodies of medium grade ore were

opened which we are mining at the present time. Some development work was also done on various other levels of the mine and some small bodies of ore were opened.

There are eighteen sets of split-check lessees working through the Cresson shaft; however, these lessees have about fifty percent of the men which would be normally employed on these blocks of ground. Most of these lessees produced during the past year a good tonnage of ore considering the handicap they were forced to work under. One of the most serious aspects of the shortage of men by the Company and lessees is the lack of development work. At the present time we are doing less work of this kind than at any time in the history of the mine. Development work is very necessary in order to open up new bodies of ore upon which the mine must depend for its future production.

The Gold Sovereign shaft was closed down in August of this year, due to a lack of lessees. This shaft had been worked entirely by split-check lessees.

Work on the Hart group on Bull Hill, which we were carrying on through the Empire State shaft of the Empire Lee Mining Co., was also suspended during the early summer. There is much more work that should be done upon this piece of ground when conditions permit.

The water level in the Cresson shaft is now sixty-five feet below the nineteenth level, and according to the present rate of drainage, it will be at least eighteen months before it would reach the twentieth level or the bottom level of the mine. The twentieth level is 700 feet above the level of the Carlton tunnel; but as I stated in last year's report, it will be necessary to drive a lateral from the Carlton tunnel into the ground in order to give complete drainage in the Cresson property. We had planned to start this lateral during the past year but this was impossible due to the shortage of labor.

The average cost per ton shipped by company and the lessees during 1942 was $3.1177 on a total of 101,203 tons.

Federal taxes	$0. 119
State income taxes	. 008
State and county taxes	. 158
Sales, service, and use tax	. 015
Federal excise tax	. 002
Capital-stock taxes	. 004
Social-security taxes	. 017
Miscellaneous taxes	. 002
	. 325
Unemployment-compensation insurance	. 019
Compensation insurance	. 062
Prepaid fire insurance	. 010
Business insurance	. 027
Carlton interests group insurance	. 010
Salary of officers and directors	. 047
General expense	. 054
Mining operations	2. 564
	2. 793
	3. 118

Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to December 31, 1942

Period	Dry short tons	Gross value [1]	Freight and treatment	Net value
1903 to Dec. 31, 1941	3,093,175	$45,178,653	$14,830,495	$30,348,159
1942:				
Company ore	39,872	246,596	129,246	117,350
Lessee ore	61,331	765,573	286,947	478,625
1903 to Dec. 31, 1942	3,194,378	46,190,822	15,246,688	30,944,134

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1941			$14.61	$9.81	$13,479,273
1942:					
Company ore			6.18	2.94	73,200
Lessee ore	$245,556	$233,070	12.48	7.80	
1903 to Dec. 31, 1942			14.46	9.69	[2] 13,552,473

[1] Settlement value.
[2] Represents 29.34 percent of gross value and 43.80 percent of net value.

Shipments from the Stratton properties in 1942 totaled 23,714 tons of ore, which had a total gross settlement value of $325,781.11 or an average settlement value of $13.74 per ton. Most of the ore was mined by lessees under the split-check system. About half of the ore produced was dump ore shipped by the Regain Corporation from three groups of dumps on Bull Hill. The principal producers of mine ore were the Alie Bell Mining Co., A. B. Cobb, Longfellow Mining Co., Jess Vetter, and J. E. Vanderwalker.

Cameron Gold Mines, Inc., operated its group of mines and 100-ton flotation mill until June 1942, when operations ceased and the corporation started liquidation proceedings. Ore treated totaled 15,509 tons yielding 702 tons of concentrates containing 1,698 ounces of gold and 1,132 ounces of silver; the concentrates were shipped to the Leadville smelter. In approximate order of gold output the Empire Lee, Acacia, Free Coinage, Forest Queen, and Jerry Johnson continued to be important producers in 1942 until December 10. Some of the other producing mines and dumps were the Black Belle, Cardinal-Great West, Dr. Jack Pot, Economic dump, Joe Dandy, New Gold Dollar, and Strong.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES

(MINE REPORT)

By A. J. MARTIN

SUMMARY OUTLINE

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SUMMARY

The principal copper, zinc, and zinc-lead mines in the Eastern States operated at or near capacity throughout 1942, and their total output of copper and zinc increased over 1941. Zinc production in New York and Tennessee and byproduct copper production from the Cornwall iron mine in Pennsylvania were larger than in any previous year. Copper production increased in Tennessee also but decreased in North Carolina. The output of zinc in New Jersey—second-largest zinc-producing State in the United States during the year—was nearly the same as in 1941, and that in Virginia decreased. Although fixed or ceiling prices on copper, lead, and zinc prevailed throughout 1942, the Government premium-price program, effective February 1, and funds obtainable through Federal lending agencies provided incentives for expansion in mining, development, and prospecting. An old zinc-lead mine in Virginia was reopened during the year, and a newly developed zinc mine in Tennessee and an old copper mine in Vermont were being equipped and prepared for operation as the year ended. Gold production in the Eastern States decreased heavily. Two mines, one in North Carolina and one in South Carolina, yielded 77 percent of the total in 1942 and 83 percent in 1941. Both these mines suspended operations before the end of October 1942, and nearly all the gold output during the last 2 months of the year (averaging 218 ounces monthly) was incident to the mining of iron and copper. Small lode and placer mines exempted from Gold Mining Limitation Order L–208 issued by the War Production Board on October 8, 1942, produced only 3 percent of the total gold output of the Eastern States in 1941 and 4 percent in 1942. The lead output in both years came from mines producing zinc as the metal of chief value, and the silver production was that recovered as a byproduct of the mining of other metals.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported, except that of zinc in New Jersey, has been calculated at the following prices. The value of the New Jersey production is the total value of the zinc recoverable as metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

Prices of gold, silver, copper, lead, and zinc, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Annual figures for the 5 years ended with 1942 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, 1938–42, 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
1938	51	26	3,159,880	19,928	$697,480	94,945	$61,380
1939	47	24	3,409,619	17,414	609,490	94,083	63,862
1940	40	18	3,674,815	18,456	645,960	102,825	73,120
1941	43	14	3,780,397	21,982	769,370	106,051	75,414
1942	36	17	4,166,226	14,699	514,465	105,307	74,885

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
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
1941	27,132,000	3,201,576	5,513	628,482	191,310	29,484,423	34,159,265
1942	28,404,000	3,436,884	4,475	599,650	199,809	36,190,180	40,816,064

[1] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[2] Includes placer gold as follows—1938: 667 ounces; 1939: 413 ounces; 1940: 452 ounces; 1941: 203 ounces; 1942: 69 ounces.
[3] Placer silver did not exceed 39 ounces in any year during the 5-year period.

Gold.—The old Haile mine in Lancaster County, S. C., near Kershaw (operated only 9 months in 1942) yielded 50 percent of the total mine output of gold in the Eastern States in 1942 and 69 percent in 1941. The Condor mine near Waxhaw, Union County, N. C.—second-largest producer of gold in both years—contributed 27 percent of the total in 1942 and 14 percent in 1941; the mine was closed in October 1942. The only other important producer of gold in 1942 was the Cornwall mine in Lebanon County, Pa., which yields gold, silver, and copper as a byproduct of iron mining. Changes in output of gold in the various States in 1942 comprised increases of 833 ounces in North Carolina and 77 ounces in Pennsylvania and decreases of 7,684 ounces in South Carolina, 281 ounces in Georgia, 131 ounces in Virginia, 68 ounces in Tennessee, and 29 ounces in Alabama. The estimated output of gold in the Southern Appalachian States from 1799 to 1942 is recorded as follows:

Mine production of gold in the Southern Appalachian States, 1799–1942

State	Period	Fine ounces	Value	State	Period	Fine ounces	Value
Alabama	1830–1942	49,489	$1,198,775	South Carolina	1829–1942	318,654	$7,556,980
Georgia	1830–1942	870,509	18,083,662	Tennessee	1831–1942	20,197	454,525
Maryland	(1)–1942	6,102	163,940	Virginia	1828–1942	167,364	3,570,719
North Carolina	1799–1942	1,164,436	24,322,523	Total	1799–1942	2,596,751	55,351,124

[1] Year of first production not recorded.

Silver.—The silver recovered from ores and gravels mined in the Eastern States in 1942 comprised 55,926 ounces derived from copper and iron (magnetite-pyrite-chalcopyrite) ores, 41,773 ounces from zinc-lead ores, 7,606 ounces from gold ores, and 2 ounces from placer gravel.

Copper.—The upward trend in copper production in the Eastern States which began in 1939 continued in 1942, when the output increased 5 percent over 1941 and was 35 percent above that in 1938. The quantity of copper recovered in 1942 from magnetite-pyrite-chalcopyrite ore of the Cornwall mine in Pennsylvania was the highest annual output to date, and that recovered from copper ore increased slightly. As the three mines that produced nearly all the copper output of the Eastern States in 1942 are in different States (North Carolina, Pennsylvania, and Tennessee), it is not possible to show the production separately by States without disclosing that of each mine; the combined output of the three States is shown under Tennessee in the following table. Copper ore yielded, in recovered metals, about 0.0003 ounce of gold and 0.05 ounce of silver to the ton of crude ore. Copper concentrates from the Cornwall ore contained some recoverable gold and silver.

Lead.—The mine output of recoverable lead in the Eastern States was 4,475 tons in 1942 compared with 5,513 tons in 1941. The figures for 1941 include some lead contained in concentrates shipped from mine stocks accumulated in previous years, whereas those for 1942 represent the recoverable metal in concentrates actually produced during the year. Comparing actual mine production in 1941 (4,039 tons) with that in 1942 shows an increase for 1942 of 11 percent.

Zinc-lead sulfide ores from the Austinville mine in Virginia and the Balmat in New York continued to yield the bulk of the lead output; the rest came from lead carbonate ore from the Embree mine (producing also zinc carbonate), mixed zinc-lead carbonate and sulfide ore from the Bunche's Hollow (Imperial) in Tennessee, and zinc-lead sulfide ore from the Valzinco in Virginia.

Zinc.—Zinc mine operators in the Eastern States made determined efforts to obtain maximum production from developed ore reserves in 1942 and to find and develop ore bodies upon which to draw to help meet the anticipated continued heavy demand for zinc for the duration of the war. Several of the mines made the largest annual production in the history of their operation, and the Eastern States total output of recoverable zinc was the largest on record—199,809 tons in 1942 compared with 191,310 tons in 1941. The figures for 1941 include some zinc contained in concentrates shipped from mine stocks accumulated in previous years, whereas those for 1942 represent the recoverable metal in concentrates actually produced during the year. Comparing actual mine production in 1941 (186,880 tons) with that in 1942 shows a 7-percent increase for 1942. The output in New York increased 19 percent and in Tennessee 22 percent; in New Jersey it varied little from 1941 (0.28 percent increase); and in Virginia actual production (not shipments) decreased 13 percent. About 95 percent of the total zinc output in the Eastern States in 1942 was produced without benefit of the Government premium. It is unlikely that this high percentage can be maintained in 1943 if the 8.25-cent ceiling price remains unchanged. The developed high-grade ore bodies are being depleted at a rapid rate, necessitating much new prospect drilling and mine development, as well as the mining of lower-grade ores. Increases in production costs thus incurred, which cannot be absorbed by the mining companies, probably will be compensated by quota adjustments. Also, production from new enterprises will be paid for at premium prices. The Valzinco zinc-lead mine in Spotsylvania County, Va., which was reopened and equipped with a 100-ton mill in 1942, began producing before the end of the year; and the American Zinc Co. of Tennessee plans to open a newly developed mine at Jefferson City, Tenn., during the first part of 1943.

MINE PRODUCTION BY STATES

Mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1942, by States, in terms of recovered metals

State	Mines producing		Ore (short tons)	Gold			Silver		
				Fine ounces		Total value	Fine ounces		Total value
	Lode	Placer		Lode	Placer		Lode	Placer	
Alabama	1		35	1		$35			
Georgia	3	15	75	15	15	1,050	6	1	$5
New Jersey	1		643,766						
New York	3		548,816				40,012		28,453
North Carolina	7	1	40,429	4,076	1	142,695	8,259		5,873
Pennsylvania	1		(1)	2,499		87,465	15,501		11,023
South Carolina	4		86,270	7,824		273,840	5,064		3,601
Tennessee	11		2,383,854	159		5,565	34,671		24,655
Virginia	5	1	462,981	56	53	3,815	1,792	1	1,275
Total, 1941	36	17	[2] 4,166,226	14,630	69	514,465	105,305	2	74,885
	43	14	[2] 3,780,397	21,779	203	769,370	106,036	15	75,414

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Alabama							$35
Georgia							1,055
New Jersey					94,040	[3] $16,517,146	[3] 16,517,146
New York			2,434	$326,156	45,807	8,520,102	8,874,711
North Carolina	(4)	(4)					[5] 148,568
Pennsylvania	(4)	(4)					[5] 98,488
South Carolina	1,000	$121					277,562
Tennessee	[4] 28,348,000	[4] 3,430,108	238	31,892	43,971	8,178,606	[6] 11,670,826
Virginia	55,000	6,655	1,803	241,602	15,991	2,974,326	3,227,673
Total, 1941	28,404,000	3,436,884	4,475	599,650	199,809	36,190,180	40,816,064
	27,132,000	3,201,576	5,513	628,482	191,310	29,484,423	34,159,265

[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, excluding the magnetite-pyrite-chalcopyrite ore from Pennsylvania, increased 10 percent in 1942 over 1941 to 4,166,226 tons, the highest annual production in the 37-year period (1906–42) for which complete data are available. Eight large, well-equipped zinc and zinc-lead mines in New Jersey, New York, Tennessee, and Virginia and three copper-iron sulfide mines in the Ducktown (Tenn.) district together yielded 96 percent of the total ore in 1942; all were operated at a high production rate, and some were operated beyond their normal capacity to provide the maximum quantity of metals needed for war purposes. War conditions caused a general shutdown of mines producing gold ores. 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 a residue which is further treated for the recovery of other metals; and zinc ore milled in Tennessee yields a commercial tailing, some of which is sold for its lime content and some for use in concrete. 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 1942, 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	106,555	11 861	7,606	1,000		
Copper ore	843,995	260	40,425	[1]28,351,000		[2]
Magnetite-pyrite-chalcopyrite ore	[3]	2,499	15,501	[1]		
Lead ore	4,627				200	
Zinc ore	2,364,229					150,270
Zinc-lead ore	846,820	10	41,773	52,000	4,275	[2] 49,539
Total, lode mines	[4] 4,166,226	14,630	105,305	28,404,000	4,475	199,809
Total, placers		69	2			
Total, 1941	[4] 4,166,226 [4] 3,780,397	14,699 21,982	105,307 106,051	28,404,000 27,132,000	4,475 5,513	199,809 191,310

[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 principal development in zinc-ore concentration during the past 7 years has been the increased tonnage treated at Mascot, Tenn., by the differential-density process of gravity concentration. This process is used as the first step in concentration and discharges a large part of the crushed mine ore at a coarse size as a finished tailing, thus reducing the quantity to be treated by jigging, fine grinding, and flotation.

The methods of recovering gold and silver in the Eastern States in 1942 are shown in the following table.

Mine production of gold and silver in the Eastern States in 1942, 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	371	119	87
Ore cyanided	105,726	11,302	7,312
Concentrates smelted [1]	77,032	2,668	91,945
Ore smelted [1]	20,812	541	5,961
Placer		69	2
Total, 1941		14,699	105,307
		21,982	106,051

[1] Excludes material containing no recoverable gold or silver. The totals for concentrates and direct-smelting ore shipped were 703,771 and 99,296 tons, respectively.

REVIEW BY STATES

ALABAMA

A lessee at the Hog Mountain mill dump in Alabama near Alexander City, Tallapoosa County, recovered 1 ounce of gold from old tailings in 1942.

GEORGIA

There was little activity at gold mines in Georgia in 1942. Of the 30 ounces of gold produced, 15 ounces came from scattered placer mines in Cherokee and Lumpkin Counties and 15 ounces from lode mines on the Brand Estate and Dean Hole properties in Cherokee County and the Russell property in Paulding County. Seven ounces of silver were recovered from the gold bullion and retorts shipped during the year.

NEW JERSEY

Zinc production in New Jersey was approximately the same in 1942 as in 1941. The producing mines in both years were the Mine Hill and the Sterling Hill at Franklin and Ogdensburg, respectively, in Sussex County. The commercial minerals in the ore are franklinite, willemite, and zincite. Each mine is equipped with a mill. In treatment, 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 are shipped to company plants at Palmerton, Pa. Part of the zinc is recovered as metal and part in oxide.

The value of the New Jersey output of zinc given in the table of this chapter under the heading Mine Production by States is the combined value of the zinc recoverable in both metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

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 mine production of recoverable zinc in New York increased 19 percent in 1942 over 1941, lead 16 percent, and silver 6 percent. The silver and lead and most of the zinc came from the Balmat mine

in St. Lawrence County about 8 miles southeast of Gouverneur. This mine and the Edwards about 12 miles northeast of the Balmat are owned and operated by the St. Joseph Lead Co. The Balmat ore contains zinc, iron, and lead sulfides, and some silver is associated with the lead; it is mined through a 2,655-foot inclined shaft (vertical depth, about 1,300 feet) and treated in the selective flotation plant at the mine. The daily capacity of the mill at the end of 1942 was 1,200 tons. The mill feed in 1942 totaled 380,893 tons (44,622 tons more than in 1941); it yielded 4,165 tons of lead concentrates containing 60.23 percent lead and 10.12 ounces of silver to the ton, 62,560 tons of zinc concentrates containing 56.47 percent zinc, and 77,087 tons of pyrite concentrates containing 41.18 percent iron and 49.41 percent sulfur. The Edwards mine and flotation mill were also operated at a higher rate than in 1941. The mine has a vertical shaft to the 1,500-foot level and an inclined shaft 1,361 feet long, of which 149 feet were sunk in 1942. Ore treated totaled 151,403 tons yielding 25,229 tons of zinc concentrates containing 58.97 percent zinc. The zinc concentrates from both mills were shipped to the company electrothermic zinc-reduction plant at Josephtown, Pa. Part of the lead concentrates from the Balmat mill were shipped to the company smelter at Herculaneum, Mo., and part to the U. S. Metals Refining Co. plant at Carteret, N. J. The pyrite concentrates were sold to sulfuric acid plants. The Universal Exploration Co. operated its Hyatt zinc mine and 200-ton flotation mill near Emeryville from January to August; mining and milling were suspended the rest of the year but were resumed in February 1943. The concentrates produced were shipped to the Donora (Pa.) smelter.

Development of the zinc and lead deposits in St. Lawrence County was begun in 1911, and the State became an important producer of zinc in 1915. The following table gives the annual output of silver, lead, and zinc from 1928 to 1942.

Mine production of silver, lead, and zinc in New York, 1928–42, in terms of recovered metals [1]

Year	Ore and old tailings treated (short tons)	Silver (fine ounces)	Lead (short tons)	Zinc (short tons)	Total value
1928	125,192			11,257	$1,373,354
1929	149,183			10,250	1,353,000
1930	270,601		1,158	22,471	2,273,016
1931	269,582		1,573	24,100	1,948,002
1932	189,679		1,280	16,794	1,084,440
1933	180,670		990	17,733	1,562,832
1934	282,952	26,406	1,690	23,188	2,136,299
1935	295,179	21,750	1,285	23,720	2,205,793
1936	377,451	18,251	1,120	26,941	2,811,275
1937	464,870	41,500	2,280	32,690	4,550,840
1938	385,600	37,200	2,005	29,896	3,078,524
1939	420,000	37,250	2,387	36,014	3,995,119
1940	432,219	35,720	1,973	35,686	4,719,137
1941	488,079	37,734	2,100	38,446	6,033,133
1942	548,816	40,012	2,434	45,807	8,874,711

[1] No output of gold or copper was recorded in New York during this period.

There are no zinc or lead smelters in New York. The Phelps Dodge Refining Corporation has a custom copper smelter and an electrolytic refinery at Laurel Hill which treat copper ore, matte, bullion, and copper-bearing scrap material.

NORTH CAROLINA

Gold production in North Carolina increased 26 percent in 1942 over 1941, silver increased 11 percent, and copper decreased 10 percent. The increase in gold resulted from continuous operation from January to about October 15 of the Condor (old Howie) mine at Waxhaw in Union County, operated under lease by Hugh Jardine. This mine was reopened in 1940, and the ore produced in that year was shipped to the Capps cyanide mill at Charlotte for treatment. Operations during the first part of 1941 were confined to development work and the building of a 100-ton countercurrent cyanide mill on the property. The mill was placed in operation on July 15, 1941, and ran steadily until October 1942, when both mine and mill were closed in compliance with the Gold-Mining Limitation Order of the War Production Board. The total production in the 3 years was 42,018 tons of ore, yielding 8,967 fine ounces of gold and 6,073 fine ounces of silver valued in all (on the basis of mint returns) at $318,187. Scattered small shippers of amalgam retorts and gold dust to the Philadelphia Mint and New York Assay Office during 1942 were: Wright Mines, Inc., in Franklin County; Passavant Bros., Enfield, Halifax County; Joe Rogers, near Indian Trail, and John L. James, Charlotte, both in Mecklenburg County; and C. F. Crisson, Nebo, McDowell County.

Copper output from the Fontana copper mine in Swain County decreased in 1942. The mine is operated by the North Carolina Exploration Co., which ships the crude ore to the Tennessee Copper Co. smelter at Copperhill, Tenn. The ore contains very small quantities of gold and silver, some of which are recovered as byproducts in refining the copper bullion. E. C. McSwain sank a 40-foot shaft at a prospect on his property in Chatham County near Hemp and shipped 33 tons of copper-silver ore to the U. S. Metals Refining Co. at Carteret, N. J., and 100 tons (wet weight) to the Daugherty Chemical Co., Troy, N. C. Diamond drilling was done on the old Silver Hill property in Davidson County, which has produced zinc-lead ore containing copper, gold, and silver.

PENNSYLVANIA

The Bethlehem Steel Co. continued in 1942 to recover gold, silver, and copper as byproducts of iron mining at its Cornwall mine in Lebanon County, Pa. The mine is developed by an open pit and three inclined shafts, which had reached a depth of 1,700 feet at the end of the year. The ore minerals are magnetite, pyrite, and chalcopyrite (carrying a little gold and silver). The ore-treatment plants comprise a 6,500-ton magnetic separation plant producing iron concentrates, a 2,400-ton sintering plant for handling the iron concentrates, and a 2,800-ton flotation mill in which the tailings from the magnetic plant are concentrated to recover copper, gold, and silver. The quantity of each of these metals recovered was larger in 1942 than in 1941.

SOUTH CAROLINA

Although gold production in South Carolina declined 50 percent in 1942 from 1941, the State continued to rank first among the Eastern States in gold output. Operations at the old Haile mine

near Kershaw, which contributed the bulk of the State output from 1937 to 1942, inclusive, were suspended in September 1942, presumably for the duration of the war. The ore was mined chiefly from open pits and was treated in the 400-ton cyanide mill on the property. The total production from the mine in the 6-year period ended 1942 was 538,046 tons of ore yielding 60,013 fine ounces of gold and 27,048 fine ounces of silver having a total net value (based on mint returns) of $2,115,079. Small tonnages of gold ore containing a little silver and copper were shipped to the U. S. Metals Refining Co. smelter at Carteret, N. J., by L. M. Martin of Kings Creek and E. R. Vreeland of Smyrna. W. K. Hunter shipped 214 tons of gold ore from Hickory Grove to the Tennessee Copper Co. smelter at Copperhill, Tenn.

TENNESSEE

Zinc production (in terms of recovered metal) in Tennessee in 1942 totaled 43,971 tons and exceeded the previous record annual output of 1941 by 7,801 tons. The output of recovered copper and lead also increased, but that of gold and silver decreased. The gold and 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 iron and steel producers, mostly in the Birmingham (Ala.) district. The zinc concentrates produced in the mills were sold to the Donora (Pa.) smelter. The copper-iron sulfide concentrates and direct-smelting crude ore were treated in the company Copperhill smelter, which also treated copper-iron sulfide ore from the Fontana mine in Swain County, N. C. The crude copper ore is treated in the reverberatory furnace, yielding matte which is sent to the converter. The concentrates are fed directly into the converter. Most of the blister copper from the converter is cast into pigs and shipped to an electrolytic refinery on the Atlantic seaboard, where the byproduct gold and silver are recovered. Shot copper is produced for use in the copper sulfate plant. Two blast furnaces maintained as stand-by equipment are operated when the company desires to increase production of sulfuric acid. In 1942 the company operated the Burra Burra, Eureka, and Boyd groups of mines and the London and Isabella selective flotation mills. The rated daily capacity of the mills at the end of the year was 1,450 and 1,050 tons, respectively. The ore is hoisted through vertical shafts, one of which is 2,400 feet deep. Development done in 1942 totaled 383 feet of shaft, 17,307 feet of drifts, and 14,802 feet of diamond drilling.

From 1928 to 1939, inclusive, the Bureau of Mines was not at liberty to publish separate State totals for lead and zinc production in some of the Eastern States, and the figures for those States were combined under Tennessee in the chapters of this series. As separate State totals may now be published for Tennessee and Virginia, the totals for Tennessee from 1928 to 1942 are shown in the accompanying table. Figures for Virginia are given in the following review for that State.

Mine production of lead and zinc in Tennessee, 1928–42, in short tons, in terms of recovered metals

Year	Ore [1] sold or treated	Lead	Zinc [1]	Year	Ore [1] sold or treated	Lead	Zinc [1]
1928	570, 199	----------	14, 597	1936	849, 833	805	23, 830
1929	682, 680	----------	19, 805	1937	987, 256	405	29, 335
1930	709, 760	13	22, 606	1938	909, 700	553	29, 810
1931	779, 500	215	25, 320	1939	1, 083, 900	517	32, 375
1932	631, 400	430	12, 841	1940	1, 216, 044	573	34, 796
1933	652, 820	296	21, 442	1941	1, 300, 916	23	36, 170
1934	828, 215	340	25, 972	1942	1, 560, 259	238	43, 971
1935	750, 440	190	23, 102				

[1] Ore figures exclude copper ore, from which some zinc was recovered as a byproduct each year from 1930 to 1942, inclusive. Such byproduct zinc is included in zinc figures.

Most of the zinc output of Tennessee in 1942, as in 1941, came from four mines in Knox and Jefferson Counties. Three of these—Mascot No. 2, Jarnagin, and Grasselli—were operated by the American Zinc Co. of Tennessee. 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 one operating shaft and an auxiliary manway shaft and is 350 feet deep. The Jarnagin has one operating shaft 280 feet deep, with an auxiliary manway shaft. All the mines are fully mechanized, and slushing is the principal method of loading. Development done at the three mines in 1942 totaled 5,419 feet of drifts, 8,516 feet of diamond drilling, and 25,877 feet of churn drilling. The crude ore from all three mines was treated in the company mill at the Mascot No. 2 mine at Mascot. The ore from the Grasselli and Jarnagin—12 and 16 miles, respectively, east of Mascot—was transported to the mill over the Southern Railway. The mill is equipped with a differential-density cone unit, jigs, and flotation machines. It treated 1,263,039 tons of crude ore in 1942, and its total output of zinc concentrates was 55,831 tons—a 25-percent increase over 1941. The company planned to open a fourth mine—the newly developed Carson Newman (Athletic Field) at Jefferson City—in 1943; the ore will be shipped to the Mascot mill. The other large zinc producer in 1942 was the Davis property of the Universal Exploration Co. at Jefferson City, which is equipped with an 800-ton flotation mill for treating sulfide ore and a small plant for concentrating carbonate ore. The flotation mill was operated at near capacity throughout the year, and the carbonate plant treated a small tonnage daily. The output of both sulfide and carbonate concentrates was larger than in 1941. The average grade of the blende shipped in 1942 was 64.53 percent zinc. The Embree Iron Co. produced several cars of zinc and lead carbonate concentrates monthly from April through December at its property near Embreeville, Washington County. In Claiborne County the Imperial Mining Co. operated the Bunche's Hollow mine 2 miles northwest of Goin during part of 1942; the mine is equipped with a small jig mill. Dr. Gant Gaither shipped 324 tons of 58-percent zinc concentrates from the Hoover mine 10 miles northeast of Murfreesboro; the ore was concentrated in a 4-cell jig. George Blow shipped ore from a prospect on his property in Union County to the flotation mill at the Austinville (Va.) mine.

VERMONT

In August 1942 the Vermont Copper Co., Inc., entered into a contract with the Metals Reserve Co. to reopen and reequip the Elizabeth copper mine near South Strafford, Orange County, and operate it for 2½ years. The copper produced is to be sold to the Metals Reserve Co. Construction of a 500-ton concentration mill and reequipment of the mine was begun in October. The mine had not been worked since June 1930. The ore minerals are chalcopyrite and pyrrhotite, carrying some silver.

VIRGINIA

Gold mines operating in Virginia in 1942 were the Red Bank lode mine 5 miles north of Virgilina, Halifax County, equipped with a small amalgamation mill, and the Ruth placer mine on Byrd Creek in Goochland and Fluvanna Counties, equipped with a dragline and portable washing plant; each of the mines operated about 3 months, and their combined output was 99 ounces of gold and 32 ounces of silver. Some gold and silver were recovered from zinc-lead-iron-copper-silver-gold ore from the old Valzinco mine 6 miles southeast of Paytes post office, Spotsylvania County, which was reopened during the year by Panaminas, Inc., subsidiary of Ventures, Ltd. The company built a 100-ton selective flotation mill at the mine and began treating ore in September. The products of the mill were zinc concentrates, carrying lead, copper, silver, and gold; and lead concentrates, carrying copper, zinc, silver, and gold. Several hundred tons of the zinc concentrates were shipped to the American Zinc & Chemical Co. smelter at Langeloth, Pa., in 1942.

The total output of recoverable lead in Virginia in 1942 was 1,803 tons and that of zinc 15,991 tons compared with 1,916 and 18,483 tons, respectively, in 1941. The foregoing 1941 figures for recoverable lead and zinc represent actual mine production during the year and are lower than those representing mine shipments given in Minerals Yearbook, 1941, which include 4,430 tons of zinc and 1,474 tons of lead contained in concentrates shipped from stocks accumulated before 1941 but not previously included in the annual production statistics. The bulk of the State output of lead and zinc from 1928 through 1942 came from the Austinville mine in Wythe County. In 1942 the mine operated two shifts a day, 6 days a week. The ore was treated in the 2,000-ton selective flotation mill at the mine. After April the mill also handled small tonnages monthly of purchased crude ore. The Lacy-Butler Co. shipped 708 tons of zinc carbonate ore to the smelters at Palmerton, Pa., and Meadowbrook, W. Va., from the leased Little Wythe mine at Cripple Creek, also in Wythe County.

The following table shows mine production of gold, silver, copper, lead, and zinc in Virginia, 1928–42; the Bureau of Mines has not been at liberty heretofore to show the annual figures for 1928 to 1939, inclusive.

Mine production of gold, silver, copper, lead, and zinc in Virginia, 1928–42, in terms of recovered metals

Year	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (short tons)	Zinc (short tons)	Total value
1928	509,217				5,824	18,320	$2,910,624
1929	501,200				6,336	20,753	3,537,732
1930	572,540				7,196	25,541	3,171,536
1931	502,150				6,186	12,992	1,445,156
1932	304,773	31	8		2,750	5,673	506,019
1933	247,530	32			1,830	11,328	1,087,796
1934	263,144	667	103	400	1,595	21,740	2,011,084
1935	318,721	653	55	700	3,507	25,730	2,567,738
1936	491,830	909	96		4,070	21,086	2,514,929
1937	587,469	1,396	111	1,000	2,854	25,920	3,755,442
1938	649,436	2,943	502	47,300	5,338	26,956	3,186,837
1939	653,581	364	1,780		3,380	23,850	2,812,068
1940	602,239	458	271		2,285	16,927	2,377,525
1941	502,130	240	135		3,390	22,913	3,831,906
1942	462,981	109	1,793	55,000	[1] 1,803	[1] 15,991	3,227,673

[1] Actual production during year; figures for some of the earlier years represent mine shipments.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

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SUMMARY

The total value of gold, silver, copper, lead, and zinc produced by Idaho mines was $46,063,326 in 1942 compared with $41,776,848 in 1941—a 10-percent increase (see fig. 1). The value of the gold output was $3,325,700 (7 percent of the State total), silver $10,414,144 (nearly 23 percent), copper $830,060 (2 percent), lead $15,263,806 (33 percent), and zinc $16,229,616 (35 percent). Production of lead in Idaho in 1942 (227,818,000 pounds) was the largest since 1930, and the output of zinc (174,512,000 pounds) was by far the greatest in any year in the history of the State. Compared with 1941 the gold output decreased nearly 37 percent, silver 12 percent, and copper 5 percent; lead increased more than 8 percent and zinc 10 percent.

The production of copper, lead, and zinc in Idaho in 1942 was affected by several factors. The Metals Reserve Co. announced that, effective February 1, 1942, premiums amounting to 5 cents a pound for copper and 2¾ cents a pound for both lead and zinc would be paid for these metals produced in excess of certain fixed basic quotas. The basic quota of each mine was fixed according to 1941 output; however, several zinc-lead producers in Idaho, particularly in the Coeur d'Alene region, could not maintain their 1941 production rate, and during the fall of 1942 lower basic production quotas were granted to certain companies. Also, effective December 1, 1942, the Metals Reserve Co. announced that it would pay an additional premium of 2¾ cents a pound for lead and two additional premiums of 2¾ cents a pound for zinc for overquota metal production.

A labor shortage began in April at the mines, mills, and smelters in Idaho, resulting from men leaving to take jobs on Government construction projects and in war industries where abnormally high wages were paid. This shortage became so acute during the summer that some mines closed and others curtailed output 50 percent. The seriousness of the condition was recognized by the War Department, which furloughed about 800 soldiers in October for service in Idaho mines. This action tended to relieve the shortage but did not insure an adequate labor supply.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan, 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1938–42, and total, 1863–1942, 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
1938	305	463	1,999,147	103,513	$3,622,955	18,993,676	$12,278,740
1939	362	465	2,108,445	116,662	4,083,170	17,222,370	11,690,336
1940	378	548	2,556,687	146,480	5,126,800	17,552,240	12,481,593
1941	331	524	2,704,680	149,816	5,243,560	16,672,410	11,855,936
1942	203	236	2,900,704	95,020	3,325,700	14,644,890	10,414,144
1863–1942			(1)	7,724,178	173,485,633	484,219,847	332,614,231

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	7,242,000	854,556	209,828,000	11,960,196	158,168,000	11,862,600	41,776,848
1942	6,860,000	830,060	227,818,000	15,263,806	174,512,000	16,229,616	46,063,326
1863–1942	[2] 101,189	31,142,807	[2] 5,631,963	603,194,868	[2] 960,623	135,022,899	1,275,460,438

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Idaho, 1938–42, 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
1938	4,987	969	410	57	1,989	384	15,459	5,818	31,234	10,100	54,079	17,328
1939	5,443	1,638	196	26	4,475	1,332	9,576	4,389	28,973	7,490	48,663	14,875
1940	6,664	1,337	291	48	5,623	758	6,569	5,427	41,262	10,226	60,409	17,796
1941	4,899	1,149	228	46	3,185	388	11,725	2,100	52,358	13,725	72,395	17,408
1942	1,197	234	83	7	563	60	6,126	879	36,611	9,291	44,580	10,471

[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."

Gold.—The output of recoverable gold in Idaho was nearly 37 percent less in 1942 than in 1941. This decrease is attributed in part to the gold-mine closing order issued by the Government in October; but several large gold producers, both lode and placer, had shut down before the closing order was issued, owing to difficulty of obtaining labor and supplies. The yield of gold from lode mines decreased 35 percent and that from placers 38 percent. About 37 percent of the State total gold in 1942 came from siliceous gold ore and more than 45 percent from all types of dredging operations. Ten floating (bucket) dredges, 2 less than in 1941, treated 7,772,947 cubic yards of gravel and recovered 36,611 ounces of gold—a decrease of 15,747 ounces from 1941; 7 dragline dredges and 5 dry-land dredges treated 1,175,937 cubic yards of gravel and recovered 6,689 ounces of gold—a decrease of 8,221 ounces. Of the total placer gold, 91 percent came from the Boise Basin, Elk City, Gibbonsville, Hoodoo, Middle Boise, and Yankee Fork districts, where dredges were operated. Nearly half of the total lode gold came from the Middle Boise (Atlanta) district. Large decreases in output of gold were made in the Elk City, Boise Basin, Yellow Pine, Yankee Fork, Warren, and Burgdorf-Marshall Lake districts.

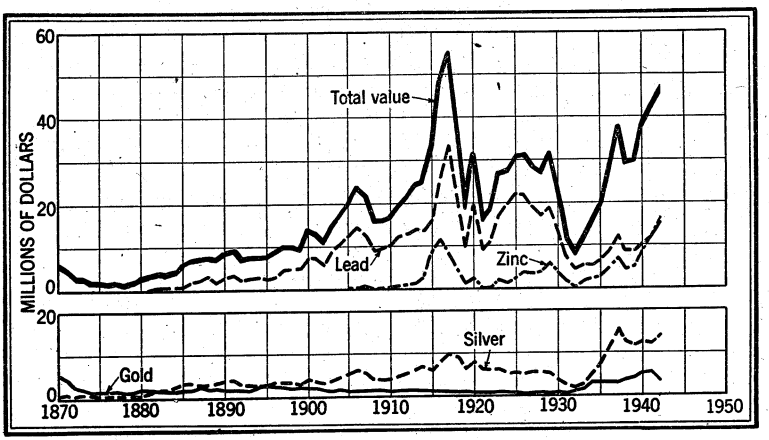

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1942. The value of copper has been less than $2,000,000 annually, except in a few years.

Talache Mines, Inc., operating a lode property at Atlanta, was by far the largest gold producer in Idaho. It was followed by the Fisher-Baumhoff Co., operating two bucket dredges near Centerville; Boise King Placers, operating a bucket dredge near Twin Springs; Northwest Goldfields bucket dredge near Harvard; Idaho-Canadian Dredging Co. bucket dredge at Idaho City; Snake River Mining Co., operating a bucket dredge at Sunbeam; Triumph lode mine near Ketchum; and De Lamar Milling Corporation at De Lamar.

Silver.—The output of recoverable silver in Idaho was 14,644,890 fine ounces in 1942—a 12-percent decrease from 1941. Production from the Sunshine mine, largest silver producer in the United States, declined more than 2,000,000 ounces. The Coeur d'Alene region produced nearly 89 percent of the State total silver in 1942; the rest came largely from the Warm Springs, Carson, Bayhorse, South

Mountain, Yellow Pine, and Middle Boise districts. Silver ore yielded 51 percent of the State total silver, zinc-lead ore 37 percent, lead ore 8 percent, and gold-silver ore and gold ore 3 percent. The yield of silver from silver ore decreased 2,340,416 ounces, but that from zinc-lead ore increased 404,842 ounces and from lead ore 60,433 ounces.

Eight mines—the Sunshine, Bunker Hill & Sullivan, Mineral Point, Hecla, Polaris, Triumph, Morning, and Page—produced 81 percent of the silver output of the State during 1942. All these mines except the Triumph are in the Coeur d'Alene region.

Copper.—The output of recoverable copper in Idaho in 1942 was 6,860,000 pounds—a 5-percent decrease from 1941. The loss resulted mainly from decreased output of silver-copper ore and copper ore. Silver ore (chiefly from mines in the Coeur d'Alene region) yielded 69 percent of the State total copper, zinc-lead ore 23 percent, copper ore 3 percent, zinc ore 3 percent, and lead ore 2 percent.

The Mineral Point and Sunshine mines produced 64 percent of the total copper output of the State in 1942.

Lead.—The output of recoverable lead in Idaho was 227,818,000 pounds in 1942—an increase of more than 8 percent over 1941. Marked increases in lead output at the Hecla, Page, Sherman, Bunker Hill & Sullivan, Dayrock, and Star properties more than offset large decreases at the Morning and Triumph mines. About 93 percent of the State total lead came from the Coeur d'Alene region; most of the remainder was produced in the Warm Springs, Bayhorse, Port Hill, and Pend d'Oreille districts. Zinc-lead ore and old tailings from the Coeur d'Alene region yielded 81 percent of the State total lead; and lead ore, chiefly from the Coeur d'Alene region, yielded 14 percent. Lead recovered from zinc-lead ore increased 13,185,657 pounds and from lead ore 4,824,358 pounds.

In 1942 the combined lead output of the three largest producers—the Bunker Hill & Sullivan, Hecla, and Morning—was 131,219,137 pounds (127,137,585 pounds in 1941), or more than 57 percent of the State total; other important producers were the Page, Star, Sherman, Tamarack, Triumph, Dayrock, Clayton, and Gold Hunter properties.

Zinc.—The output of recoverable zinc in Idaho was 174,512,000 pounds in 1942—a 10-percent increase over the former record output (1941). The gain was due principally to increased output of zinc from mines in the Coeur d'Alene region, especially from the Hecla, Star, Page, Tamarack, and Spokane-Idaho properties; however, a substantial decrease was reported from the Bunker Hill & Sullivan mine. Nearly 90 percent of the State total zinc in 1942 came from the Coeur d'Alene region and nearly all the remainder from the Warm Springs, South Mountain, Bayhorse, Deadwood Basin, and Alder Creek districts. Zinc-lead ore and old tailings concentrated yielded 97 percent of the State total zinc, and zinc ore concentrated most of the remainder.

Seven mines—the Star, Morning, Hecla, Bunker Hill & Sullivan, Tamarack, Triumph, and Page—produced 82 percent of the State total zinc in 1942.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1942, 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	1	4	516	$18,060	152	$108
Adams	4		16	560	547	389
Benewah		2	14	490		
Blaine	25		5,059	177,065	652,590	464,064
Boise	15	38	14,731	515,585	37,052	26,348
Bonner	4		3	105	54,699	38,897
Bonneville		2	33	1,155		
Boundary	1		11	385	39,673	28,212
Butte	4		2	70	1,551	1,103
Camas	4	2	265	9,275	8,827	6,277
Clark	1				66	47
Clearwater		12	22	770	7	5
Custer	19	5	6,190	216,650	215,003	152,891
Elmore	9	15	29,576	1,035,160	96,878	68,891
Gem	3	2	2,917	102,095	21,496	15,286
Idaho	29	69	12,774	447,090	8,280	5,888
Jerome		12	38	1,330		
Kootenai	1				14	10
Latah		4	6,021	210,735	329	234
Lemhi	17	32	6,843	239,505	42,200	30,009
Lewis		2	2	70		
Nez Perce		1	3	105		
Owyhee	10	8	3,548	124,180	329,071	234,006
Shoshone	49	7	2,688	94,080	12,977,287	9,228,293
Twin Falls		13	37	1,295	7	5
Valley	5	5	3,708	129,780	152,380	108,359
Washington	2	1	3	105	6,781	4,822
Total, 1941	203	236	95,020	3,325,700	14,644,890	10,414,144
	331	524	149,816	5,243,560	16,672,410	11,855,936

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada							$18,168
Adams	35,900	$4,344					5,293
Benewah							490
Blaine	340,000	41,140	7,646,400	$512,309	12,593,000	$1,171,149	2,365,727
Boise	2,100	254	25,000	1,675			543,862
Bonner	2,200	266	780,600	52,300			91,568
Bonneville							1,155
Boundary	16,000	1,936	2,088,000	139,896			170,429
Butte			70,400	4,717	27,700	2,576	8,466
Camas	700	85	15,300	1,025	300	28	16,690
Clark			13,300	891			938
Clearwater							775
Custer	156,000	18,876	3,317,000	222,239	1,608,000	149,544	760,200
Elmore							1,104,051
Gem	11,000	1,331	90,700	6,077	5,000	465	125,254
Idaho	3,100	375	2,400	161			453,514
Jerome							1,330
Kootenai			900	60			70
Latah							210,969
Lemhi	73,000	8,833	444,000	29,748	72,000	6,696	314,791
Lewis							70
Nez Perce							105
Owyhee	193,200	23,377	124,700	8,355	2,970,000	276,210	666,128
Shoshone	5,986,000	724,306	212,947,000	14,267,449	156,625,000	14,566,125	38,880,253
Twin Falls							1,300
Valley	26,000	3,146	247,600	16,589	611,000	56,823	314,697
Washington	14,800	1,791	4,700	315			7,033
Total, 1941	6,860,000	830,060	227,818,000	15,263,806	174,512,000	16,229,616	46,063,326
	7,242,000	854,556	209,828,000	11,960,196	158,168,000	11,862,600	41,776,848

Gold and silver produced at lode mines in Idaho in 1942, 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	40	20	121	Gem	6,843	2,909	21,496
Adams	89	16	547	Idaho	12,053	3,867	6,421
Blaine	114,938	5,059	652,590	Kootenai	2		14
Boise	1,473	1,597	33,795	Lemhi	48,307	2,312	41,864
Bonner	12,092	3	54,699	Owyhee	83,522	3,530	329,040
Boundary	41,353	11	39,673	Shoshone	2,327,417	2,626	12,977,280
Butte	1,759	2	1,551	Valley	114,128	3,660	152,349
Camas	404	263	8,827	Washington	310	2	6,781
Clark	24		66				
Custer	47,961	1,397	212,587		2,900,704	50,440	14,634,419
Elmore	87,989	23,166	94,718	Total, 1941	2,704,680	77,421	16,655,002

Gold and silver produced at placer mines in Idaho in 1942, 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
Ada	4				492	31					496	31
Benewah	14										14	
Boise	389	78					79	23	12,666	3,156	13,134	3,257
Bonneville	33										33	
Camas	2										2	
Clearwater	17	4			5	3					22	7
Custer	6	4							4,787	2,412	4,793	2,416
Elmore	64	11							6,346	2,149	6,410	2,160
Gem	8										8	
Idaho	346	73	15		61	11	3,581	653	4,904	1,122	8,907	1,859
Jerome	38										38	
Latah	13								6,008	329	6,021	329
Lemhi	144	10	21				2,466	203	1,900	123	4,531	336
Lewis	2										2	
Nez Perce	3										3	
Owyhee	13	16			5	15					18	31
Shoshone	15		47	7							62	7
Twin Falls	37	7									37	7
Valley	48	31									48	31
Washington	1										1	
	1,197	234	83	7	[2] 563	[2] 60	[3] 6,126	[3] 879	[4] 36,611	[4] 9,291	44,580	10,471
Total, 1941	4,899	1,149	228	46	3,185	388	11,725	2,100	52,358	13,725	72,395	17,408

[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 75,362 cubic yards of gravel treated by 5 dry-land dredges.
[3] Recovered from 1,100,575 cubic yards of gravel treated by 7 dragline floating dredges.
[4] Recovered from 7,772,947 cubic yards of gravel treated by 10 floating bucket dredges.

MINING INDUSTRY

The marked increase in output of lead, zinc, antimony, and tungsten, the closing of gold properties in October by Government order, and the serious shortage of labor at mines, mills, and smelters in the Coeur d'Alene region during the summer were the most important features of the mining industry of Idaho during 1942. The production of zinc, antimony, and tungsten was greater than in any year in the history of the State, and the output of lead was the largest since 1930. Zinc-lead ore (by far the chief output of the State) increased 15 percent over 1941 and lead ore nearly 48 percent; gold ore and gold-silver ore combined declined 23 percent, silver ore more than 6 percent, copper ore 72 percent, and zinc ore 9 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 1942, 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	88	142,952	35,452	130,336	19,763	99,689	
Dry and siliceous gold-silver ore	7	173,389	7,494	358,263	3,291	60,526	
Dry and siliceous silver ore	18	458,533	331	7,528,893	4,721,804	1,264,769	
	[1] 112	774,874	43,277	8,017,492	4,744,858	1,424,984	
Copper ore	8	2,210	153	27,390	190,653	8,090	
Lead ore	40	313,317	313	1,103,683	153,272	31,978,714	132,762
Lead-copper ore	1	83		12,354	7,262	36,515	
Zinc ore	8	20,561	222	127,670	195,608	261,057	4,355,608
Zinc-lead ore	52	1,789,659	6,475	5,345,830	1,568,347	194,108,640	170,023,630
Total, lode mines	[1] 203	2,900,704	50,440	14,634,419	6,860,000	227,818,000	174,512,000
Total, placers	236		44,580	10,471			
Total, 1941	439	2,900,704	95,020	14,644,890	6,860,000	227,818,000	174,512,000
	855	2,704,680	149,816	16,672,410	7,242,000	209,828,000	158,168,000

[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 2,900,704 tons of ore produced in 1942 in Idaho, 2,762,323 tons (95 percent) were treated at concentration plants, 111,772 tons (4 percent) were treated at amalgamation and cyanidation mills, and 26,609 tons (1 percent) were shipped crude to smelters.

Ore treated at concentration plants in 1942 comprised 32,138 tons of gold ore, 168,913 tons of gold-silver ore, 447,130 tons of silver ore, 560 tons of copper ore, 306,083 tons of lead ore, 17,906 tons of zinc ore, and 1,789,593 tons of zinc-lead ore.

Ore treated at straight amalgamation mills in 1942 totaled 11,402 tons, and ore treated at combined amalgamation and concentration plants comprised 97,670 tons. Ore treated at straight cyanidation plants in 1942 totaled 700 tons, and ore treated at combined cyanidation and concentration plants comprised 2,000 tons.

The lead smelter and refinery and the antimony plant of the Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley were operated at capacity in 1942 on ore and concentrates, chiefly from mines and mills in the Coeur d'Alene region. The 100-ton electrolytic zinc plant of the Sullivan Mining Co. near Bradley operated at capacity on concentrates from the same source.

In April 1943, the Bunker Hill & Sullivan Mining & Concentrating Co. completed its zinc-fuming plant at Bradley. According to a report by P. C. Fedderson, smelter superintendent at the Bunker Hill lead smelter, the operation will follow closely that practiced for some years by the Anaconda Copper Mining Co. at East Helena, Mont. The plant will treat all current hot slag and in addition cold reclaimed dump slag; it is expected to handle approximately 400 tons of slag a day, and this will produce about 50 tons of oxide fume containing 30 to 35 tons of zinc and about 5 tons of lead. That portion of the existing slag dump which can be re-treated economically for zinc recovery

contains about 1,000,000 tons, with an average zinc content of 10 percent. In September 1942 the Sunshine Mining Co. completed an electrolytic antimony plant (100-ton capacity) adjoining its concentration mill near Kellogg to recover antimony from silver-copper-antimony concentrates.

Mine production of metals in Idaho in 1942, 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	109,072	16,580	8,531			
Ore cyanided	2,700	391	3,304			
Concentrates smelted	406,954	30,649	14,319,082	6,636,794	221,566,560	173,810,377
Ore smelted	26,609	2,820	303,502	223,206	6,251,440	701,623
Placer		44,580	10,471			
		95,020	14,644,890	6,860,000	227,818,000	174,512,000
Total, 1941		149,816	16,672,410	7,242,000	209,828,000	158,168,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Idaho in 1942, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ada	40	10	1	2	10	120		
Boise	1,139	663	258	2	10	2		
Custer	3,230	292	502	38	419	12,404		
Elmore	87,784	12,676	6,466	1,552	10,416	88,167		
Idaho	6,604	1,874	650	82	934	4,238	1,300	400
Lemhi	541	85	13					
Owyhee	234	37	32	9	37	170		
Valley	9,500	943	609					
	109,072	16,580	8,531	1,685	11,826	105,101	1,300	400
Total, 1941	173,321	20,874	12,883	2,570	18,065	167,010	8,500	3,300

CYANIDATION MILLS

Custer	2,000	297	3,023	11	9	23		700
Idaho	220	44	257					
Lemhi	480	50	24					
	2,700	391	3,304	11	9	23		700
Total, 1941	6,182	659	1,486					
Grand total: 1942	111,772	16,971	11,835	1,696	11,835	105,124	1,300	1,100
1941	179,503	21,533	14,369	2,570	18,065	167,010	8,500	3,300

Mine production of metals from concentrating mills in Idaho in 1942, 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	111,111	28,949	4,219	637,273	332,115	7,553,263	12,585,705
Bonner	12,020	630	2	47,072	1,600	713,712	
Boundary	41,353	1,541	11	39,673	16,000	2,088,000	
Butte	1,759	113	2	1,551		70,400	27,700
Camas	5	2		101		702	300
Custer	38,638	3,570	53	141,173	24,544	2,978,312	1,095,000
Elmore	200	7	36	57			
Gem	6,791	2,122	2,906	21,421	10,868	89,700	5,000
Idaho	5,168	59	879	1,129	1,200	1,600	
Lemhi	45,900	1,065	2,050	33,113	68,200	89,400	
Owyhee	83,253	3,700	3,377	327,687	193,200	124,700	2,970,000
Shoshone	2,311,531	354,290	2,579	12,819,649	5,961,767	207,611,671	156,515,672
Valley	104,594	9,210	2,700	144,059	26,000	244,000	611,000
	2,762,323	405,258	18,814	14,213,958	6,635,494	221,565,460	173,810,377
Total, 1941	2,492,644	350,802	33,331	15,924,836	6,619,249	201,793,685	158,030,826

Gross metal content of concentrates produced from ores mined in Idaho in 1942, 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	5,018	18,341	121,707	16,693	110,458	
Dry gold-silver	7,876	5,092	314,016			
Dry silver	1	1	332			
Copper	8,091	164	6,374,672	4,719,226	215,338	
Lead	184,158	2,597	5,554,027	1,177,017	214,906,445	21,755,331
Lead-copper	2,686	323	960,127	508,500	643,104	265,664
Zinc	145,601	1,284	501,547	591,196	7,861,236	155,098,723
Zinc-lead	38,009	331	191,310	126,513	6,540,421	38,099,518
Dry iron (from zinc-lead ore)	15,514	2,516	301,344	231,838	388,467	712,576
	406,954	30,649	14,319,082	7,370,983	230,665,469	215,931,812
Total, 1941	353,372	51,396	16,091,846	7,496,404	210,025,930	192,921,203

Mine production of metals from Idaho concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	2	10	120			
Blaine	28,949	4,219	637,273	332,115	7,553,263	12,585,705
Boise	2	10	2			
Bonner	630	2	47,072	1,600	713,712	
Boundary	1,541	11	39,673	16,000	2,088,000	
Butte	113	2	1,551		70,400	27,700
Camas	-2		101		702	300
Custer	3,619	481	153,600	24,544	2,979,012	1,095,000
Elmore	1,559	10,452	88,224			
Gem	2,122	2,906	21,421	10,868	89,700	5,000
Idaho	141	1,813	5,367	2,500	2,000	
Lemhi	1,065	2,050	33,113	68,200	89,400	
Owyhee	3,709	3,414	327,857	193,200	124,700	2,970,000
Shoshone	354,290	2,579	12,819,649	5,961,767	207,611,671	156,515,672
Valley	9,210	2,700	144,059	26,000	244,000	611,000
	406,954	30,649	14,319,082	6,636,794	221,566,560	173,810,377
Total, 1941	353,372	51,396	16,091,846	6,627,749	201,796,985	158,030,826
BY CLASSES OF CONCENTRATES						
Dry gold	5,018	18,341	121,707	13,745	98,801	
Dry gold-silver	7,876	5,092	314,016			
Dry silver	1	1	332			
Copper	8,091	164	6,374,672	4,307,400	173,250	
Lead	184,158	2,597	5,554,027	996,769	206,332,549	
Lead-copper	2,686	323	960,127	438,782	614,092	
Zinc	145,601	1,284	501,547	553,034	7,327,017	139,524,410
Zinc-lead	38,009	331	191,310	113,853	6,208,738	34,285,967
Dry iron (from zinc-lead ore)	15,514	2,516	301,344	213,211	312,113	
	406,954	30,649	14,319,082	6,636,794	221,566,560	173,810,377

Gross metal content of Idaho crude ore shipped to smelters in 1942, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	2,266	1,541	3,193	6,303	1,352	
Dry and siliceous gold-silver	1,252	1,001	37,848	4,593	85,083	
Dry and siliceous silver	11,403	36	64,453	11,757	867,357	
Copper	1,650	151	27,310	167,221	12,128	
Lead	7,234	85	156,453	39,819	5,512,430	
Lead-copper	83		12,354	8,333	38,434	
Zinc	2,655	5	987	11,604	37,515	930,073
Zinc-lead	66	1	904	400	13,930	45,545
	26,609	2,820	303,502	250,030	6,568,229	975,618
Total, 1941	32,533	4,492	548,787	655,222	8,466,662	168,085

Mine production of metals from Idaho crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Adams	89	16	547	35,900		
Blaine	3,827	840	15,317	7,885	93,137	7,295
Boise	334	924	33,535	2,100	25,000	
Bonner	72	1	7,627	600	66,888	
Camas	399	263	8,726	700	14,598	
Clark	24		66		13,300	
Custer	4,093	327	55,462	131,456	337,988	513,000
Elmore	5	38	28			
Gem	52	3	75	132	1,000	
Idaho	61	136	147	600	400	
Kootenai	2		14		900	
Lemhi	1,386	127	8,714	4,800	354,600	72,000
Owyhee	35	79	1,151			
Shoshone	15,886	47	157,631	24,233	5,335,329	109,328
Valley	34	17	7,681		3,600	
Washington	310	2	6,781	14,800	4,700	
	26,609	2,820	303,502	223,206	6,251,440	701,623
Total, 1941	32,533	4,492	548,787	614,251	8,031,015	137,174

BY CLASSES OF ORE

Dry and siliceous gold	2,266	1,541	3,193	6,018	888	
Dry and siliceous gold-silver	1,252	1,001	37,848	3,291	60,526	
Dry and siliceous silver	11,403	36	64,453	10,554	807,519	
Copper	1,650	151	27,310	162,253	8,090	
Lead	7,234	85	156,453	32,620	5,292,395	
Lead-copper	83		12,354	7,262	36,515	
Zinc	2,655	5	987	858	32,257	661,286
Zinc-lead	66	1	904	350	13,250	40,337
	26,609	2,820	303,502	223,206	6,251,440	701,623

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1942, 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	1		40	20		20	121		121				$786
Boise		1			4	4							140
Snake River		3			492	492		31	31				17,242
Adams County: Seven Devils	4		89	16		16	547		547	35,900			5,293
Benewah County:													
Tyson Creek (Camas Cove)		2			14	14							490
Blaine County:													
Mineral Hill and Camas	16		2,804	546		546	11,302		11,302	7,000	79,700	72,400	40,067
Sawtooth (Vienna)	2		116	25		25	1,672		1,672		1,400		2,158
Warm Springs	7		112,018	4,488		4,488	639,616		639,616	333,000	7,565,300	12,520,600	2,323,502
Boise County:													
Banner		1			1	1							35
Boise Basin	9	31	1,062	1,300	13,112	14,412	33,660	3,250	36,910	2,100	25,000		532,596
Payette River		2			1	1							35
Rabbit Creek		1			12	12		7	7				425
South Fork of Payette River		1			1	1							35
Summit Flat	6	2	411	297	7	304	135		135				10,736
Bonner County: Pend d'Oreille	4		12,092	3		3	54,699		54,699	2,200	780,600		91,568
Bonneville County: Mount Pisgah		2			33	33							1,155
Boundary County: Port Hill	1		41,353	11		11	39,673		39,673	16,000	2,088,000		170,429
Butte County:													
Dome	1		1,500				1,011		1,011		57,000		4,538
Lava Creek	3		259	2		2	540		540		13,400	27,700	3,928
Camas County:													
Little Smoky and Carrietown	3	2	381	19	2	21	8,713		8,713	700	15,300	300	8,069
Skeleton Creek	1		23	244		244	114		114				8,621
Clark County: Birch Creek	1		24				66		66		13,300		938
Clearwater County:													
Burnt Creek		1			1	1							35
Moose Creek and Independence Creek		3			3	3							105
Pierce		8			18	18		7	7				635
Custer County:													
Alder Creek	2		3,429	143		143	2,551		2,551	104,000	27,600	513,000	68,961
Bayhorse	8	1	39,266	61	1	62	193,379		193,379	51,800	3,288,700	1,095,000	468,130
Stanley and Stanley Basin	1	1	2,000	306	2	308	3,046		3,046		700		12,993
Yankee Fork	8	3	3,266	887	4,790	5,677	13,611	2,416	16,027	200			210,116

Elmore County:													
Bear Creek	4	3	116	53	2	55	45		45				1,957
Boise River (Twin Springs)		4			2	2							70
Middle Boise	4	6	87,872	23,106	6,385	29,491	94,666	2,160	96,826				1,101,039
Pine Grove	1		1	7		7	7		7				250
Snake River		2			21	21							735
Gem County: West View	3	2	6,843	2,909	8	2,917	21,496		21,496	11,000	90,700	5,000	125,254
Idaho County:													
Burgdorf-Marshall Lake	4	2	3,144	1,600	15	1,615	4,552	7	4,559	200	400		59,818
Camp Howard (Salmon River)		7			32	32		7	7				1,125
Dewey-Harpster	1		43	3		3	24		24	600			195
Dixie	3	7	155	73	221	294	45	38	83				10,349
Elk City	4	13	232	56	5,845	5,901	263	1,087	1,350				207,495
Florence and French Creek		10			26	26		7	7				915
Lolo Creek		4			11	11							385
Lower Salmon River		3			68	68		14	14				2,390
Newsome		2			512	512		111	111				17,999
Orogrande	5	1	115	130	955	1,085	111	204	315		400		38,226
Ramey Ridge	1		3,000	825		825	218		218	1,100			29,163
Salmon River (Shoup)		2			11	11							385
Simpson (Salmon River)		7			20	20							700
Snake River		1			15	15							525
Ten Mile	6		5,218	1,089		1,089	1,170		1,170	1,200	1,600		39,199
Warren	5	10	146	91	1,176	1,267	38	384	422				44,645
Jerome County: Snake River		12			38	38							1,330
Kootenai County: Wolf Lodge	1		2				14		14		900		70
Latah County:													
Hoodoo		3			6,012	6,012		329	329				210,654
Moscow Mountain		1			9	9							315
Lemhi County:													
Blue Wing	1		25,340	9		9	31,566		31,566	39,600	76,000		32,646
Eureka	2	2	1,040	82	17	99	90		90	28,400			6,965
Gibbonsville (Dahlonega)	2	9	74	25	4,415	4,440	14	329	343				155,644
Indian Creek	1		15	6		6							210
Junction	1		26				142		142	200	7,300		614
Kirtley Creek		7			21	21							735
Mackinaw	1	9	2	1	72	73	7	7	14		200		2,578
Mineral Hill	2		20,015	2,074		2,074	1,485		1,485	200	13,400		74,568
Nicholia	1		434	2		2	526		526	600	13,700	72,000	8,131
Parker Mountain	1		1	3		3	14		14				115
Salmon River		5			6	6							210
Texas	2		1,300	75		75	7,920		7,920	3,800	325,700		30,539
Unorganized (Reno)	1		19				31		31		7,700		538
Yellow Jacket	2		41	35		35	69		69	200			1,298
Lewis County:													
Clearwater River (Kamiah)		2			2	2							70
Nez Perce County: Snake River		1			3	3							105
Owyhee County:													
Carson or French	7	5	72,096	3,266	14	3,280	206,294	31	206,325				261,520
Castle Creek	1		225	51		51	59		59				1,827
Flint	1		13	1		1	332		332				271
Snake River		3			4	4							140
South Mountain	1		11,188	212		212	122,355		122,355	193,200	124,700	2,970,000	402,370

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1942, 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*	
Shoshone County:													
Beaver	8	3	83,513	119	7	126	141,923	-------	141,923	73,700	5,747,600	8,883,300	$1,325,487
Coeur d'Alene	1	1	1	3	12	15	7	-------	7	-------	-------	-------	530
Evolution	6	-------	417,898	278	-------	278	7,341,871	-------	7,341,871	4,626,100	413,700	185,600	5,835,353
Hunter	5	-------	557,225	404	-------	404	1,085,833	-------	1,085,833	319,300	50,372,700	68,124,300	10,535,454
Lelande	7	-------	412,686	540	-------	540	1,580,026	-------	1,580,026	414,200	56,506,000	26,458,700	7,439,153
Placer Center	6	-------	141,746	247	-------	247	368,730	-------	368,730	108,600	15,213,700	14,930,100	2,691,811
St. Joe	-------	2	-------	-------	10	10	-------	-------	-------	-------	-------	-------	350
Summit	-------	1	-------	-------	33	33	-------	7	7	-------	-------	-------	1,160
Yreka	16	-------	714,348	1,035	-------	1,035	2,458,890	-------	2,458,890	444,100	84,693,300	38,043,000	11,050,955
Twin Falls County: Snake River	-------	13	-------	-------	37	37	-------	7	7	-------	-------	-------	1,300
Valley County:													
Big Creek	1	-------	2	12	-------	12	14	-------	14	-------	-------	-------	430
Deadwood Basin	1	-------	7,733	80	-------	80	41,549	-------	41,549	26,000	244,000	611,000	108,663
Lake City	-------	1	-------	-------	2	2	-------	-------	-------	-------	-------	-------	70
South Fork of Salmon River	-------	2	-------	-------	2	2	-------	-------	-------	-------	-------	-------	70
Thunder Mountain	1	2	9,500	943	44	987	609	31	640	-------	-------	-------	35,000
Unorganized (Knox)	1	-------	32	5	-------	5	7,667	-------	7,667	-------	3,600	-------	5,868
Yellow Pine	1	-------	96,861	2,620	-------	2,620	102,510	-------	102,510	-------	-------	-------	164,596
Washington County:													
Snake River	-------	1	-------	-------	1	1	-------	-------	-------	-------	-------	-------	35
Washington (Mineral Creek)	2	-------	310	2	-------	2	6,781	-------	6,781	14,800	4,700	-------	6,998
Total Idaho	203	236	2,900,704	50,440	44,580	95,020	14,634,419	10,471	14,644,890	6,860,000	227,818,000	174,512,000	46,063,326

Comment on districts with small production has been omitted owing to lack of space.

ADA COUNTY

Snake River district.—Dry-land dredging at three properties in Ada County near Grand View in 1942 recovered 492 fine ounces of gold and 31 fine ounces of silver. Cecil Rhodes operated the Eldridge and Hot Shot groups and John R. Rhodes the Dixie property.

ADAMS COUNTY

Nearly all the output in Adams County in 1942 was copper ore (80 tons) containing gold and silver from the Helena, Lucky Strike, and South Peacock properties near Cuprum in the Seven Devils district.

BLAINE COUNTY

Mineral Hill and Camas district.—The most important mining operation in the Mineral Hill and Camas district in 1942 was by the Lurline Mining Co. at the Camas property, 10 miles west of Hailey; shipments of gold ore during the last 4 months of 1942 totaled 1,460 tons. The remainder of the district output was principally old tailings from the Minnie Moore and Triumph properties and gold ore from the Treasure Vault mine.

Warm Springs district.—Mining of zinc-lead-silver ore from the Triumph-North Star-Independence groups near Ketchum by the Triumph Mining Co. continued to be the most important mining operation in southern Idaho; however, the grade of the ore in 1942 was lower than in 1941. The old 300-ton concentration mill at the North Star mine, which was remodeled in 1941, treated 32,512 tons of low-grade marginal zinc-lead-silver ore in 1942 that could not be mined at a profit in 1941. In addition, 78,148 tons of zinc-lead-silver ore were shipped to custom mills at Bauer and Tooele, Utah. The company was granted a basic quota of about 550 tons of lead and 900 tons of zinc a month. The quota has been revised several times, and as of May 1943 the company was still seeking further revisions. The rest of the district output was mainly gold-silver ore (771 tons) from the Red Cloud mine and gold ore (438 tons) from the June Day mine.

BOISE COUNTY

Boise Basin district (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).—When the price of gold rose to $35 an ounce in 1935, placer mining, especially bucket dredging, became the most important type of mining in the Boise Basin district; it attained a record output of 22,990 ounces of gold in 1940 but declined to 13,112 ounces in 1942. All bucket dredging ceased in October 1942 owing to the gold-mine closing order of the War Production Board. The Fisher-Baumhoff Co., operating two bucket dredges at Centerville, remained the largest producer of placer gold in the State; the two dredges washed about 1,500,000 cubic yards of gravel and recovered 7,087 fine ounces of gold and 1,788 fine ounces of silver. The Idaho-Canadian Dredging Co. operated its 7½-cubic foot bucket dredge at Idaho City until October 15 and recovered 5,579 fine ounces of gold and 1,368 fine

ounces of silver from 1,394,695 cubic yards of gravel. The rest of the district placer gold was recovered largely by hydraulicking and sluicing at the White Rose, Moe, Fairchild, and Bell Flower properties. The output of lode mines in the district was chiefly high-grade gold-silver ore (269 tons) from the Come-Back mine at Pioneerville. Producers of gold ore included the Coin Bond, Hay Fork, Julian, Mineral Hill, Summit, and Texida properties.

Summit Flat district.—The output of 304 ounces of gold and 135 ounces of silver in the Summit Flat district in 1942 was chiefly lode gold recovered by amalgamation from ore mined at the King, Golden Chariot, San Cristobal, and Viking properties.

BONNER COUNTY

Pend d'Oreille district.—The Whitedelf mine near Clark Fork, the largest producer of silver and lead in the Pend d'Oreille district in 1941, was closed in May 1942 owing to difficulty in obtaining adequate labor and supplies. During the first 4½ months of 1942 about 1,700 tons of silver-lead ore were treated in the company 50-ton flotation plant. The Hope (Elsie K.) mine, also near Clark Fork, was operated throughout 1942 by Hope Silver-Lead Mines, Inc.; 10,320 tons of ore containing 18,500 ounces of silver, 709,350 pounds of lead, and 326,800 pounds of zinc were treated in the company 150-ton flotation plant. In 1942 the company added more flotation equipment to the mill and did considerable metallurgical work in endeavoring to recover the zinc; however, no zinc concentrates were marketed in 1942. Small lots of high-grade silver ore were produced from the Brown Bear mine and lead ore from the Lawrence mine.

BOUNDARY COUNTY

The Idaho-Continental mine in the Port Hill district was operated continuously in 1942 by Trueman Higginbotham; 41,353 tons of ore containing about 45,000 ounces of silver, 2,450,000 pounds of lead, and a little gold and copper were treated in a 90-ton flotation mill.

BUTTE COUNTY

Lava Creek district.—The output of the Lava Creek district in 1942 was 153 tons of zinc ore from the Multa Metals group near Arco and 106 tons of zinc-lead ore from the Hornsilver and Moran mines. All the ore was shipped to a custom milling plant in Utah.

CLEARWATER COUNTY

Virtually all the output in Clearwater County in 1942 was placer gold recovered from stream gravel at various claims in the Burnt Creek, Independence Creek, and Pierce districts. The chief operation consisted of dredging gravel at the Meadow claim on French Creek in the Pierce district.

CUSTER COUNTY

Alder Creek district.—Lessees operated the White Knob property, 4 miles south of Mackay, in 1942 and shipped 2,109 tons of crude zinc ore to the International slag-fuming plant at Tooele, Utah, and 46 tons of silver-lead ore to a smelter; shipments of zinc ore to the slag-fuming plant ceased in July. The rest of the district output was crude

copper ore (1,274 tons) shipped from the Empire mine at Mackay. This mine was closed in August, but in December the Federal Bureau of Mines started a drilling project.

Bayhorse district.—The mining of zinc-lead ore at the Clayton mine by Clayton Silver Mines in 1942 was the most important operation in the Bayhorse district. In May the company completed installation of additional milling equipment for recovering zinc, and during the last 7 months of the year lead concentrates and zinc concentrates were shipped to smelters; only lead concentrates were produced during the first 5 months. The mill treated 38,014 tons of ore containing 146,443 ounces of silver, 3,120,000 pounds of lead, 3,193,000 pounds of zinc, and a little gold and copper. The remainder of the district output was largely lead-silver ore (225 tons) and copper-silver ore (208 tons) from the Ramshorn mine and lead ore (624 tons) from the South Butte mine.

Stanley and Stanley Basin district.—The Valley Creek property near Stanley was operated a few months in 1942 by the Western Gold Exploration Co.; about 2,000 tons of gold ore were concentrated, and nearly all the concentrates were cyanided.

Yankee Fork district.—Placer gold recovered by bucket dredging was the principal output of the Yankee Fork district in 1942. The 8-cubic foot bucket dredge of the Snake River Mining Co. at Sunbeam washed 1,428,326 cubic yards of gravel, which yielded 4,787 fine ounces of gold and 2,412 fine ounces of silver; operations ceased in October owing to Government regulations. The lode output of the district was chiefly gold-silver ore (3,224 tons), treated by amalgamation and concentration, from the General Custer-Lucky Boy group; this property was shut down May 1. About 20 tons of high-grade gold ore (some lots averaging 9 ounces of gold to the ton) were produced from the Fourth of July claim. Other gold producers included the Bachelor Mountain, Last Chance, and Yankee Fork properties.

ELMORE COUNTY

Middle Boise (Atlanta) district.—In 1942, as in 1941, the Middle Boise district was the largest gold-producing area in the State, resulting chiefly from operation of lode property (Boise-Rochester-Monarch groups) by Talache Mines, Inc. The company treated 87,747 tons of gold ore in its 400-ton amalgamation and concentration mill compared with 121,355 tons in 1941. In addition to gold and silver, the ore contains arsenic and tungsten; in 1942 some tungsten concentrates were produced and marketed. The rest of the district output was principally placer gold, recovered chiefly by the 7½-cubic foot bucket dredge of Boise King Placers. The dredge treated 1,310,879 cubic yards of stream gravel in 1942 and recovered 6,346 fine ounces of gold and 2,149 fine ounces of silver; operations ceased October 30.

GEM COUNTY

West View district.—In 1942 gold ore (6,650 tons) from the Lincoln group at Pearl was the most important output in the West View district. The mine and 75-ton flotation mill were operated until December 15, when operations ceased, probably for the duration of the war. The remainder of the district output was largely zinc-lead ore (141 tons) from the Friday mine.

IDAHO COUNTY

Burgdorf-Marshall Lake district.—The Golden Anchor Mining Co. operated its mine and 50-ton amalgamation-concentration plant at Czizek until April 30, 1942, when operations were closed permanently; 2,827 tons of gold ore were treated in 1942 and yielded 1,498 ounces of gold and 4,482 ounces of silver. The mine had been a large producer of gold since 1935. Gold ore was produced also from the Gold Crest, Jewell, and Leadville properties. The district output of placer gold and silver was recovered by hydraulicking and sluicing at the Ruby and Black Creek claims.

Dixie district.—A dragline floating dredge operated a few months in 1942 at the Dixie Placers and recovered 196 fine ounces of gold and 36 fine ounces of silver. The rest of the district output was principally lode gold from the Slip Easy and Ontario properties.

Elk City district.—Four dredges (three dragline and one bucket-line) in the Elk City district treated 919,880 cubic yards of gravel in 1942 and recovered 5,805 fine ounces of gold and 1,083 fine ounces of silver. The bucket-line dredge (on Crooked River), operated by H. & H. Mines, was again the largest producer; it operated from January 1 to June 20 and recovered 2,859 fine ounces of gold and 560 fine ounces of silver. The dragline dredges, operated by the American River Mining Co. and the Tyee Mining Co., were also large producers of gold. Nearly all the lode output of the district was gold ore cyanided (220 tons) from the Blue Ribbon mine.

Newsome district.—Gold Hill Placers operated its dragline floating dredge on Newsome Creek 3 months in 1942 and recovered 500 fine ounces of gold and 105 fine ounces of silver from 82,000 cubic yards of gravel. A little placer gold and silver was produced from the Hay Fork claim.

Orogrande district.—The principal output in the Orogrande district in 1942 was placer gold recovered from a property on Crooked River by the 2-cubic foot bucket dredge of the Mt. Vernon Co.; the dredge treated 167,966 cubic yards of gravel from March 15 to August 8 and recovered 955 fine ounces of gold and 204 fine ounces of silver. The lode output of the district was largely old mill cleanings from the Penman and Orogrande-Frisco mills.

Ramey Ridge district.—The Snowshoe mine near Big Creek was the only producer in the Ramey Ridge district in 1942; about 3,000 tons of gold ore were treated in a 25-ton amalgamation and concentration mill.

Ten Mile district (Golden).—All the output in the Ten Mile district in 1942 was gold ore, chiefly from the Center Star mine. Lessees operated the mine and treated about 4,900 tons of gold ore in a 50-ton gravity-flotation mill; the jig concentrates were treated by amalgamation, and the flotation concentrates were shipped to a smelter. Other producers of gold ore included the Blackbird, Bob, Lone Pine, and Shamrock properties.

Warren district.—The principal output in the Warren district in 1942 was placer gold recovered by the 2½-cubic foot bucket-line dredge operated on Warren Meadows by W. W. Prather; the dredge treated about 215,000 cubic yards of gravel and recovered 1,090 fine ounces of gold and 358 fine ounces of silver. Other placer producers included the Cook, Smith Gulch, and Steamboat properties. Nearly all the output from lode mines in the district was gold ore (amalgamated) from the Rescue mine.

LATAH COUNTY

Hoodoo district.—In 1942, as in 1941, the output of the Hoodoo district was placer gold and silver, virtually all recovered by the 4½-cubic foot bucket-line dredge of Northwest Goldfields. The dredge operated from January 1 to October 14 and treated 1,021,726 cubic yards of gravel.

LEMHI COUNTY

Blue Wing district.—The Ima mine at Patterson, only producer in the Blue Wing district, was operated continuously in 1942 by the Ima Mines Corporation; 25,340 tons of ore containing 45,612 ounces of silver, 75,000 pounds of copper, 126,000 pounds of lead, 506,000 pounds of iron, and 253,000 pounds of tungsten were treated in a 150-ton gravity and flotation mill equipped with a magnetic separator. Iron concentrates (640 tons) containing chiefly silver, copper, and lead were shipped to a smelter in Utah, and tungsten concentrates (113 tons) were shipped to an eastern market.

Eureka district.—Lessees operated the Pope-Shenon mine a few months in 1942 and treated 560 tons of copper ore in a concentration mill. Gold ore (480 tons) from the Queen of the Hills mine was amalgamated. The rest of the district output was placer gold recovered from the Best Bet and Queen Gulch properties.

Gibbonsville district.—The principal output in the Gibbonsville district in 1942 was placer gold recovered chiefly by two dredges. A dragline floating dredge (Smith Bros.) at the Hagel property recovered 2,466 fine ounces of gold and 203 fine ounces of silver from 415,000 cubic yards of gravel, and a 4-cubic foot bucket-line dredge (Idaho-Warren Dredging Co.) at the Hughes Creek Placer recovered 1,900 fine ounces of gold and 123 fine ounces of silver from 380,000 cubic yards of gravel. The lode output of the district was gold ore from the Nevada and Red Star mines.

Mineral Hill district.—Gold Producers, Inc., continued in 1942 to operate the Grunter open-pit mine at Shoup and treated about 20,000 tons of gold ore by flotation. A little high-grade gold ore (15 tons) from the Rico claim was shipped direct to a smelter.

Nicholia district.—Lessees operated the Viola mine near Reno and shipped 434 tons of carbonate zinc ore to the International slag-fuming plant at Tooele, Utah.

Texas district.—The principal output in the Texas district in 1942 was 820 tons of crude silver-lead ore from the Latest Out mine near Gilmore.

OWYHEE COUNTY

Carson district (Silver City, De Lamar).—The De Lamar Milling Corporation operated its 250-ton flotation mill continuously in 1942 until December 22, when the plant was closed permanently; 72,052 tons from De Lamar waste dumps were treated, and the resulting high-grade gold-silver concentrates (274 tons) were shipped to a smelter in Utah. The rest of the district output was largely gold ore from the Pauper and South Central properties.

South Mountain district.—Mining operations by the South Mountain Mining Co. at the Golconda mine were continuous throughout 1942. The company shipped 11,188 tons of ore containing 260 ounces of gold, 132,243 ounces of silver, 225,718 pounds of copper, 139,610 pounds of lead, and 3,870,161 pounds of zinc to the International flotation mill at Tooele, Utah.

SHOSHONE COUNTY

COEUR D'ALENE REGION

The value of the metal output of the Coeur d'Alene region was $38,880,253 in 1942, a 20-percent gain over 1941. The output of lead increased 11 percent, zinc 15 percent, and copper less than 1 percent; gold decreased 21 percent and silver nearly 12 percent. The output of zinc in 1942 exceeded the former record of 1941, and the output of lead was the largest since 1930.

Calculated from reports of production for the first quarter of 1943 and of new producers of zinc, the output of zinc in 1943 should be about 4 percent greater than in 1942; however, the output of lead will be less.

The chief producers of zinc in the region in 1942, according to rank (each producing more than 11,000,000 pounds), were the Star, Morning, Hecla, Bunker Hill & Sullivan, Tamarack, and Page properties; the chief producers of lead, according to rank (each producing more than 10,000,000 pounds), were the Bunker Hill & Sullivan, Hecla, Morning, Page, Star, Sherman, and Tamarack properties. Nearly 71 percent of the material produced in the Coeur d'Alene region in 1942 was zinc-lead ore and old tailings, more than 18 percent silver ore, and 10 percent lead ore. Nearly all mines worked 6 days a week and milling plants 7 days a week. Miners' wages increased from $6.25 a shift in March 1941 to $8.25 a shift in May 1942, the highest ever paid in the district. In 1942 the region was the largest silver-producing area in the United States; it ranked second in lead and third in zinc.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1941–42, and total, 1884–1942, 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*	
1941	58	21	2,051,390	3,419	14,678,356	5,957,000	191,057,000	136,642,000	$32,398,932
1942	49	7	2,327,417	2,688	12,977,287	5,986,000	212,947,000	156,625,000	38,880,253
Total, 1884–1942	------	------	(1)	385,085	400,543,895	[2] 60,260	[2] 5,245,463	[2] 886,546	978,091,576

[1] Figures not available.
[2] Short tons.

Beaver district.—All the lode output (83,513 tons of ore) in the Beaver district in 1942 was zinc-lead ore; the chief producers were the Interstate-Callahan mine and waste dump, the Sunset mine, and the Amazon-Manhattan group. The Daylight Lease operated the Interstate-Callahan mine throughout the year and hauled 26,029 tons of ore containing principally silver, lead, and zinc to Zanetti Bros. flotation mill near Wallace; 17,453 tons of similar ore from the mine waste dump, operated by Zanetti Bros., were treated in the same mill. About 20,200 tons of zinc-lead ore from the Sunset mine were treated in the Golconda 250-ton custom flotation mill near Wallace. Zinc-lead ore (11,115 tons) from the Amazon-Manhattan group was treated in the Dayrock and Hercules custom mills, also near Wallace. Other producers of zinc-lead ore were the Silver Tip (Portland), Port Arthur, Monarch, and Sitting Bull properties.

Evolution district.—The principal output in the Evolution district in 1942 was silver ore (414,019 tons) from the Sunshine, Mineral Point, and Polaris properties near Osburn. The chief producer was the Sunshine mine, although its output of silver ore decreased from 305,180 tons in 1941 to 251,700 tons in 1942 and the production of silver from 7,138,426 to 4,976,859 ounces. According to the printed annual report of the Sunshine Mining Co., the decrease in tonnage of ore mined was due to a labor shortage. A constructive step was taken by the Army to relieve the shortage by releasing soldiers with previous coal- and metal-mine experience for employment in nonferrous metal mines. Late in the fall 109 furloughed soldiers were employed at the Sunshine mine, and more could be used. Indications point to a further shortage of labor during the spring of 1943, and production depends more on manpower than any other factor. In March 1942 the company started to construct a plant to recover, by leaching and electrolytic deposition, the antimony contained in the high-grade silver-copper-antimony concentrate. A pilot antimony plant operated through May, when it was shut down for the transfer and installation of its equipment at the new full-sized plant. During the 5 months operated, the pilot plant produced 142,400 pounds of antimony metal. The new plant began operating the middle of September and has processed the total tonnage of silver-copper-antimony concentrate produced since September 1; to the end of the year it had produced 250,000 pounds of antimony metal. The residue remaining after the antimony had been leached was shipped to a copper smelter for the recovery of the silver and copper content. In 1942 the 1,200-ton differential flotation plant produced 3,121 tons of high-grade silver-copper-antimony concentrates and 4,329 tons of low-grade silver-iron concentrates. The ore reserves are estimated at 583,000 tons—a decrease of 167,000 tons from the estimate of 1941. The 600-ton flotation mill at the Mineral Point mine of the Coeur d'Alene Mines Corporation treated 122,301 tons of silver-copper-antimony ore in 1942. The company reported that ore was mined on all levels from the 600- to the 1,800-foot, inclusive. A raise driven from the 600-foot level shows a good grade of ore for 300 feet above the level. Drifting west on the 1,600- and 1,800-foot levels shows a lengthening ore shoot to the west, and a major portion of ore output is now coming from the two levels. The concentrates (4,914 tons) contained 1,586,460 ounces of silver, 3,132,398 pounds of copper, and 1,839,936 pounds of antimony. The property was the largest producer of copper in Idaho and ranked second in antimony and third in silver. About 40,000 tons of silver ore from the Polaris mine were treated in the company 200-ton flotation mill; the concentrates contained 63 ounces of gold, 773,074 ounces of silver, 238,450 pounds of copper, 135,800 pounds of lead, 194,524 pounds of antimony, and some iron. The company reported that development in 1942 aggregated 1,977 feet, of which 879 feet were in ore and 1,098 feet in waste; ore reserves are estimated at 29,150 tons. The rest of the district output was virtually all old zinc-lead tailings (3,789 tons) from two dumps at Osburn.

Hunter district (Mullan).—In 1942, as in 1941, the output of recoverable zinc (68,124,300 pounds) in the Hunter district was larger than in any other district in Idaho; the chief producer was the Star mine of the Sullivan Mining Co. at Burke. The 1,000-ton flotation

mill at the mine treated 242,900 tons of ore yielding lead concentrates and zinc concentrates, which contained 240,069 ounces of silver, 16,678,000 pounds of lead, and 42,269,434 pounds of zinc; the mine was again the largest producer of zinc in Idaho. The company reported that the mine operated at capacity to June 1, when a shortage of labor began in the district; by September operations dropped to 50 percent of capacity. The output of zinc-lead-silver ore from the Morning mine of the Federal Mining & Smelting Co. at Mullan decreased to 236,902 tons in 1942 from 270,787 tons in 1941. The 1,250-ton flotation mill at the mine operated continuously in 1942 and yielded lead concentrates and zinc concentrates containing 200 ounces of gold, 622,530 ounces of silver, 32,405,528 pounds of lead, and 36,156,146 pounds of zinc. The mine ranked second in the State in zinc output and third in lead. According to the printed annual report of the company, the labor shortage became so acute during the summer that underground work at the mine was placed on a one-shift-a-day basis August 17. This continued until November 9, when some improvement in the labor supply permitted resumption on a two-shift-a-day basis; ore production during the summer was only about 50 percent of normal. In the last 6 months of 1942 operations at the mine resulted in earnings of only $54,911 owing to increased operating expense and shortage of labor. In 3 of these months there was an actual operating loss. Were it not for the fact that the quota was reduced, it is doubtful if the Morning operations could be conducted at much profit and might result in an actual loss. Leasing operations at the Gold Hunter mine produced 65,417 tons of silver-lead ore in 1942, which was treated in the 500-ton Gold Hunter flotation plant. The rest of the district output comprised 6,756 tons of zinc-lead ore from the Golconda mine and 5,250 tons of similar ore from the Lucky Friday mine, all treated in the 250-ton custom flotation mill of Golconda Lead Mines near Wallace.

Lelande district (*Burke, Mace, Frisco*).—Zinc-lead-silver ore from the Hecla mine at Burke was, as usual, the most important output in the Lelande district in 1942. The company reported that 274,938 tons of zinc-lead-silver ore were treated in the 900-ton flotation plant at the mine, and 5,474 tons of crude silver-lead ore were smelted. The concentrates and crude ore contained 340 ounces of gold, 1,106,460 ounces of silver, 378,764 pounds of copper, 43,190,323 pounds of lead, and 25,570,047 pounds of zinc; the mine ranked second in the State in lead output, third in zinc, and fourth in silver. According to the printed annual report of the company, capacity operations at the Hecla mine were maintained for the first 8 months of the year, after which production was cut 15 percent. Development in 1942 totaled 3,576 feet, of which 2,316 feet were in ore and 1,260 feet in waste; no additional ore of importance was discovered. Ore reserves at the end of 1942 are estimated at 145,522 tons. Development and an increase in width in some stopes resulted in gaining some tonnage over the estimate for 1941. This, together with the decreased output per month, has extended the life of mine operations. Beginning about May 1, 1943, the declining tonnage from the mine will be supplemented in the mill with ore from the Silver Cable lease in Montana, and with old tailings deposited at Osburn, Idaho, estimated to contain 2,000,000 tons of material averaging about 34 pounds of lead and about 40 pounds of zinc to the ton. The company has

built a sink-and-float plant on the property to handle 2,000 tons of material a day; this plant will reject approximately 40 percent as waste, and the remaining product will be treated at the Hecla and Polaris mills. It is expected that milling will begin about May 1, 1943.

The Sherman Lead Co. operated its mine and 300-ton flotation mill throughout the year. The company reported that 69,804 tons of ore were treated, containing 434,962 ounces of silver, 13,938,580 pounds of lead, and 3,000,000 pounds of zinc. Heretofore, no zinc has been recovered, but in November the mill started producing some zinc-lead concentrate in addition to lead concentrate. Leasing operations (Hull Lease) at the Frisco mine produced 27,067 tons of zinc-lead milling ore in 1942. In March 1942 the Federal Mining & Smelting Co., owners of the mine, began unwatering the lower levels, which have been flooded since 1916. Production by the company started November 1, and during the last 2 months of the year 2,770 tons of zinc-lead ore were treated in the Morning mill. The company reported that from the present outlook it is believed the mine will produce a substantial tonnage of zinc-lead ore in 1943. The remainder of the district output was largely old zinc-lead tailings (27,673 tons) deposited at various places along Canyon Creek above Wallace; 23,961 tons of tailings were hauled by the Small Leasing Co. to the Golconda custom mill.

Placer Center district.—The chief output in the Placer Center district in 1942 was zinc-lead ore from the Tamarack mine, treated in the company 300-ton flotation mill. According to the printed annual report of the Tamarack & Custer Consolidated Mining Co., the mine produced 110,735 tons of ore in 1942 containing 203,522 ounces of silver, 11,897,235 pounds of lead, and 17,693,087 pounds of zinc. Despite the large production of ore in 1942 and the unfavorable results of development on the 2,000-foot level, the ore reserves were not seriously diminished at the end of the year. The average crew required at the Tamarack mine to maintain normal production and development is not less than 160 men. Only during the first 4 months and the last 2 months of 1942 was enough manpower available. Although production did not suffer greatly, development had to be decreased. The mine and mill are prepared for maximum production in 1943. The Dayrock Mining Co. operated its mine and 200-ton flotation mill continuously in 1942 and treated 26,278 tons of silver-lead ore. According to the printed annual report of the company the ore contained 188,241 ounces of silver, 4,772,720 pounds of lead, and 750,000 pounds of zinc; however, no zinc was recovered. Ore reserves were substantially diminished in 1942, as new discoveries of ore were equivalent to only a fraction of the tonnage extracted during the year. The 500-foot level was extended westerly 578 feet but there is difficulty in tracing the Dayrock vein downward. The remainder of the district output was mainly old zinc-lead tailings (2,823 tons) from a property near Wallace and zinc ore (2,200 tons) from the Success mine operated by lessees.

Yreka district (Kellogg).—The value ($11,050,955) of the metal output of the Yreka district and the output of recoverable lead (84,693,300 pounds) in 1942 were larger than in any district of Idaho, and that of recoverable zinc and silver ranked second. Zinc-lead-silver ore from the Bunker Hill & Sullivan mine at Kellogg was, as usual, the principal output in the district; 408,549 tons of ore were

treated by gravity and flotation concentration and 68,833 tons of old tailings (silver-lead-iron) were treated by straight gravity concentration. The company reported that the lead concentrates and zinc concentrates produced from both ore and old tailings contained 1,657,425 ounces of silver, 60,087,300 pounds of lead, and 27,223,700 pounds of zinc. The property remained the largest producer of lead and second in output of silver in Idaho and was fourth in zinc. According to the printed annual report of the company, exploration in 1942 resulted in finding good ore in quantity at several points. The Emery vein, extensively mined on 21 level, has been cut 400 feet lower on the 23 (bottom) level of the mine and shows very well, both as to grade and quantity, with good promise for further deeper mine development. An important find of ore on 13 level was made in an area of the mine not heretofore prospected. Westward mining on 21 level continues to disclose ore of importance. Ore reserves on January 1, 1943, undercut and available for mining, totaled 2,839,620 tons of zinc-lead-silver ore—an increase of 109,222 tons over the ore reserves reported January 1, 1942.

The Blackhawk and Page mines and the Page 500-ton flotation mill were operated continuously in 1942 by the Federal Mining & Smelting Co. The company reported that 139,848 tons of zinc-lead ore from the Page mine and 14,992 tons of similar ore from the Blackhawk mine contained 602,319 ounces of silver, 24,526,600 pounds of lead, and 16,598,850 pounds of zinc. According to the printed annual report of the company "the labor shortage experienced by most of the companies in the Coeur d'Alene region did not affect seriously operations at these properties." Development on the 2,100 and 2,400 levels discovered ore shoots of excellent length and good average grade.

The 100-ton flotation mill at the Constitution mine (Spokane-Idaho Mining Co.) on Pine Creek operated throughout the year and treated 20,307 tons of zinc-lead ore. Milling of zinc-lead ore from the Highland-Surprise mine was begun in June and suspended in November; during the 5 months a total of 14,474 tons of zinc-lead ore was treated. The Little Pittsburg mine and its 100-ton flotation mill on Pine Creek were operated in 1942 by the Denver Development Co.; 11,656 tons of ore were treated, containing an average of 1.50 ounces of silver to the ton, 3.31 percent lead, and 8.32 percent zinc. The remainder of the district output was mainly 9,793 tons of old tailings (silver-lead) from the Sierra Nevada property, 7,983 tons of silver ore from the Crescent mine, 7,500 tons of zinc-lead ore from the Douglas mine dump, 3,700 tons of old zinc-lead tailings from various dumps, and zinc-lead ore from the Sidney and Liberal King mines.

VALLEY COUNTY

Deadwood Basin district.—The Hall-Interstate group, 54 miles east of Cascade, was operated in 1942 by the Callahan Zinc-Lead Co.; 7,733 tons of zinc-lead ore were treated by flotation, yielding 240 tons of silver-lead-copper concentrates and 590 tons of zinc concentrates.

Thunder Mountain district.—The output of the Thunder Mountain district in 1942 was 943 fine ounces of gold and 609 fine ounces of silver recovered from gold ore amalgamated from the Sunnyside-Dewey group and 44 fine ounces of gold and 31 fine ounces of silver recovered principally from the Bonanza placer on Mule Creek.

Yellow Pine district.—The practice of treating gold-silver-antimony-tungsten ore from the Yellow Pine mine was changed in 1942 from bulk sulfide flotation to selective flotation of antimony minerals from pyrite and arsenopyrite, and tabling of flotation-made tungsten concentrate was abandoned for improved flotation metallurgy. There were 96,861 tons of ore treated in 1942, containing an average of 0.039 ounce of gold and 1.41 ounces of silver to the ton, 4.79 percent antimony, and 2.59 percent tungsten. The 400-ton mill yielded 2,294 tons of high-grade tungsten concentrate, 6,887 tons of low-grade tungsten concentrate, 7,564 tons of gold-silver-antimony concentrate, and 816 tons of gold-antimony-iron concentrate. The capacity of the mill was increased to 800 tons of ore a day early in 1943.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By G. E. Woodward and Paul Luff

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SUMMARY

Copper remained the chief source of metal value in Montana and was the only metal to show increased output in 1942. The aggregate value of the gold, silver, copper, lead, and zinc produced from Montana ores and gravels was, in terms of recoverable metal, $60,129,853 compared with $59,181,627 in 1941 (see fig. 1). This slight advance was due to a greater output of copper and a higher average price paid for copper, lead, and zinc in 1942. Gold and silver production—more particularly gold—was cut drastically by the widespread closing of gold mines in every section of Montana. The output of lead and zinc was affected seriously when all zinc-lead mines at Butte, operated by the Anaconda Copper Mining Co., closed in late May; however, this closing enabled the Anaconda Copper Mining Co. to maintain and even increase its output of copper. Silver Bow County, which includes the Butte area and yields nearly all the copper and most of the zinc and silver output of the State, produced gold, silver, copper, lead, and zinc valued at $46,942,464 in 1942 compared with $44,195,725 in 1941. This increase was due to the greater output of copper by the Anaconda Copper Mining Co.

Several factors influenced the production of metals in Montana during 1942. The great majority of the mining districts in Montana are primarily gold-producing; in consequence of, first, a serious labor shortage and, finally, the Government closing order issued in October, many of the large gold mines either shut down or greatly reduced their output. This labor shortage was first felt in several of the districts in late 1941 or early in 1942 and prompted many gold producers, more particularly operators of lode mines, to make and carry out plans for suspending operations for the duration of the war even before the Government issued its closing order in October. Gold production from Beaverhead, Broadwater, Madison, Park, Lewis and Clark, Jefferson, Phillips, and Powell Counties was affected most.

A premium pay plan stimulated the production of copper, lead, and zinc. The plan, authorized by the Metals Reserve Company (a Government agency), effective February 1, 1942, granted producers of base

metals a premium of 5 cents a pound for copper and 2¾ cents a pound for lead and zinc produced in excess of certain fixed basic quotas. This plan was modified further to include one additional premium of 2¾ cents for lead and two additional premiums of 2¾ cents for zinc. The effective date of the modification was the opening of business December 1, 1942. Eligibility for these additional premiums was based upon the producer's ability to maintain the present rate of production or to increase output, chiefly from marginal ore bodies. Each case was to be considered independently by the quota committee at Washington, D. C.

Although the Government stimulated the production of base metals by means of premium payments and successive reductions of quotas for various mining companies, the effect of the program was more than offset by the critical shortage of labor at mines, mills, and smelters. Several plans were tried to alleviate this shortage, including wage increases, taking miners from gold mines, stabilization of labor at mines, and the furloughing of soldier-miners to work in the mines. The last plan was the most helpful action taken, although it, too, failed to satisfy the full need. During October and November over 4,000 soldiers were furloughed for service in western mines. Of this number, Montana received about 1,100 men, most of whom were employed at the copper mines at Butte. As these mines, operated by the Anaconda Copper Mining Co., had previously taken over miners from the closed zinc mines, the addition of the soldiers tended to raise the number employed at the copper mines to an operating minimum. The company still needed approximately 700 trained miners before the zinc mines could be reopened.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.

[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Company for over-quota production but excludes value of foreign copper delivered to Metals Reserve Company for domestic consumption.

[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Company for over-quota production.

[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Montana, 1938–42, and total, 1862–1942, 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
1938	482	265	2,724,466	203,313	$7,115,955	6,403,962	$4,139,935
1939	594	282	3,792,780	264,173	9,246,055	9,087,571	6,168,533
1940	687	285	5,099,241	272,602	9,541,070	12,361,050	8,790,080
1941	612	325	5,642,249	246,475	8,626,625	12,386,925	8,808,480
1942	370	170	5,678,280	146,892	5,141,220	11,188,118	7,955,995
1862–1942	--------	--------	(1)	16,827,410	373,412,562	724,391,028	529,152,667

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	256,072,000	30,216,496	42,518,000	2,423,526	121,420,000	9,106,500	59,181,627
1942	282,388,000	34,168,948	40,100,000	2,686,700	109,430,000	10,176,990	60,129,853
1862–1942	[2] 6,178,651	1,792,068,410	[2] 647,292	69,194,368	[2] 1,754,382	264,968,420	3,028,796,427

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Montana, 1938–42, 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
1938	[2] 3,896	[2] 351	(2)	(2)	5,721	1,533	4,375	1,410	21,356	3,240	35,348	6,534
1939	2,075	232	208	20	9,164	2,722	9,737	1,937	33,815	6,723	54,999	11,634
1940	2,163	272	281	41	11,252	2,640	11,439	1,302	39,012	7,400	64,147	11,655
1941	2,305	353	139	17	14,663	2,408	10,660	833	33,844	6,424	61,611	10,035
1942	2,732	356	--------	------	3,674	434	3,553	407	31,283	5,740	41,242	6,937

[1] 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 146,892 fine ounces of gold in 1942 compared with 246,475 ounces in 1941—a 40-percent decrease; the output from lode mines decreased 79,214 ounces and from placer mines 20,369 ounces. Siliceous ores yielded 55 percent of the State total gold, and base-metal ores 17 percent; there was a decrease from all classes except copper ore. Losses in gold output were general throughout the State but were largest in Madison, Broadwater, Lewis and Clark, Silver Bow, Phillips, Park, and Beaverhead Counties; slight increases were noted in Flathead and Judith Basin Counties, but these counties have negligible importance as gold producers. Gold ore mined totaled 322,140 tons, compared with 695,481 tons in 1941, and included 251,939 tons treated in amalgamation and cyanidation mills, 30,873 tons in concentrating mills, and 39,328 tons shipped crude to smelters. Ore treated at amalgamation and cyanidation plants (with or without concentrating equipment)

yielded 25 percent of the State total gold, that at concentrating mills 22 percent, ores of all classes shipped crude to smelters 25 percent, and placers 28 percent.

The leading gold producers in Montana in 1942 (not representative of capacity to produce, but merely of good fortune in keeping adequate operating personnel) were the company-operated copper mines of the Anaconda Copper Mining Co. at Butte, the West Mayflower property in Madison County, the Winston dredge operating on Prickly Pear Creek near Clancey, the Ohio Keating mine in Broadwater County,

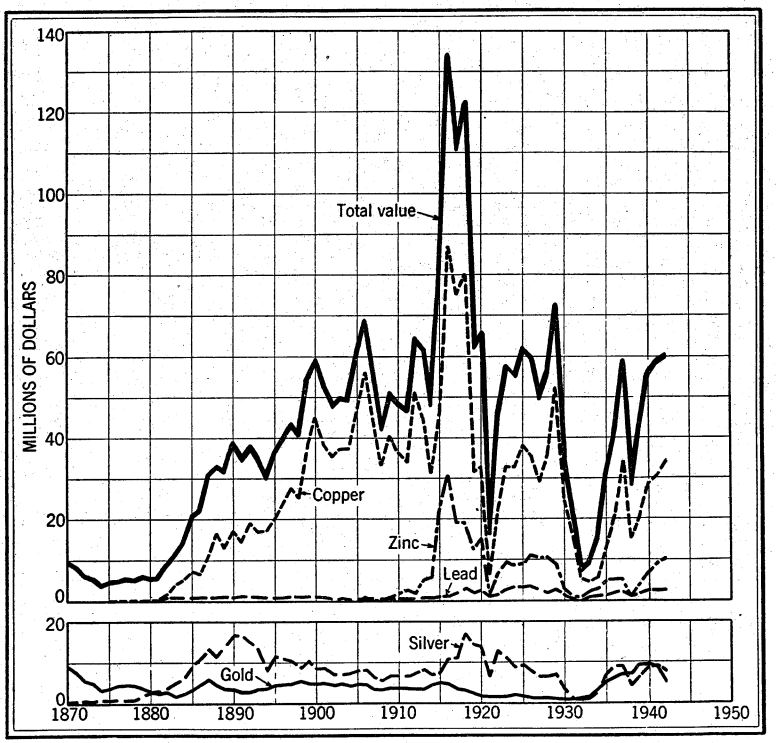

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc, and total value in Montana, 1870–1942.

Porter Bros. dredge near Helena, and the Perry Schroeder dredge on Missouri River in Lewis and Clark County.

Silver.—The output of recoverable silver in Montana in 1942 was 11,188,118 fine ounces compared with 12,386,925 ounces in 1941—a 10-percent decrease. This loss in output can be attributed almost entirely to the closing of all zinc mines of the Anaconda Copper Mining Co. in late May 1942, as these mines produced over 1,000,000 ounces of recoverable silver during nearly 6 months of operation. Copper ore yielded 56 percent of the State total silver, zinc-lead ore 22 percent, siliceous ore 20 percent, and lead ore, zinc ore, and placers together 2 percent. Ore treated at concentration mills yielded 83 percent of the total silver, and crude smelting ore 16 percent. The output of silver ore was 134,153 tons and of gold-silver ore 77,231 tons.

Copper mines, dumps, tailings piles (at Anaconda), zinc mines at

Butte, and the Flathead mine in Flathead County, all operated by the Anaconda Copper Mining Co., produced 75 percent of the State total silver. Other large producers included the Granite-Bimetallic mine (tailings) in Granite County; the Lexington group in the Montana district, Cascade County; the Emma mine at Butte (including by-product silver); and the St. Joseph Lead Co. property in Judith Basin County.

Copper.—Copper produced in Montana in 1942, in terms of recoverable metal, was 282,388,000 pounds, compared with 256,072,000 in 1941—a 10-percent gain. This gain was due entirely to the greater output of the Anaconda Copper Mining Co., which again was the only important copper producer in Montana. All active copper mines at Butte are owned and operated by the Anaconda Copper Mining Co., except the property of the North Butte Mining Co. In 1942 this property was operated by the Anaconda Copper Mining Co. through contract agreement. Copper produced from all sources at Butte gained in 1942, except that derived from the treatment of mine dumps; the quantity from this source is comparatively small, and the loss was easily offset by gains elsewhere. Copper ore and precipitates yielded gold, silver, and copper valued at $38,408,147, or 64 percent of total State value.

Lead and zinc.—The value of the production of lead and zinc in Montana, in terms of recoverable metals, increased in 1942 compared with 1941; however, the increases in total value were due to higher average price for the metals, as the quantities decreased. Zinc showed a 12-percent gain in value but a 10-percent decrease in quantity. Lead showed an 11-percent gain in value but a 6-percent loss in quantity. The closing, on May 25, of all zinc mines at Butte operated by the Anaconda Copper Mining Co. was the chief cause of decreased output of both metals. This closing is calculated to have reduced the output of lead from Montana about 7,000,000 pounds and the output of zinc about 40,000,000 pounds. The output from the slag-fuming plant at East Helena operated by the Anaconda Copper Mining Co. increased in 1942 by 811,000 pounds in lead and 2,878,000 pounds in zinc. The Emma mine, operated by the Anaconda Copper Mining Co. under lease, reported a decrease of about 1,000,000 pounds in lead and 5,000,000 pounds in zinc from zinc-lead ore but a gain of about 3,600,000 pounds in lead and about 8,200,000 pounds in zinc as a byproduct.

In 1942 the leading sources of zinc, named in order of output, were the slag-fuming plant at East Helena, all zinc mines operated by the Anaconda Copper Mining Co. at Butte, the Emma byproduct zinc, the Poulin mine at Butte, the Mike Horse mine in Lewis and Clark County, the Emma mine at Butte, the St. Joseph Lead Co. property in Judith Basin County, and the Hecla slag dump in Beaverhead County; these sources supplied 96 percent of the State total. The leading lead producers in Montana in 1942 were all zinc mines at Butte, the Emma byproduct lead, the Mike Horse mine in Lewis and Clark County, the Jack Waite mine in Sanders County, the slag-fuming plant at East Helena, the St. Joseph Lead Co. property in Judith Basin County, the Flathead property in Flathead County, the Forest Rose properties in Granite County, and the Mount Washington mine in Jefferson County; these sources contributed 80 percent of the State total.

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MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1942, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Beaverhead	27	10	4,808	$168,280	59,736	$42,479
Broadwater	36	19	14,853	519,855	39,652	28,197
Cascade	11		2,765	96,775	730,620	519,552
Deer Lodge	5	1	2,152	75,320	5,971	4,246
Fergus	2	2	1,754	61,390	744	529
Flathead	3		370	12,950	770,206	547,702
Granite	26	10	11,100	388,500	584,640	415,744
Jefferson	60	8	16,048	561,680	158,535	112,736
Judith Basin	3		221	7,735	216,135	153,696
Lewis and Clark	51	25	22,181	776,335	298,509	212,273
Lincoln	2	8	105	3,675	2,527	1,797
Madison	88	14	28,324	991,340	97,283	69,179
Meagher		6	62	2,170	7	5
Mineral	1	19	76	2,660	270	192
Missoula	4	7	2,007	70,245	391	278
Park	3	9	9,899	346,465	34,584	24,593
Phillips	2		5,226	182,910	38,783	27,579
Powell	13	18	1,465	51,275	5,452	3,877
Ravalli	1	3	964	33,740	66	47
Sanders	4	1	131	4,585	20,219	14,378
Silver Bow	28	10	22,381	783,335	8,123,788	5,776,916
	370	170	146,892	5,141,220	11,188,118	7,955,995
Total, 1941	612	325	246,475	8,626,625	12,386,925	8,808,480

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	106,000	$12,826	1,578,700	$105,773	1,500,700	$139,565	$468,923
Broadwater	27,000	3,267	700,700	46,947	165,600	15,401	613,667
Cascade	32,000	3,872	2,067,000	138,489	1,018,700	94,739	853,427
Deer Lodge	3,000	363					79,929
Fergus							61,919
Flathead	101,000	12,221	1,227,700	82,256			655,129
Granite	228,000	27,588	1,315,600	88,145	1,452,000	135,036	1,055,013
Jefferson	89,000	10,769	1,493,300	100,051	1,185,000	110,205	895,441
Judith Basin	115,000	13,915	3,407,000	228,269	1,751,000	162,843	566,458
Lewis and Clark	743,000	89,903	8,824,000	591,208	42,916,000	3,991,188	5,660,907
Lincoln			114,300	7,658			13,130
Madison	73,000	8,833	794,300	53,218	5,300	493	1,123,063
Meagher							2,175
Mineral			12,000	804	18,700	1,739	5,395
Missoula	700	85					70,608
Park	148,000	17,908	126,100	8,449	95,000	8,835	406,250
Phillips							210,489
Powell	1,300	157	30,700	2,057			57,366
Ravalli							33,787
Sanders	23,000	2,783	3,997,600	267,839	696,000	64,728	354,313
Silver Bow	280,698,000	33,964,458	14,411,000	965,537	58,626,000	5,452,218	46,942,464
	282,388,000	34,168,948	40,100,000	2,686,700	109,430,000	10,176,990	60,129,853
Total, 1941	256,072,000	30,216,496	42,518,000	2,423,526	121,420,000	9,106,500	59,181,627

Gold and silver produced at lode mines in Montana in 1942, 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	27,522	3,550	59,563	Mineral	94		270
Broadwater	43,375	11,479	39,337	Missoula	191	282	360
Cascade	77,208	2,765	730,620	Park	25,175	5,547	33,961
Deer Lodge	8,879	2,151	5,971	Phillips	52,539	5,226	38,783
Fergus	54,815	1,749	744	Powell	2,592	859	5,286
Flathead	27,879	370	770,206	Ravalli	50	31	
Granite	100,206	8,488	584,415	Sanders	24,274	126	20,219
Jefferson	53,622	7,180	155,139	Silver Bow	4,753,741	22,360	8,123,781
Judith Basin	36,724	221	216,135				
Lewis and Clark	317,474	7,731	297,083		5,678,280	105,650	11,181,181
Lincoln	890	64	2,527	Total, 1941	5,642,249	184,864	12,376,890
Madison	71,030	25,471	96,781				

Gold and silver produced at placer mines in Montana in 1942, 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	23	3	------	------	1,122	160	113	10	------	------	1,258	173
Broadwater	1,722	153	------	------	29	5	1,623	157	------	------	3,374	315
Deer Lodge	1	------	------	------	------	------	------	------	------	------	1	------
Fergus	5	------	------	------	------	------	------	------	------	------	5	------
Granite	63	5	------	------	------	------	------	------	2,549	220	2,612	225
Jefferson	12	------	------	------	623	208	------	------	8,233	3,188	8,868	3,396
Lewis and Clark	69	10	------	------	129	21	------	------	14,252	1,395	14,450	1,426
Lincoln	41	------	------	------	------	------	------	------	------	------	41	------
Madison	31	6	------	------	------	------	888	174	1,934	322	2,853	502
Meagher	62	7	------	------	------	------	------	------	------	------	62	7
Mineral	76	------	------	------	------	------	------	------	------	------	76	------
Missoula	29	------	------	------	1,696	31	------	------	------	------	1,725	31
Park	37	8	------	------	------	------	------	------	4,315	615	4,352	623
Powell	531	157	------	------	75	9	------	------	------	------	606	166
Ravalli	4	------	------	------	------	------	929	66	------	------	933	66
Sanders	5	------	------	------	------	------	------	------	------	------	5	------
Silver Bow	21	7	------	------	------	------	------	------	------	------	21	7
Total, 1941	2,732	356	------	------	3,674	434	3,553	407	31,283	5,740	41,242	6,937
	2,305	353	139	17	14,663	2,408	10,660	833	33,844	6,424	61,611	10,035

[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 copper mines at Butte by the Anaconda Copper Mining Co., at the expense of closing the zinc mines, caused the State output of copper to increase; and the closing of the zinc mines at Butte caused the production of silver, lead, and zinc to decrease. However, despite this decrease the output of zinc and zinc-lead ore increased in several counties, principally Judith Basin, Lewis and Clark, Beaverhead, and Granite. The widespread closing of gold mines, both lode and placer, resulted in a sharp drop in gold output. Metals from ores treated at amalgamation and cyanidation plants and ore shipped crude to smelters declined in 1942.

Decreases of 20,369 fine ounces in gold and 3,098 fine ounces in silver were noted in the yield from placer mines. Seven connected-bucket floating dredges were active in 1942. They treated 7,539,916 cubic yards of gravel and recovered gold valued at $1,094,905 indicating an average recoverable gold value of 14.5 cents per cubic yard treated. Dragline and power shovels with both dry-land and floating washing plants were reported in operation at 14 properties. The plants washed 976,651 cubic yards of gravel and recovered gold valued at $252,945, indicating an average recoverable gold value of 25.9 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 1942, 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	180	322,140	69,374	165,162	235,382	95,329	----------
Dry and siliceous gold-silver ore	45	77,231	8,224	489,357	199,954	481,266	----------
Dry and siliceous silver ore	54	134,153	3,395	1,573,091	1,436,737	1,183,832	----------
	279	533,524	80,993	2,227,610	1,872,073	1,760,427	----------
Copper ore	17	4,338,714	15,261	6,212,356	[1] 276,498,651	----------	----------
Lead ore	84	15,936	2,368	181,267	53,178	4,481,887	----------
Zinc ore	8	[2] 218,235	101	64,830	75,542	4,761,802	42,193,000
Zinc-lead ore	25	571,871	6,927	2,495,118	3,888,556	29,095,884	67,237,000
Total, lode mines	[3] 370	5,678,280	105,650	11,181,181	[1] 282,388,000	40,100,000	109,430,000
Total, placers	170	----------	41,242	6,937	----------	----------	----------
	540	5,678,280	146,892	11,188,118	[1] 282,388,000	40,100,000	109,430,000
Total, 1941	937	5,642,249	246,475	12,386,925	[4] 256,072,000	42,518,000	121,420,000

[1] Includes 5,327,407 pounds recovered from precipitates.
[2] Includes 204,362 tons of current slag fumed.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 5,503,585 pounds recovered from precipitates.

METALLURGIC INDUSTRY

The 5,678,280 tons of ore produced from Montana lode mines in 1942 were treated as follows: 12,773 tons at amalgamation plants, 239,166 tons at cyanidation plants, 4,977,953 tons at concentration mills, 244,026 tons shipped crude to smelters, and 204,362 tons treated at a slag-fuming plant.

Three cyanidation mills treated 75,730 tons of gold ore, which contained 4,281 ounces of gold and 18,260 ounces of silver; the bullion and precipitates produced yielded 3,603 fine ounces of gold and 14,934 ounces of silver, indicating an average recovery of 84 percent of gold and 82 percent of silver. These three mills reported the consumption of 23,247 pounds of sodium cyanide, 27,070 pounds of calcium cyanide, 11,915 pounds of zinc dust, and 259,780 pounds of lime.

Ore treated at straight concentration plants increased from 4,661,117 tons in 1941 to 4,977,953 tons in 1942. The 1942 total comprised 82,758 tons of siliceous ores, 4,319,953 tons of copper ore, 880 tons of lead ore, 2,491 tons of zinc ore, and 571,871 tons of zinc-lead ore.

The East Helena smelter operated continuously in 1942 and treated ores and concentrates chiefly from Montana and Idaho. The Anaconda Copper Mining Co. operated its electrolytic zinc plants at Anaconda and Great Falls throughout 1942. Zinc concentrates were received and treated from most of the Western States but principally from Montana, Idaho, Utah, Washington, Nevada, New Mexico, and California; the concentrates from New Mexico were treated upon a toll basis. In addition to treatment of concentrates from domestic sources, the Anaconda and Great Falls plants treated over 100,000 tons of zinc concentrates from foreign sources, chiefly upon a toll basis, for the accounts of the Metals Reserve Co., United States Smelting, Refining & Mining Co., and American Zinc Co. These foreign concentrates originated at mines in Australia, Canada, Chile, Mexico, and Peru. The Metals Reserve Co. maintains a stock pile of zinc concentrates at Anaconda, which are received into the Anaconda Copper Mining Co. account as smelting capacity permits. Currently the stock pile is equivalent to about a 20-day run. At the beginning of 1942 the plants comprised 4 units at Anaconda and 8

units at Great Falls. During the year the capacity was increased 25 percent, and at the beginning of 1943 the Anaconda section had 5 units and the Great Falls 10 units. As of April 1943, the Anaconda and Great Falls sections combined were producing at the rate of approximately 2,750,000 pounds of slab zinc, dross, and oxide per unit per month. At Anaconda the capacity of the copper concentrator was increased 20 percent—rated now as about 16,000 tons per day—and at the smelter an entirely new converter plant was erected.

Details of the treatment of all ores produced in Montana in 1942 are given in the tables that follow.

Mine production of metals in Montana in 1942, 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	12,773	956	207			
Ore and old tailings cyanided	239,166	27,061	66,202			
Concentrates smelted [1]	681,716	41,382	9,318,651	273,865,329	30,247,943	67,549,300
Copper precipitates smelted	4,644			5,327,407		
Ore smelted	244,026	36,251	1,768,711	3,195,264	5,987,057	1,500,700
Slag fumed	204,362		27,410		3,865,000	40,380,000
Placer		41,242	6,937			
		146,892	11,188,118	282,388,000	40,100,000	109,430,000
Total, 1941		246,475	12,386,925	256,072,000	42,518,000	121,420,000

[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 1942, 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)
Broadwater	846	324	41					
Granite	40	14	4					
Jefferson	210	72	22	7	19	145	244	1,786
Lewis and Clark	157	70	35	4	4	52		
Madison	8,633	116	37	296	1,451	236	9,962	
Park	2,747	308	67	309	319	146	900	
Powell	90	21	1					
Ravalli	50	31						
	12,773	956	207	616	1,793	579	11,106	1,786
Total, 1941	99,482	7,938	2,508	2,200	4,477	4,159	11,180	21,969

CYANIDATION MILLS

Beaverhead	11,000	2,949	432					
Broadwater	32,885	2,985	977	3,304	4,718	892	2,000	
Deer Lodge	8,252	2,053	1,039					
Fergus	54,804	1,743	741					
Granite	3,038	61	37					
Lewis and Clark	34,721	4,417	21,709					
Madison	39,900	7,066	3,139	256	2,892	1,432		
Phillips	52,466	5,075	38,052					
Silver Bow	2,100	712	76					
	239,166	27,061	66,202	3,560	7,610	2,324	2,000	
Total, 1941	443,388	56,293	166,587	143	1,888	815	1,156	22,550
Grand total: 1942	251,939	28,017	66,409	4,176	9,403	2,903	13,106	1,786
1941	542,870	64,231	169,095	2,343	6,365	4,974	12,336	44,519

Mine production of metals from concentrating mills in Montana in 1942, 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)
Broadwater	6,172	1,375	1,234	7,199	8,941	99,685	165,600
Cascade	77,083	4,273	2,524	682,001	29,747	2,034,462	1,018,700
Granite	24,906	2,483	56	80,068	52,193	1,085,797	1,452,000
Jefferson	28,893	2,445	306	74,524	46,561	918,347	1,185,000
Judith Basin	36,516	4,943	135	215,208	107,415	3,406,860	1,751,000
Lewis and Clark	65,102	7,535	556	223,838	702,326	4,632,165	2,536,000
Lincoln	890	103	64	2,527		114,300	
Madison	4,727	560	1,276	2,659	36,788	6,520	5,300
Mineral	94	45		270		12,000	18,700
Park	22,309	967	4,845	29,041	147,100	107,900	95,000
Powell	573	28	3	1,628	164	22,078	
Sanders	23,552	3,060	47	17,370	19,910	3,395,043	696,000
Silver Bow	4,687,136	649,723	20,933	7,979,415	272,701,078	14,411,000	58,626,000
	4,977,953	677,540	31,979	9,315,748	273,852,223	30,246,157	67,549,300
Total, 1941	4,661,117	660,251	53,681	10,097,415	247,693,040	29,468,528	83,918,000

Gross metal content of concentrates produced from ore mined in Montana in 1942, 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	5,194	10,586	3,137	15,626		
Dry silver	1,142	2,169	357,244	17,077	103,088	
Copper	556,914	21,034	6,179,917	273,256,772		
Lead	15,648	1,414	894,522	1,080,903	18,345,488	1,859,659
Lead-copper	4,979	461	212,013	670,537	5,068,261	583,171
Zinc	60,385	3,669	1,245,299	1,940,500	5,189,037	59,532,263
Zinc-lead	15,810	764	251,842	279,563	3,278,410	15,536,827
Dry iron (from zinc-lead ore)	21,644	1,285	174,677	336,598	582,975	1,689,997
	681,716	41,382	9,318,651	277,597,576	32,567,259	79,201,917
Total, 1941	662,594	60,046	10,102,389	252,652,104	32,047,952	97,392,428

Mine production of metals from Montana concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Broadwater	4,679	5,952	8,091	10,941	99,685	165,600
Cascade	4,273	2,524	682,001	29,747	2,034,462	1,018,700
Granite	2,483	56	80,068	52,193	1,085,797	1,452,000
Jefferson	2,452	325	74,669	46,805	920,133	1,185,000
Judith Basin	4,943	135	215,208	107,415	3,406,860	1,751,000
Lewis and Clark	7,539	560	223,890	702,326	4,632,165	2,536,000
Lincoln	103	64	2,527		114,300	
Madison	1,112	5,619	4,327	46,750	6,520	5,300
Mineral	45		270		12,000	18,700
Park	1,276	5,164	29,187	148,000	107,900	95,000
Powell	28	3	1,628	164	22,078	
Sanders	3,060	47	17,370	19,910	3,395,043	696,000
Silver Bow	649,723	20,933	7,979,415	272,701,078	14,411,000	58,626,000
	681,716	41,382	9,318,651	273,865,329	30,247,943	67,549,300
Total, 1941	662,594	60,046	10,102,389	247,705,376	29,513,047	83,918,000

Mine production of metals from Montana concentrates shipped to smelters in 1942, in terms of recovered metals—Continued

BY CLASSES OF CONCENTRATES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	5,194	10,586	3,137	14,287		
Dry silver	1,142	2,169	357,244	14,347	98,964	
Copper	556,914	21,034	6,179,917	269,915,706		
Lead	15,648	1,414	894,522	918,141	17,601,986	
Lead-copper	4,979	461	212,013	569,841	4,865,507	
Zinc	60,385	3,669	1,245,299	1,840,958	4,694,831	53,566,000
Zinc-lead	15,810	764	251,842	265,585	2,983,348	13,983,300
Dry iron (from zinc-lead ore)	21,644	1,285	174,677	326,464	3,307	
	681,716	41,382	9,318,651	273,865,329	30,247,943	67,549,300

Gross metal content of Montana crude ore shipped to smelters in 1942, 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	39,328	24,778	87,581	36,182	97,381	
Dry and siliceous gold-silver	75,081	7,814	462,819	188,292	537,483	
Dry and siliceous silver	84,418	1,093	988,073	1,757,844	280,346	
Copper	18,761	195	40,321	1,460,017		
Lead	15,056	2,310	178,748	62,019	4,560,090	
Zinc	11,382	61	11,169	89,166	874,432	2,382,291
	244,026	36,251	1,768,711	3,593,520	6,349,732	2,382,291
Total, 1941	267,670	60,587	2,105,406	3,112,577	10,570,644	

Mine production of metals from Montana crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	16,522	601	59,131	106,000	1,578,700	1,500,700
Broadwater	3,472	2,218	30,228	16,059	601,015	
Cascade	125	241	48,619	2,253	32,538	
Deer Lodge	627	98	4,932	3,000		
Fergus	11	6	3			
Flathead	27,879	370	770,206	101,000	1,227,700	
Granite	72,222	8,357	504,306	175,807	229,803	
Jefferson	24,519	6,783	80,448	42,195	573,167	
Judith Basin	208	86	927	7,585	140	
Lewis and Clark	13,132	2,684	24,039	40,674	326,835	
Madison	17,770	12,670	89,278	26,250	787,780	
Missoula	191	282	360	700		
Park	119	75	4,707		18,200	
Phillips	73	151	731			
Powell	1,929	835	3,657	1,136	8,622	
Sanders	722	79	2,849	3,090	602,557	
Silver Bow	64,505	715	144,290	2,669,515		
	244,026	36,251	1,768,711	3,195,264	5,987,057	1,500,700
Total, 1941	267,670	60,587	2,105,406	2,863,039	9,950,953	

BY CLASSES OF ORE

Dry and siliceous gold	39,328	24,778	87,581	33,160	93,161	
Dry and siliceous gold-silver	75,081	7,814	462,819	181,428	428,825	
Dry and siliceous silver	84,418	1,093	988,073	1,417,119	238,401	
Copper	18,761	195	40,321	1,443,229		
Lead	15,056	2,310	178,748	53,178	4,367,969	
Zinc	11,382	61	11,169	67,150	858,701	1,500,700
	244,026	36,251	1,768,711	3,195,264	5,987,057	1,500,700

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Montana in 1942, 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	15		13,060	3,300		3,300	13,244		13,244	6,000	440,600		$155,164
Bannack	1	6	45	57	159	216	90	31	121	1,800			7,864
Big Hole		1			6	6		1	1				211
Blue Wing	2		20				540		540				384
Bryant	3		12,946	133		133	26,474		26,474	95,700	929,400	1,500,700	236,896
Elkhorn	1		57	4		4	519		519	1,900	1,000		806
Horse Prairie	1	3	284	13	1,093	1,106	1,693	141	1,834	200	172,700		51,609
Medicine Lodge	1		129				225		225	200	34,400		2,489
Vipond	3		981	43		43	16,778		16,778	200	600		13,500
Broadwater County:													
Backer	3	5	121	173	50	223	104	7	111		300		7,904
Beaver	9		2,684	1,417		1,417	30,091		30,091	22,700	467,600	165,600	120,470
Cedar Plains	9	3	39,011	8,775	4	8,779	5,535		5,535	4,000	170,000		323,075
Park or Indian Creek	15	11	1,559	1,114	3,320	4,434	3,607	308	3,915	300	62,800		162,218
Cascade County:													
Montana	10		77,094	2,765		2,765	730,101		730,101	32,000	2,049,300	977,400	848,031
Unorganized (Barker)	1		114				519		519		17,700	41,300	5,396
Deer Lodge County:													
Dry Gulch		1			1	1							35
Georgetown	3		8,361	2,141		2,141	1,156		1,156	2,000			75,999
Oro Fino	2		518	10		10	4,815		4,815	1,000			3,895
Fergus County:													
Cone Butte	1		11	6		6	3		3				212
North Moccasin	1	1	54,804	1,743	3	1,746	741		741				61,637
Warm Springs		1			2	2							70
Flathead County: Hog Heaven	3		27,879	370		370	770,206		770,206	101,000	1,227,700		655,129
Granite County:													
Boulder	5	1	648	731	3	734	1,336		1,336	7,700	1,600	17,300	29,288
Dunkleberg	3		22,507	18		18	54,824		54,824	44,100	1,052,400	1,149,400	222,357
First Chance	5	7	583	329	2,599	2,928	346	225	571				102,886
Flint Creek	6		75,908	6,900		6,900	526,275		526,275	175,900	238,600	285,300	679,543
Gold Creek	1		3	1		1	38		38		1,000		129
Henderson	1		59	1		1	1,094		1,094	300			849
Maxville	2		80	10		10	457		457		22,000		2,149
Red Lion	2		127	61		61	7		7				2,140
Rock Creek	1	1	291	437	2	439	38		38				15,392
Welcome Gulch		1			8	8							280

Jefferson County:													
Amazon	3		152	10		10	841		841	1,200	10,600		1,803
Big Foot	2		46	28		28	464		464		10,000	3,300	2,287
Boulder	1		6				218		218				155
Cataract	15	1	2,210	553	5	558	27,104		27,104	30,700	52,600		46,043
Clancey	2	2	27	6	8,688	8,694	246	3,358	3,604		3,400		307,081
Colorado	8		31,982	829		829	102,060		102,060	49,700	1,160,000	1,176,700	294,758
Elkhorn	6		2,036	70		70	13,701		13,701	1,300	77,700		17,556
Golconda	2		6	1		1	69		69		600		124
Homestake	1		7	2		2	45		45				102
Lowland	1		246	8		8	3,337		3,337	2,700			2,980
McClellan Creek	4		215	99		99	374		374	300			3,767
Mitchell	1		4	1		1	3		3				37
Montana City		4			171	171		38	38				6,012
Pipestone	1	1	3	2	4	6	3		3				212
Warm Springs	2		77	72		72	329		329	300	1,600	5,000	3,362
Whitehall	10		16,308	4,667		4,667	4,929		4,929	1,000	160,400		177,718
Wilson and Ticer Creeks	1		297	832		832	1,416		1,416	1,800	16,400		31,444
Judith Basin County:													
Barker	2		36,526	137		137	215,235		215,235	107,700	3,407,000	1,751,000	561,995
Yogo	1		198	84		84	900		900	7,300			4,463
Lewis and Clark County:													
Blue Cloud	1		9				59		59		1,700		156
Dry Gulch	3	1	10,174	1,656	2	1,658	1,710		1,710				59,246
Greenhorn		2			26	26							910
Heddleston	2		62,938	146		146	197,259		197,259	683,800	4,579,600	2,532,000	770,432
Helena	6	13	120	116	7,387	7,503	239	682	921		3,000		263,461
Lincoln	1	4	3		136	136	14	24	38		300		4,807
Marysville	12		24,155	4,085		4,085	21,264		21,264	4,300	54,700	4,000	162,653
Missouri River		1			6,884	6,884		713	713				241,447
Ophir Gulch	1		20	55		55	17		17	700			2,022
Rimini	12	1	993	162	7	169	10,845	7	10,852	1,800	115,300		21,575
Scratch Gravel	4		2,622	184		184	4,050		4,050	1,100	77,400		14,639
Smelter	2		210,345	15		15	30,098		30,098	36,100	3,976,900	40,380,000	4,048,088
Stemple-Gould	6	3	6,092	1,312	8	1,320	31,507		31,507	15,200	14,700		71,429
Wolf Creek	1		3				21		21		400		42
Lincoln County:													
Libby	2	6	890	64	30	94	2,527		2,527		114,300		12,745
Troy		1			3	3							105
West Fisher		1			8	8							280
Madison County:													
McCarthy Mountain	2		370	96		96	4,365		4,365	300	220,700		21,287
Norris and Norwegian	14	2	14,765	7,323	491	7,814	4,649	59	4,708	100			276,850
Pony and South Boulder	5		4,863	1,398		1,398	2,693		2,693	36,700			55,286
Renova	5		10,564	9,818		9,818	60,871		60,871	700			387,001
Rochester	14		1,280	284		284	5,656		5,656	11,300	194,000		28,327
Sand Creek	1		2	1		1							35
Sheridan	13	1	2,737	515	8	523	8,429		8,429	6,700	278,000		43,736
Silver Star	8		35,531	5,410		5,410	3,600		3,600	16,900	57,600	5,300	198,307
Tidal Wave	9		196	215		215	1,073		1,073	100	42,300		11,134
Virginia City	14	9	684	371	908	1,279	5,341	180	5,521	200			48,715
Washington	3	2	38	40	1,446	1,486	104	263	367		1,700		52,385

Mine production of gold, silver, copper, lead, and zinc in Montana in 1942, 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:													
Beaver and Thomas		6			62	62		7	7				$2,175
Mineral County:													
Cedar and Trout		19			76	76							2,660
Iron Mountain	1		94				270		270		12,000	18,700	2,735
Missoula County:													
Coloma	3		172	281		281	291		291				10,042
Elk Creek		1			1	1							35
Nine Mile		6			1,724	1,724		31	31				60,362
Wallace	1		19	1		1	69		69	700			169
Park County:													
Emigrant		9			4,352	4,352		623	623				152,763
New World	2		22,376	4,847		4,847	33,743		33,743	147,100	126,100	95,000	228,723
Sheepeater	1		2,799	700		700	218		218	900			24,764
Phillips County: Little Rockies	2		52,539	5,226		5,226	38,783		38,783				210,489
Powell County:													
Big Blackfoot	1	3	16	16	346	362	28	131	159		300		12,803
Finn		4			102	102		14	14				3,580
Nigger Hill	5	3	624	35	6	41	2,098		2,098	1,300	28,000		4,960
Ophir Gulch	1	3	1	1	45	46		7	7				1,615
Pioneer		5			107	107		14	14				3,755
Yourname Creek	1		91	28		28	3		3				982
Zozell	5		1,860	779		779	3,157		3,157		2,400		29,671
Ravalli County: Overwich	1	3	50	31	933	964		66	66				33,787
Sanders County:													
Eagle	1		23,195	38		38	20,025		20,025	17,000	3,997,600	696,000	350,194
Plains	1		10				14		14	1,700			216
Revais Creek	1		800	12		12	83		83	4,300			999
Vermillion	1	1	269	76	5	81	97		97				2,904
Silver Bow County:													
Divide Creek	1		9	4		4	45		45				172
German Gulch		1			10	10		4	4				353
Highland	1		2,100	712		712	76		76				24,974
Lost Child		1			2	2							70
Melrose	1	1	19		2	2	329		329	200			328
Summit Valley	25	7	4,751,613	21,644	7	21,651	8,123,331	3	8,123,334	280,697,800	14,411,000	58,626,000	46,916,567
Total Montana	370	170	5,678,280	105,650	41,242	146,892	11,181,181	6,937	11,188,118	282,388,000	40,100,000	109,430,000	60,129,853

BEAVERHEAD COUNTY

Argenta district.—The Ermont Mines, Inc., was again the chief gold producer in the Argenta district. In 1942 the company operated its 100-ton countercurrent cyanide mill until about October 15, when all work stopped. During the 9½ months of activity the mill treated about 11,000 tons of gold ore, equivalent to about one-third of that treated in 1941. The decreased output of ore was due to a shortage of miners. Virtually all the remainder of the district output was lead ore.

Bannack district.—Placer gravels in 1942 continued to be the chief source of gold in the Bannack district. The Ralph E. Davis Syndicate operated its dragline dredge at the Grasshopper Creek placer until May 11, and the Traderhorn Mining & Construction Co. operated its dry-land dredge at the Rimrock placer until April 30.

Bryant district.—A total of 12,863 tons of siliceous tailings, crude lead ore, and old zinc slag was shipped direct to Utah smelters from the Hecla and Greenwood mines in 1942 by L. D. Foreman. Most of the 12,863 tons shipped was old zinc slag (11,382 tons) from the Hecla slag dump and contained about 2.5 percent lead and 10 percent zinc, in addition to the other usual lead blast-furnace slag constituents. The slag was shipped to Tooele and there treated first in the lead blast furnace, followed by treatment in the slag-fuming plant. The remaining production from the district was copper ore shipped crude to Washoe.

Horse Prairie (Colorado) district.—Virtually all the placer output from the Horse Prairie district in 1942 came from the Chinatown property of Associated Placers, Inc., on Colorado and Jeff Davis Creeks and the Golden Leaf property of W. C. McLeod on Jeff Davis Creek. Both operators used dry-land dredges and washed a total of 106,000 cubic yards of gravel. Hoffman & Steele shipped 284 tons of lead ore in 1942 to Midvale (Utah) from the H. & S. mine.

Vipond district.—Most of the production from the Vipond district in 1942 was silver ore shipped to Washoe from the Lone Pine & Argyle property.

BROADWATER COUNTY

Backer district.—The Superior mine was the chief source of lode gold; its output comprised gold ore shipped direct to a smelter and gold ore amalgamated. Most of the placer output came from a dry-land dredge operated in Confederate Gulch by R. G. Woodard.

Beaver district.—The value of the metal production from the Beaver district in 1942 was much lower than in 1941 because the output of gold ore was smaller. Lead ore and zinc-lead ore, both rich in gold, were shipped from the East Pacific and East Pacific Tunnel No. 4 to East Helena and Anaconda zinc concentrator, respectively, and gold ore from the Vosburg property was shipped crude to East Helena. The remainder of the lode output was crude ore shipped direct to smelters and was chiefly gold ore from the Edna No. 2, Custer Group, Iron Age, and Martha Washington properties.

Cedar Plains district.—The M & M Mining Co. was again the leading producer in the district and treated 32,000 tons of gold ore from the Ohio Keating mine in its 100-ton cyanidation-concentration mill. The property, unlike most other gold properties in Broadwater County, was active throughout 1942 and is still active in 1943. The

C. G. Gold Corporation operated the Keating mine and its 100-ton flotation concentrator until May 1, 1942, when all work ceased for the duration of the war.

Park district.—The most important lode producer in the Park district was again the Marietta mine, from which gold ore (112 tons) and lead ore (269 tons) were shipped direct to smelters. The output from placer operations continued to be the chief source of gold in the district, but it was less than half that produced in 1941. A. R. Douglas, the outstanding producer in the district, operated a dry-land dredge on Indian Creek until September, when all activity ceased. The Cooley Gravel Co., formerly the chief producer in the district, operated until October 14, when all work ceased.

CASCADE COUNTY

Montana district.—The Montana district reported a substantial decrease in output of gold, silver, lead, and zinc in 1942 compared with 1941. Zinc-lead ore from the Broadwater group treated by the Klies Mining Co. in its 80-ton flotation mill amounted to 23,783 tons compared with 29,190 tons in 1941. The ore treated in 1942 had a higher silver and gold content but a lower zinc and lead content, which explained most of the decrease in the zinc and lead output of the district. In addition to ore from the Broadwater group, the company milled 5,082 tons of silver-lead ore from the Graham and Hollowbush group. The latter group was closed indefinitely on December 31. Silver ore milled by the Lexington Mining Co. from the Big Seven Group represented nearly half of the silver output of the district. In 1942 the company treated about 22,000 tons of silver ore compared with 32,718 tons in 1941 in its 100-ton flotation mill and made high-grade silver concentrates. In addition, 74 tons of lead ore rich in silver were shipped direct to East Helena. The Florence Co. operated the Florence mine throughout 1942 but closed its mill in September; the remainder of the year was spent developing the mine. During the period of operation about 11,000 tons of silver ore were milled in the company 75-ton flotation mill, making lead concentrates. Silver ore from the Star group was treated in the New London Mining Corporation 40-ton flotation mill, making lead concentrates. The Queen Leasing Co. operated the Queen of the Hills mines through March, when the property was closed. The 60-ton flotation mill was dismantled and moved from the property.

DEER LODGE COUNTY

Georgetown district.—The Sentinel Mines, Inc., operated the Holdfast-Southern Cross group from January until August, when all activity stopped. During this period 8,252 tons of gold ore were treated in the company 65-ton countercurrent cyanidation mill, yielding 2,053 ounces of gold and 1,037 ounces of silver.

FERGUS COUNTY

North Moccasin district.—The North Moccasin Mines Syndicate operated its Barnes-King open-cut mine throughout 1942 and treated 54,804 tons of gold ore by cyanidation compared with 75,535 tons in 1941. Gold occurs in porphyry, limestone, and clays, which are carried to the cyanide mill on a conveyor belt and leached.

FLATHEAD COUNTY

Hog Heaven district.—The Anaconda Copper Mining Co. operated its Flathead mine throughout 1942, although the rate of output declined considerably during the latter part of 1942. During the year the company shipped 23,024 tons of highly siliceous silver ore crude to Washoe and 4,395 tons of lead ore crude to East Helena. The West Flathead, also owned and operated by the Anaconda Copper Mining Co., produced 448 tons of high-grade silver ore, all of which was shipped direct to Washoe.

GRANITE COUNTY

Boulder district.—High-grade gold ore from the Gold King and Gold Mountain mine was shipped crude to East Helena in 1942 and represented most of the district output.

Dunkleberg district.—Virtually all of the output of the Dunkleberg district in 1942 was zinc-lead ore from the Forest Rose and Wasa mines, both operated by the Forest Rose Syndicate. The Wasa properties are under lease to the Forest Rose Syndicate and are contiguous to the Forest Rose mine. According to the Forest Rose Syndicate, work was started on the Wasa and Monarch properties in 1942, and considerable fine oxide cappings underlaid by sulfide ores were investigated at shallow depth. This work is promising, showing as much as 12-foot widths of fair-grade zinc-lead ore. Roads have been built to connect the properties. An aggregate of 22,500 tons of zinc-lead ore (Forest Rose and Wasa mines), which averaged about 4 percent zinc and 4 percent lead, was treated in 1942 in the Forest Rose 100-ton flotation mill. The output of zinc and lead concentrates produced was nearly double that in 1941.

First Chance district.—Most of the placer gold output in 1942 was recovered from the floating connected-bucket dredge of the Star Pointer Exploration Co., which operated in Bear Gulch. The company operated its electrically powered Yuba dredge from January through October and handled 1,308,700 cubic yards of gravel. Crude gold ore shipped direct to smelters comprised the output from lode mines and came principally from lessee operations on the Mitchell-Mussigbrod and Grant and Hartford groups.

Flint Creek district.—Old tailings from the Granite-Bimetallic mine continued to be the chief source of metal output from the Flint Creek district. In 1942 the Philipsburg Mining Co., operator of the mine, shipped over 66,000 tons of these tailings direct to the Tacoma, Washoe, and East Helena smelters, for flux. The Moorlight Mining Co. operated the True Fissure mine and shipped crude lead and silver ore direct to East Helena and Washoe, respectively, and zinc ore to the Anaconda zinc concentrator. The Marie Leasing Co. operated the Marie mine throughout 1942 and shipped 68 tons of crude lead ore and 1,080 tons of rich silver ore direct to smelters; the ore was extracted concurrently with the mining of manganese ore. Manganese-ore tailings from the Trout mine, which contained gold and silver, were cyanided in a 50-ton cyanide plant; operations were suspended in July.

Rock Creek district.—The only lode production in the Rock Creek district in 1942 was from the MacDonald (Ella) mine.

JEFFERSON COUNTY

Cataract district.—The Basin Montana Tunnel Co., although inactive itself in 1942, granted leases for the purpose of cleaning up the Comet 200-ton flotation mill and shipping ore from the Grey Eagle dump. These lessees shipped a total of 793 tons of gold-silver ore and were the largest producers in the district. Other production included crude gold-silver ore from the Crystal, Hope, and Morning Glory mines and lead ore from the Crescent mine.

Clancey district.—Winston Bros. Co. operated its 6-cubic foot electrically driven Yuba bucket dredge in 1942 from January 14 to October 15, when all work was suspended. During the period of operation the bucket dredge washed 1,520,042 cubic yards of gold-bearing gravel compared with 2,157,277 in 1941. The company was again the largest producer of placer gold in Montana. The remainder of the placer output came from operation of a dry-land dredge on Clancey Creek by Jefferson Placers.

Colorado district.—The value of the metal output from the Colorado district in 1942 increased compared with 1941 because of much larger output of base metals. The Monongahela-Mount Washington Mining Co. started operations on its Mount Washington property April 7 and continued the rest of the year. During the operating period, 28,799 tons of zinc-lead ore were treated in the company 150-ton flotation mill, resulting in the production of 1,050 tons of lead concentrates and 1,350 tons of zinc concentrates. The lead concentrates were smelted at East Helena, Mont., and the zinc concentrates at Amarillo, Tex. In addition to the zinc-lead ore milled, the company shipped 329 tons of crude lead ore to East Helena, and a lessee shipped 252 tons from the Mount Washington dump. The company, although active for only 9 months in 1942, was one of the major producers of lead and zinc in the State.

Elkhorn district.—Most of the output from the Elkhorn district in 1942 came from the Elkhorn mine, from which 1,720 tons of silver dump ore were shipped to a smelter.

Montana City district.—Two dry-land dredges treated a total of 10,943 cubic yards of gold-bearing gravel (recovering 168 ounces of gold and 38 ounces of silver) and supplied nearly all the district output in 1942.

Whitehall district.—A lessee operated the Golden Sunlight mine, which was again by far the largest producer in the district, and shipped over 15,000 tons of gold ore crude to Washoe.

Wilson Creek district.—Gold ore shipped crude to a smelter and gold ore amalgamated and concentrated from the Callahan group (Deer Horn) comprised the only output from the Wilson Creek district in 1942.

JUDITH BASIN COUNTY

Barker district.—Virtually all the output of the Barker district in 1942 was derived from the zinc-lead ores of the Block P group, operated by the St. Joseph Lead Co. Rehabilitation work on the Block P mine and 400-ton flotation mill was begun in 1941, and by early 1942 the work was completed and actual mining and milling operations started. During the year the mill treated over 36,000 tons of zinc-lead ore, making about 2,900 tons of lead concentrates and about 2,000 tons of zinc concentrates.

LEWIS AND CLARK COUNTY

Dry Gulch district.—The Golden Messenger Corporation operated its Golden Messenger mine until March, treated about 10,000 tons of ore by cyanidation, and recovered 1,446 ounces of gold and 1,568 ounces of silver.

Heddleston district.—The Mike Horse Mining & Milling Co. operated the Mike Horse mine and its flotation mill throughout 1942 and more than doubled the 1941 output of zinc and copper, while the output of lead was increased substantially. The company increased its milling capacity from 150 tons a day to 200 tons and treated nearly 63,000 tons of zinc-lead-copper ore, which made about 4,500 tons of lead-copper concentrates and about 2,800 tons of zinc concentrates. The mill was operated three shifts a day 7 days a week.

Helena district.—Porter Bros. Corporation operated its 6-cubic foot Yuba dredge in 1942 from January 1 to October 18, when work was suspended temporarily. On December 8 the dredge was again active and remained in operation the rest of the year. A total of 1,455,393 cubic yards of gravel was washed in 1942 compared with 1,864,078 in 1941, supplying nearly all the placer gold output in the Helena district. Lode production came from several small mines, including the Court House, Spring Hill, and Whitlatch.

Lincoln district.—The Missoula Lincoln Metals Co. operated a dry-land dredge on the Blue Bird placers from June 1 to August 1 and produced nearly all the placer output of the district in 1942. Crude silver ore from the Silver Egal mine was shipped to East Helena.

Marysville district.—The Martin Mining Co. continued to be the most important producer in the district and in 1942 treated 17,888 tons of old tailings in its 120-ton cyanidation mill. The tailings were mined from the Eck, Brown, and Chevalier ranches by power shovel, hauled to the cyanidation mill, and there roasted, crushed, and cyanided and the gold and silver precipitated. All work was suspended October 5. The Montana Rainbow Mining Co. and individual lessees operated the Drumlummon mine. The production in 1942 comprised 2,117 tons of gold ore, which contained 880 ounces of gold and 3,460 ounces of silver and was shipped crude to East Helena. The company also moved a 160-ton flotation-amalgamation mill from near Libby to the property. The Silver Crescent, Inc., operated the Belmont mine from March 1 to September 5; during this time the company treated 2,594 tons of ore in the 60-ton Drumlummon cyanide mill, which was remodeled in 1941. The company also shipped 177 tons of gold ore crude to East Helena. H. E. Luderer treated gold-silver ore in a 35-ton flotation mill and made 112 tons of lead concentrates, which were shipped to East Helena.

Missouri River district.—The Perry-Schroeder Mining Co. operated its 6-cubic foot Yuba dredge on the Missouri River, 15 miles north of Helena, throughout 1942 and washed 1,869,500 cubic yards of gold-bearing gravel. No platinum was reported recovered in 1942 from this operation.

Rimini district.—The South Dakota Mining Associates acquired control of a large number of mines, dumps, and prospects in the Rimini district in 1942 and shipped test lots of siliceous and lead ore from many of the properties, the more productive being the Bunker Hill, Evergreen, Free Speech, Lexington, Mineral Deposit, and

Transit claims. The aggregate production was 354 tons of lead ore and 268 tons of siliceous gold-silver ore.

Scratch Gravel district.—Most of the output from the Scratch Gravel district in 1942 was siliceous dump ore from the Helena mine dump shipped crude to East Helena.

Smelter district.—The slag-fuming plant at East Helena, owned and operated by the Anaconda Copper Mining Co., was active throughout 1942, and the output of zinc-lead fume was considerably greater than in 1941. The company treated 204,362 tons of current slag and old slag from the East Helena lead smelter and produced zinc-lead fume valued at approximately $4,025,000. The American Smelting & Refining Co. re-treated about 5,900 tons of gold-silver-lead-copper slag in 1942.

Stemple district.—The Gould mine, operated by the Standard Silver-Lead Mining Co., was again the leading producer in the district in 1942, although all work was suspended March 1. During the first 2 months of the year the company treated 4,239 tons of gold ore in its 100-ton cyanidation mill and recovered 714 ounces of gold and 5,078 ounces of silver from bullion shipped to the mint. The company also shipped several tons of crude gold ore and some rich cleanings to East Helena. The Swan Sea Mines, Inc., treated about 1,500 tons of gold-silver ore in a concentrating mill, making 120 tons of lead-copper concentrates, which were shipped to East Helena.

LINCOLN COUNTY

Libby district.—Most of the lode output in the Libby district in 1942 came from the Snowshoe group of properties, operated by Snowshoe Mines & Co. The company operated the property from April 12 to November 9 and treated about 880 tons of lead ore in its 60-ton flotation mill, making 102 tons of lead concentrates.

MADISON COUNTY

McCarthy Mountain district.—Mueller Bros. operated the B. B. & I. E. property throughout 1942 and shipped 349 tons of silver-lead ore crude to East Helena; the remainder of the district output was a test lot of gold ore shipped crude to Washoe and a little gold ore amalgamated from the Hidden Treasure mine.

Norris district.—The Boaz mine operated its 50-ton cyanide-concentration mill all of 1942 on company and custom ore. On company account 13,349 tons of ore were treated, yielding 3,719 fine ounces of gold and 2,089 ounces of silver in bullion and 255 tons of gold concentrates containing 2,882 ounces of gold and 1,420 ounces of silver. The Grubstake mine shipped 111 tons of crude gold ore, which contained 293 ounces of gold, to Washoe and 5 tons of gold ore for treatment at the Boaz mill; this property was the second-largest producer in the district in 1942. The Montana Coal & Iron Co. operated the Golconda mine from January 1 to June 23 and shipped crude gold ore to Washoe; after June, all equipment was removed and the property was abandoned. Other producers included the Red Bluff, Madisonian dump, and Heleene mine. Homer Wilson operated a floating connected-bucket dredge (5-cubic foot Yuba) on the Norwegian Placer claim from May to September 8 and washed 265,000 cubic yards of gravel, recovering 489 fine ounces of gold and 59 ounces of silver.

Pony district.—Gold ore from the Mammouth mine, which was operated all year by the Liberty Montana Mines Co., continued to be the chief source of metal in the district. The company treated 4,687 tons (17,585 in 1941) in its 120-ton flotation-gravity concentration mill, making 28 tons of gold concentrates and 514 tons of copper concentrates.

Renova district.—The West Mayflower mine, owned and operated by the Anaconda Copper Mining Co., was by far the largest producer in the district, and in 1942 the company shipped to Washoe 10,367 tons of ore, which contained 9,670 ounces of gold and 60,688 ounces of silver.

Rochester (Rabbit) district.—Gold ore from the Thistle mine, lead ore from the Jack Rabbit mine, and copper ore from the Ellen Marshall mine, all shipped crude to smelters, comprised most of the output from the Rochester district in 1942.

Sheridan district.—The Sheridan Gold Mining & Milling Co. remained the largest producer in the Sheridan district in 1942 and operated the Toledo group and Uncle Sam mine. The Toledo group was active during the first 10 months of 1942; then Victoria Mines, Inc., Silverstar, Mont., took over the lease and option held by the Sheridan Gold Mining & Milling Co. During the period of activity at the Toledo group, 1,673 tons of high-grade lead ore and 326 tons of gold ore were shipped crude to smelters; the Uncle Sam mine produced 98 tons of crude gold ore. The Standard Silver Lead Mining Co. operated the Buckeye mine and shipped 497 tons of gold-silver ore to a smelter. Several other small lode mines were active in 1942; most of them shipped crude gold ore to smelters.

Silver Star district.—The Victoria Mines, Inc., was the chief producer in the district in 1942 and treated about 26,000 tons of gold ore in its 125-ton cyanidation mill; in addition, the company shipped 398 tons of rich crude gold-lead ore to East Helena and 476 tons of gold ore to Washoe. The cyanide mill was closed in the fall of 1942 but is expected to reopen to treat base-metal ores from the Toledo group of properties in the Sheridan district. The Green Campbell Mining Co. treated about 8,000 tons of gold ore in its 25-ton amalgamation-concentration mill and ranked second in output in the district. The mill and property were closed in late 1942, but the mill is expected to reopen to treat chrome ore from local producers.

Tidal Wave district.—The output from the district in 1942 came from several small lode mines and was of two classes—gold and lead. The largest producers of gold ore were the Agitator and Carolina mines and the largest producers of lead ore the Last Chance and Keystone mines.

Virginia City district.—In 1942 virtually all the ore produced in the Virginia City district was gold and gold-silver ore shipped crude to smelters. The principal producers were the Prospect, U. S. Grant, Kearsarge, Alameda, Easton, and Bartlett properties. R. E. Davis operated a dry-land dredge in 1942 on Barton Gulch, washed 83,945 cubic yards of gravel, and recovered virtually all the placer gold produced in the district.

Washington district.—The Gold Creek Mining Co. operated its bucket dredge in 1942 until November 1, when all activity was suspended indefinitely. Approximately 400,000 cubic yards of gravel were washed, which yielded 1,445 ounces of fine gold and 263 ounces of

silver. Lode production was crude gold and lead ore shipped direct to smelters.

MINERAL COUNTY

Iron Mountain district.—Zinc-lead ore from the Little Anaconda group was shipped to the Bauer mill (Utah); it comprised the only output from the Iron Mountain district in 1942.

MISSOULA COUNTY

Nine Mile district.—Most of the placer output from the Nine Mile district in 1942 came from operation of a dry-land dredge by the Beaver Dredging Co. from March 3 to June 2, when all placer activity was suspended for the duration of the war. During the operating period 267,000 cubic yards of gravel were treated, yielding 1,696 ounces of gold and 30 ounces of silver.

PARK COUNTY

Emigrant Creek district.—The Emigrant Dredging Co. operated its 10-cubic foot electrically powered Yuba dredge from January 1 until October 15, 1942, when all work was suspended for the duration of the war. During its active period the dredge treated 1,048,668 cubic yards of gravel, which yielded 4,315 ounces of gold and 615 ounces of silver.

New World district.—The McLaren Gold Mines Co. operated its Estelle property and 100-ton flotation mill in 1942 until October 28, with a shut-down between May 21 and July 1. During the active periods in 1942 the mill treated 19,809 tons of gold ore, making 753 tons of copper concentrates (rich in gold), which were shipped to Washoe. All operations were suspended indefinitely after the mill was destroyed by fire on October 28. The Irma Mines, Inc., operated its Irma property until August 15, when Willow Creek Mines, Inc., Montana Operation, took over the property and worked it until December 19 to permit sampling the mine. In 1942 the Irma property produced an aggregate of about 2,500 tons of zinc-lead ore, which was milled in the Irma mill, and 67 tons of crude lead ore, which was shipped direct to East Helena.

Sheepeater (Jardine) district.—The Jardine Mining Co., only operator in the Jardine district in 1942, closed its mine and 225-ton amalgamation-concentration mill in January 1942. A program to develop the arsenic ore bodies in the mine was undertaken October 1, 1942, under contract with the Chemical Warfare branch of the Army.

PHILLIPS COUNTY

Little Rockies district.—The Ruby Gulch Mining Co. worked the Ruby Gulch property in 1942 until the last of August, when operations were suspended indefinitely. During 8 months of activity about 45,600 tons of gold ore were treated in the company 300-ton cyanidation mill. The Little Ben Mining Co. suspended operations at the Little Ben mine in June.

POWELL COUNTY

Finn district.—Ray W. Crumb operated a dry-land dredge in Madison Gulch and produced nearly all the placer output of the Finn district in 1942.

Nigger Hill district.—Hopkins & Sons Mining Co. operated the Charter Oak mine throughout 1942 and was the chief producer in the district. The first 7 months of the year were spent in developing the property and building a 50-ton flotation mill. In August the mill was put into operation, and during the rest of the year 573 tons of silver ore were treated, which made 28 tons of lead concentrates. The remainder of the output was ore of several classes shipped crude to smelters and came chiefly from the Lilly group, Evening Star, and Cyclone properties.

Zozell (Emery) district.—The Bonanza mine, operated by the Bonanza Leasing Co. in 1942, was by far the chief source of mineral output in the Zozell district. It yielded 1,706 tons of gold ore shipped crude to a smelter. Other producers in the district were the Hidden Hand, Emma Darling, and Bull Moose properties, from which crude ore was shipped to smelters.

RAVALLI COUNTY

Overwich district.—A dragline dredge was operated by the J. L. Shiely Co., Inc., on Hughes Creek in the Overwich district from April 6 to June 16, 1942.

SANDERS COUNTY

Eagle district.—The Jack Waite mine extends over the State line into Idaho; however, all production in 1942 came from that portion within Montana. The property was operated throughout 1942 by the American Smelting & Refining Co. and produced 22,752 tons of zinc-lead ore containing 19,111 ounces of silver, 3,758,630 pounds of lead, and 1,032,940 pounds of zinc. The ore was milled in the company 300-ton flotation plant and made 2,209 tons of lead concentrates and 819 tons of zinc concentrates. In addition, the mine produced 443 tons of high-grade crude lead ore, which was shipped direct to East Helena. The grade of mill ore treated was lower in 1942 than in 1941. The 300-ton flotation plant, situated in Idaho, was active one shift a day, 6 days a week in 1942.

Revais Creek district.—The Green Mountain Mining Co. operated the Drake property in 1942, treated about 800 tons of ore in its 50-ton flotation mill, and made 32 tons of copper concentrates.

Other districts.—C. N. Franck produced 269 tons of gold ore from the Shoestring No. 1 mine in the Vermillion district in 1942; it was shipped to Washoe. Operators of the Glaucus mine in the Plains district shipped 10 tons of copper ore crude to Washoe.

SILVER BOW COUNTY

Output of all metals except copper from mines in Silver Bow County decreased in 1942 owing to curtailment of operations at all zinc mines of the Anaconda Copper Mining Co. after May 25. The following table gives the output of mines in Silver Bow County, which includes the Butte or Summit Valley district, in 1941 and 1942 and the total from 1882 to the end of 1942.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1941–42, and total, 1882–1942, in terms of recovered metals

	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
1941	[1] 65	4,421,641	29,485	8,993,693	254,863,000	17,260,900	76,140,400	$44,195,725
1942	38	4,753,741	22,381	8,123,788	280,698,000	14,411,000	58,626,000	46,942,464
1882–1942	-------	[2]	1,975,192	525,901,025	[3] 6,147,029	[3] 222,942	[3] 1,539,204	2,465,049,603

[1] Corrected figure.
[2] Figures not available.
[3] Short tons.

Butte or Summit Valley district.—All productive mines of the Anaconda Copper Mining Co. maintained capacity operations during 1942 commensurate with the current supply of available labor. The company-operated zinc mines at Butte were operated until in May, when the labor shortage at both zinc and copper mines became so acute that all zinc mines were closed and the mine labor was transferred to the copper mines. During the remainder of the year only a small production came from company-owned zinc mines, and it was incidental to the mining of copper. The aggregate output from all copper mines, dumps, and tailings piles exceeded that in 1941 by 10 percent. The copper concentrator at Anaconda treated 3,287,817 tons of copper ore from company-owned Butte mines compared with 2,869,051 tons in 1941, and 4,589 tons of mine-water precipitates were treated compared with 4,500 in 1941. In addition the copper concentrator at Anaconda treated 241,526 tons of mine-dump material averaging about 1 percent copper compared with 405,862 tons in 1941, 727,464 tons of Old Works tailings and Upper Old Works tailings averaging slightly over 1½ percent copper, and 16,365 tons of New Works tailings averaging less than 1 percent; crude ore smelted amounted to 18,193 tons, and old tailings totaled 42,268 tons. The North Butte Mining Co. property was reopened in 1942 and operated by the Anaconda Copper Mining Co. under a contract agreement. The output from this property amounted to 46,781 tons of copper milling ore and 55 tons of copper precipitates. During the period of activity at the zinc mines they produced 307,900 tons of zinc-lead ore compared with 472,133 tons in 1941. All ores were treated in the company zinc concentrator at Anaconda. Development work in 1942 at all copper mines comprised 232,748 feet of drifts, 201 feet of shafts, and 19,301 feet of diamond drilling; at all zinc mines, 33,068 feet of drifts, 991 feet of shafts, and 1,607 feet of diamond drilling. Operations were continued throughout 1942 at the Emma mine, leased from the Butte Copper & Zinc Co. by the Anaconda Copper Mining Co. Production amounted to 13,583 tons of zinc-lead ore and 30,286 tons of zinc-lead sulfide concentrates (middlings from the treatment of manganese ore), all treated at the zinc concentrator. Development at the Emma mine comprised 1,263 feet of shafts and 1,882 feet of diamond drilling in the zinc section of the mine and 26,454 feet of drifts and 1,725 feet of diamond drilling in the manganese section. At other manganese mines operated by the Anaconda Copper Mining Co. at Butte, development totaled 3,864 feet of drifts and 479 feet of diamond drilling. It is notable that the total advance of 297,397

feet (excluding shafts) in 1942 was higher than in any year of record.

Lessees of the Anaconda Copper Mining Co. operated several company properties; the most productive were the Poulin, which yielded zinc-lead ore containing over 4,000,000 pounds of zinc and nearly a million pounds of lead, and the Black Rock group, which yielded 2,218 tons of silver ore and 46 tons of zinc ore. All lessee operations were on a much smaller scale in 1942 than in 1941.

Highland district.—The Butte Highland Mining Co. operated the Highland group (Tilton) and its 75-ton cyanide mill in 1942 until about April, when the property was closed owing to the low grade of the ore.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By CHARLES WHITE MERRILL AND H. M. GAYLORD

SUMMARY OUTLINE

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SUMMARY

The total value of gold, silver, copper, lead, and zinc recovered from ore, old tailings, and gravels in Nevada decreased 8 percent in 1942 compared with 1941; all five metals except copper decreased in both quantity and value. Copper production—167,326,000 pounds—was the largest in the State's history; in value it exceeded each year since 1929. Higher wages, enlistment of miners in the armed forces, migration of miners to war industries and military construction jobs, rising prices of supplies and equipment and difficulties in obtaining them, increased taxes, and fixed prices for gold and silver were factors in reducing the total output, despite Nevada's great mineral resources and the war demand on many of them. War Production Board Order L–208 of October 8, 1942, terminated activities at some large gold mines (many small and some large had closed previously). Probably base-metal mines obtained some much-needed skilled miners as a result of the order and thereby benefited. There was very little evidence, however, that the order itself had much effect on the 1942 decline in gold production (because of reprieves) or in stimulating base-metal output.

Comparing 1942 with 1941, gold output decreased 19 percent and silver 36 percent in both quantity and value; copper increased 6 percent in quantity and 9 percent in value; and lead decreased 44 percent in quantity and 34 percent in value and zinc 33 percent in quantity and 16 percent in value. Of the total value of the five metals copper comprised 57 percent, gold 29 percent, silver 7 percent, zinc 5 percent, and lead 2 percent.

White Pine County increased its lead over other counties and produced 59 percent of the State total value of the five metals; this county stood first in output of copper and gold. Lincoln County produced 8 percent of the State total value and ranked second to White Pine County; it led in the State in silver, zinc, and lead 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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1938–42, and total, 1859–1942, 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
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
1941	799	78	8,799,635	366,403	12,824,105	5,830,238	4,145,947
1942	434	49	9,383,379	295,112	10,328,920	3,723,435	2,647,776
1859–1942 [2]			[3]	25,070,558	556,031,206	584,429,765	536,926,177

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	157,822,000	18,622,996	19,246,000	1,097,022	30,258,000	2,269,350	38,959,420
1942	167,326,000	20,246,446	10,752,000	720,384	20,394,000	1,896,642	35,840,168
1859–1942 [2]	[4] 1,549,157	440,740,968	[4] 522,335	55,828,767	[4] 269,036	37,359,926	1,626,887,044

[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 1942, inclusive, the output was as follows: Gold, 13,243,681.51 ounces, valued at $311,547,973; silver, 296,016,916 ounces, $199,767,954; copper, 1,547,231 tons, $440,094,340; lead, 284,544 tons, $33,192,205; zinc, 269,036 tons, $37,359,926; total value, $1,021,962,398.
[3] Figures not available.
[4] Short tons.

Gold.—Gold production in Nevada continued near the 1941 rate through May 1942, but thereafter a decline set in; the September output was about two-thirds that of May. The production curve showed no downward break for October and November but declined

somewhat in December, indicating some reaction to War Production Board Order L–208, but general economic conditions overshadowed the Government order in causing the decrease from 1941 in output of gold. The 10 leading gold-producing mines in 1942 supplied 74 percent of Nevada's output, and the 5 leaders contributed 56 percent. By the end of the year, however, operations at all but the leading three had been suspended. The War Production Board permitted Getchell Mine, Inc., to continue because of its byproducts—tungsten and arsenic—and gave limited permission to operate to the Manhattan dredge, because the operators were in a narrow canyon and equipment was subject to destruction by cloudbursts.

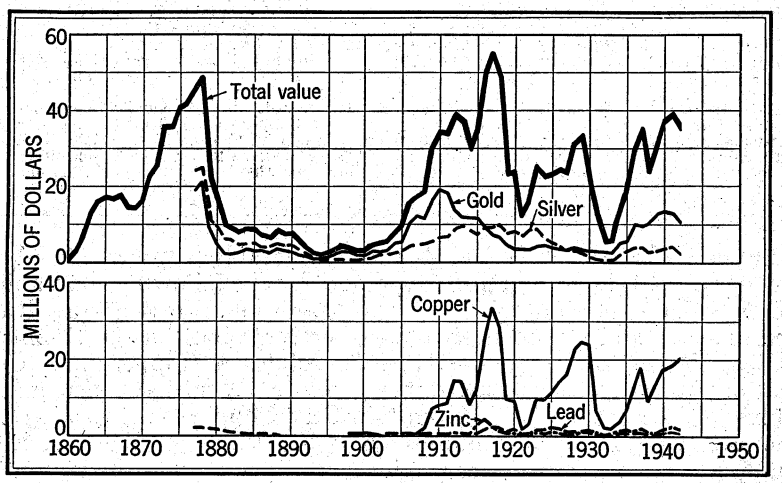

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada, 1860–1942.

Ten leading gold-producing mines in Nevada in 1942, in order of output

Rank	Mine	District	County	Rank in 1941	Operator	Source of gold
1	Getchell	Potosi	Humboldt	1	Getchell Mine, Inc	Gold ore.
2	Ruth and Copper Flat Pit.	Robinson	White Pine	2	Nevada Consolidated Copper Corporation.	Copper ore.
3	Coppermines group	do	do	3	Consolidated Coppermines Corporation.	Do.
4	Manhattan dredge	Manhattan	Nye	4	Manhattan Gold Dredging Co.	Dredge.
5	Dayton dredge	Silver City	Lyon	9	Dayton Dredging Co	Dragline dredge.
6	Goldacres	Bullion	Lander	42	Willow Creek Mines, Inc	Gold ore.
7	Overman	Comstock	Storey	8	Consolidated Chollar Gould & Savage Mining Co.	Do.
8	Keystone	do	do	10	Dayton Consolidated Mines Co. and lessees.	Do.
9	Northumberland	Northumberland.	Nye	7	Northumberland Mining Co.	Do.
10	Gold Standard	Imlay	Pershing	6	Standard Cyaniding Co	Do.

Silver.—The 10 leading silver-producing mines in Nevada in 1942, listed in the following table, produced 61 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; only 25 percent was derived from straight silver ore.

Ten leading silver-producing mines in Nevada in 1942, in order of output

Rank	Mine	District	County	Rank in 1941	Operator	Source of silver
1	Nivloc	Silver Peak	Esmeralda	1	Desert Silver, Inc.	Silver ore.
2	Mizpah	Tonopah	Nye	4	Various lessees	Gold-silver ore.
3	Bristol Silver	Jack Rabbit	Lincoln	5	Bristol Silver Mines Co.	Copper ore.
4	Pioche Nos. 1 and 2	Pioche	do	2	Combined Metals Reduction Co.	Zinc-lead ore.
5	Rip Van Winkle	Merrimac	Elko	18	Rip Van Winkle Consolidated Mining Co.	Lead ore.
6	Financier	Pioche	Lincoln	24	W. A. Free	Do.
7	Dan Tucker	Sand Springs	Churchill	6	Summit King Mines, Ltd.	Gold-silver ore and old tailings.
8	Ruth and Copper Flat Pit.	Robinson	White Pine	11	Nevada Consolidated Copper Corporation.	Copper ore.
9	Adelaide Crown	Gold Run	Humboldt	16	Adelaide Crown Mines	Gold-silver ore.
10	El Dorado-Rover group.	Eldorado Canyon.	Clark	7	El Dorado-Rover Mining Co.	Gold-silver ore and old tailings.

Copper.—Over 98 percent of the recoverable copper output of Nevada in 1942 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 (both in the Robinson district, White Pine County); the Consolidated Coppermines Corporation, working the Coppermines group 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). The State copper-production capacity was increased in March when the International Smelting & Refining Co. placed in operation its new 350-ton concentrator at the Copper Canyon Lease property (in the Battle Mountain district, Lander County).

Lead.—Over half the lead produced in Nevada in 1942 was mined in the Pioche district, Lincoln County, where Pioche Nos. 1 and 2 operated by the Combined Metals Reduction Co., the Financier operated by the Salt Lake-Pioche Mining Co. and lessees, and the Prince operated by the Prince Consolidated Mining Co. were the leading properties. Other important producers were the Rip Van Winkle Consolidated Mining Co., Rip Van Winkle mine (in the Merrimac district, Elko County); Hall Bros. Co., Inc., Tybo mine (in the Tybo district, Nye County); and Bristol Silver Mines Co., Bristol Silver mine (in the Jack Rabbit district, Lincoln County).

Zinc.—As in recent years, zinc production was centered in the Pioche district, Lincoln County, where 88 percent of the State total was mined in 1942. The Combined Metals Reduction Co. and the Prince Consolidated Mining Co. were the principal producers. The addition of a slag-fuming plant for recovering zinc from lead blast-furnace slag and from oxidized zinc ore at the Tooele (Utah) plant of the International Smelting & Refining Co. offered a new market to some Nevada miners.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1942, 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	12		4,058	$142,030			4,058	$142,030	200,018	$142,235
Clark	27		8,035	281,225			8,035	281,225	201,562	143,333
Douglas	1		1	35			1	35	1,066	758
Elko	38	3	1,477	51,695	76	$2,660	1,553	54,355	210,921	149,988
Esmeralda	41	4	12,662	443,170	59	2,065	12,721	445,235	714,680	508,217
Eureka	17	5	833	29,155	206	7,210	1,039	36,365	17,903	12,731
Humboldt	23	2	53,360	1,867,600	45	1,575	53,405	1,869,175	252,249	179,377
Lander	26	3	19,877	695,695	108	3,780	19,985	699,475	124,017	88,190
Lincoln	23		2,693	94,255			2,693	94,255	739,274	525,706
Lyon	29	2	3,021	105,735	21,660	758,100	24,681	863,835	26,679	18,972
Mineral	22	2	848	29,680	21	735	869	30,415	50,209	35,704
Nye	64	11	18,094	633,290	24,645	862,575	42,739	1,495,865	448,903	319,220
Pershing	28	13	10,711	374,885	478	16,730	11,189	391,615	22,254	15,825
Storey	24	1	33,150	1,160,250	12	420	33,162	1,160,670	298,654	212,376
Washoe	10		300	10,500			300	10,500	7,020	4,992
White Pine	49	3	78,638	2,752,330	44	1,540	78,682	2,753,870	408,026	290,152
	434	49	247,758	8,671,530	47,354	1,657,390	295,112	10,328,920	3,723,435	2,647,776
Total, 1941	799	78	329,506	11,532,710	36,897	1,291,395	366,403	12,824,105	5,830,238	4,145,947

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill			30,000	$2,010			$286,275
Clark			170,000	11,390	456,000	$42,408	478,356
Douglas							793
Elko	14,352,000	$1,736,592	1,860,000	124,620	896,000	83,328	2,148,883
Esmeralda	2,000	242	22,000	1,474			955,168
Eureka	2,000	242	30,000	2,010			51,348
Humboldt	16,000	1,936	222,000	14,874	8,000	744	2,066,106
Lander	1,272,000	153,912	196,000	13,132	2,000	186	954,895
Lincoln	1,380,000	166,980	6,640,000	444,880	18,004,000	1,674,372	2,906,193
Lyon	108,000	13,068					895,875
Mineral	18,000	2,178	316,000	21,172	146,000	13,578	103,047
Nye	6,000	726	1,072,000	71,824			1,887,635
Pershing	18,000	2,178	64,000	4,288	16,000	1,488	415,394
Storey							1,373,046
Washoe	6,000	726	2,000	134			16,352
White Pine	150,146,000	18,167,666	128,000	8,576	866,000	80,538	21,300,802
	167,326,000	20,246,446	10,752,000	720,384	20,394,000	1,896,642	35,840,168
Total, 1941	157,822,000	18,622,996	19,246,000	1,097,022	30,258,000	2,269,350	38,959,420

[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 in Nevada has been the principal cause of the increasing tonnage of ore treated since 1940. Production of copper ore increased 15 percent in 1942 compared with 1941, and the quantity of dry and siliceous ore and old tailings sold or treated declined 26 percent. There was a short-lived revival of old-tailings cyanidation in Nevada, when a 1,000-ton plant went into operation at Millers, Esmeralda County, March 6.

The connected-bucket dredge of the Manhattan Gold Dredging Co. in the Manhattan district, Nye County, was again the largest producer

of placer gold and the fourth largest of total gold in the State; the dragline operation in the Silver City district, Lyon County (started January 1, 1941, by the Dayton Dredging Co.), made the second-largest placer-gold and the fifth-largest total gold output in the State in 1942. In addition to these large placer operators, 1 dragline dredge, 2 nonfloating washing plants with mechanical excavators, 2 hydraulic mines, 36 (19 dry) small-scale hand-method mines, and 7 drift mines were in operation. Quicksilver consumption at placer mines was 162 pounds in 1942.

ORE CLASSIFICATION

The following table classifying ores produced in Nevada in 1942 shows that 84 percent of the tonnage (including old tailings) sold or treated was copper ore, 9 percent gold ore and old tailings, 4 percent gold-silver ore and old tailings, 1 percent each zinc-lead ore and silver ore, and the remainder zinc ore, lead ore, and lead-copper 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 Nevada in 1942, 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	895,992	1,777	136,793	260,775	43,400	9,100	----------
Dry and siliceous gold-silver ore	259,148	78,826	26,509	1,238,568	25,600	371,400	8,000
Dry and siliceous silver ore	80,837	830	3,000	919,570	10,500	282,300	2,000
	1,235,977	81,433	166,302	2,418,913	79,500	662,800	10,000
Copper ore	7,904,443	----------	78,548	558,330	[1] 167,169,500	714,200	89,800
Lead ore	25,673	6,408	1,432	434,355	70,700	5,229,200	988,800
Lead-copper ore	7	----------	----------	44	600	2,200	----------
Zinc ore	47,522	----------	537	87,425	5,400	778,900	8,584,600
Zinc-lead ore	81,916	----------	939	204,388	300	3,364,700	10,720,800
Total, lode mines	9,295,538	87,841	247,758	3,703,455	[1] 167,326,000	10,752,000	20,394,000
Total, placers	----------	----------	47,354	19,980	----------	----------	----------
Total, 1941	9,295,538	87,841	295,112	3,723,435	[1] 167,326,000	10,752,000	20,394,000
	8,789,982	9,653	366,403	5,830,238	157,822,000	19,246,000	30,258,000

[1] Includes 6,172,600 pounds from precipitates.

METALLURGIC INDUSTRY

Of the 9,383,379 tons of lode material from Nevada sold or treated during 1942, 85 percent went to concentrating mills, 13 percent to amalgamation and cyanidation mills, and 2 percent to smelters; of the total, less than 1 percent was old tailings—all amalgamated, cyanided, or smelted. Flotation was employed at concentration mills to the virtual exclusion of gravity concentration. Of the gold recovered as bullion, cyanidation supplied 94 percent and amalgamation 6 percent; of the silver recovered as bullion, 99.5 percent was derived by cyanidation and 0.5 percent by amalgamation. The total quantity of crude ore and old tailings shipped to smelters in 1942 declined 29 percent compared with 1941.

The new 350-ton flotation mill built by the International Smelting & Refining Co. at the Copper Canyon mine in the Battle Mountain district, Lander County, began operation in March 1942. The year 1942, however, witnessed suspension of operations at many mills, particularly after promulgation of Order L–208 by the War Production Board.

Quicksilver consumed in Nevada in 1942 at mills using amalgamation totaled 930 pounds in recovering 8,521 ounces of gold and 7,239 ounces of silver from 89,857 tons of material.

Data obtained on cyanide consumption in 1942 at Nevada mills are nearly complete. In the treatment of 796,193 tons of ore, 36,968 tons of old tailings, and 200 tons of concentrates, 389,867 pounds of 91-percent sodium cyanide and 1,490,526 pounds of commercial-grade calcium cyanide (50-percent NaCN equivalent) were used, with a recovery of 104,984 ounces of gold and 1,213,552 ounces of silver; in terms of 98-percent NaCN the consumption was 1,092,401 pounds, or 1.31 pounds to the ton of material treated compared with 0.98 pound in 1941.

Mine production of metals in Nevada in 1942, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore and old tailings amalgamated	89,857	8,521	7,239			
Ore, old tailings, sands, slimes, and concentrates cyanided	1,167,244	134,064	1,506,409			
Concentrates smelted:						
Flotation	327,966	83,107	947,561	153,652,300	6,000,000	18,757,100
Gravity	94	854	8,497		19,300	
Ore and old tailings smelted	143,032	21,212	1,233,749	7,501,100	4,732,700	1,636,900
Precipitates				6,172,600		
Total, lode mines		247,758	3,703,455	167,326,000	10,752,000	20,394,000
Total, placers		47,354	19,980			
		295,112	3,723,435	167,326,000	10,752,000	20,394,000
Total, 1941		366,403	5,830,238	157,822,000	19,246,000	30,258,000

All of Nevada's custom cyanide mills suspended operations during 1942. The leading ones were operated by the Dayton Consolidated Mines Co., Silver City, Lyon County; Adelaide Crown Mines, Gold Run district, Humboldt County; Silver State Milling Corporation, Westgate, Churchill County; and Ohio Mines Corporation, Gold Point, Esmeralda County. Most of these mills received the major part of their mill feed from mines controlled by the mill operators. The 500-ton selective-flotation mill, operated by the Combined Metals Reduction Co. at Pioche, Lincoln County, treated zinc-lead and zinc ores upon a custom basis for several neighboring mines and also milled company zinc-lead ore. The Nevada Consolidated Copper Corporation treated all the copper ore produced by the Consolidated Coppermines Corporation upon a contract basis, in addition to milling its own ore. The Nevada Consolidated Copper Corporation also operated the McGill copper smelter, which was Nevada's only smelter and the most important metallurgical plant in the State.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1942, 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	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	41		13	10						
Clark	21,160		370	564	271	2,504	28,770			
Elko	670		219	181						
Esmeralda	43		55	14						
Humboldt	1,812		551	272						
Lander	1,412		497	83						
Lincoln	70		11	32						
Lyon	33	50	14	6						
Mineral	101		26	18						
Nye	6,974		2,650	2,802						
Pershing	2,879		1,721	1,378	24	346	626		200	
Storey	52,827	1,499	2,133	1,788	1	32	26			
Washoe	282		251	89	1	4	4			
White Pine	4		10	2						
	88,308	1,549	8,521	7,239	297	2,886	29,426		200	
Total, 1941	250,335	367	25,757	19,120	390	3,832	44,754	1,000		

CYANIDATION MILLS

Churchill	15,103	3,339	4,032	198,217	1	9	95			
Clark	60,928	18,530	4,250	158,923	33	281	7,103		900	
Douglas		4	1	1,066						
Elko	266		140	2,042						
Esmeralda	81,725	56,600	8,844	666,856						
Humboldt	385,505	120	50,680	141,036	59	324	1,562	1,600	9,800	3,900
Lander	85,207		12,662	2,921						
Lyon	7,025	53	2,922	15,842	5	66	11	100		
Mineral	321		184	1,894						
Nye	80,658		10,860	11,488						
Pershing	119,543		8,498	6,982						
Storey	249,894	1,589	30,985	296,802						
Washoe	34		5	382						
White Pine		800	1	1,958						
	1,086,209	81,035	134,064	1,506,409	98	680	8,771	1,700	10,700	3,900
Total, 1941	1,420,579	5,161	185,170	2,236,009	42	601	10,189			
Grand total:										
1942	1,174,517	82,584	142,585	1,513,648	395	3,566	38,197	1,700	10,900	3,900
1941	1,670,914	5,528	210,927	2,255,129	432	4,433	54,943	1,000		

[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 Nevada in 1942, in terms of recovered metals

BY COUNTIES

	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Elko	121,398	26,473	467	185,088	9,664,000	1,480,300	830,800
Esmeralda	2	1	1	34			
Humboldt	8,500	1,768	1,208	106,575	13,000	204,000	
Lander	86,640	6,458	4,729	56,566	1,145,800	300	
Lincoln	130,393	23,658	1,463	293,014	1,000	4,210,400	17,914,200
Mineral	200	9		5,057		7,000	
Nye	5,724	271	1	39,909	2,300	87,200	
Pershing	28	12		323		2,200	8,200
White Pine	7,654,570	269,015	72,526	231,295	142,824,500	17,000	
	8,007,455	327,665	80,395	917,861	153,650,600	6,008,400	18,753,200
Total, 1941	7,042,097	325,648	73,209	1,565,093	147,168,200	14,463,600	29,270,000

BY CLASSES OF CONCENTRATES

Dry gold	165	60	386		4,700	5,500
Dry gold-silver	1	1	34			
Copper	299,793	77,513	302,484	153,609,900	300	
Lead	9,085	2,306	516,209	34,000	5,708,600	509,900
Zinc	18,621	515	98,748	6,700	294,800	18,237,800
	327,665	80,395	917,861	153,650,600	6,008,400	18,753,200

Gross metal content of concentrates produced from ores mined in Nevada in 1942, 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	517	3,335	30,900	2,329	10,905	8,719
Dry gold-silver	34	282	7,137		963	
Copper	299,793	77,513	302,484	155,894,621	349	
Lead	9,091	2,316	516,745	42,597	5,953,290	809,294
Zinc	18,625	515	98,792	8,352	330,448	20,294,393
	328,060	83,961	956,058	155,947,899	6,295,955	21,112,406
Total, 1941	326,080	77,642	1,620,036	150,737,250	15,193,908	34,258,607

Mine production of metals from Nevada concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	1	9	95			
Clark	304	2,785	35,873		900	
Elko	26,473	467	185,088	9,664,000	1,480,300	830,800
Esmeralda	1	1	34			
Humboldt	1,827	1,532	108,137	14,600	213,800	3,900
Lander	6,458	4,729	56,566	1,145,800	300	
Lincoln	23,658	1,463	293,014	1,000	4,210,400	17,914,200
Lyon	5	66	11	100		
Mineral	9		5,057		7,000	
Nye	271	1	39,909	2,300	87,200	
Pershing	36	346	949		2,400	8,200
Storey	1	32	26			
Washoe	1	4	4			
White Pine	269,015	72,526	231,295	142,824,500	17,000	
	328,060	83,961	956,058	153,652,300	6,019,300	18,757,100
Total, 1941	326,080	77,642	1,620,036	147,169,200	14,463,600	29,270,000

BY CLASSES OF CONCENTRATES

Dry gold	517	3,335	30,900	1,700	9,200	5,500
Dry gold-silver	34	282	7,137		900	
Copper	299,793	77,513	302,484	153,609,900	300	
Lead	9,091	2,316	516,745	34,000	5,713,900	509,900
Zinc	18,625	515	98,792	6,700	295,000	18,241,700
	328,060	83,961	956,058	153,652,300	6,019,300	18,757,100

Gross metal content of Nevada crude ore and old tailings shipped to smelters in 1942, by classes of material

Class of material	Material shipped		Gross metal content				
	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	18,551		11,303	30,742	44,821	5,166	28,319
Dry and siliceous gold-silver	31,367	322	6,886	474,878	14,870	201,498	5,292
Dry silver	16,826	26	564	209,073	9,225	270,037	3,018
Copper	57,401		1,035	255,846	[1] 13,894,767	796,768	142,307
Lead	9,214	6,408	1,403	261,762	67,996	3,764,858	217,592
Lead-copper	7			44	733	2,312	
Zinc	2,375		14	693	6,667	70,715	1,479,398
Zinc-lead	535		7	711	405	122,844	255,191
	136,276	6,756	21,212	1,233,749	[1] 14,039,484	5,234,198	2,131,117
Total, 1941	197,544	4,125	40,937	1,941,040	11,096,748	5,267,456	1,209,269

[1] Includes 6,236,762 pounds of copper contained in precipitates.

Mine production of metals from Nevada crude ore and old tailings shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Material shipped		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	51		4	1,696		30,000	
Clark	1,691		630	6,202		169,100	456,000
Elko	13,299		651	23,600	4,688,000	379,700	65,200
Esmeralda	4,654		3,762	47,748	2,000	22,000	
Eureka	2,121		833	17,889	2,000	30,000	
Humboldt	2,697		597	2,794	1,400	8,200	4,100
Lander	7,846	4	1,989	64,433	126,200	195,700	2,000
Lincoln	24,223	200	1,219	446,228	1,379,000	2,429,600	89,800
Lyon	617		19	165	107,900		
Mineral	4,918		638	43,223	18,000	309,000	146,000
Nye	15,767	6,430	4,583	385,711	3,700	984,800	
Pershing	592		146	12,751	18,000	61,600	7,800
Washoe	191		40	6,545	6,000	2,000	
White Pine	57,609	122	6,101	174.764	[1] 7,321,500	111,000	866,000
	136,276	6,756	21,212	1,233,749	[1] 13,673,700	4,732,700	1,636,900
Total, 1941	197,544	4,125	40,937	1,941,040	10,652,800	4,782,400	988,000

BY CLASSES OF MATERIAL

Dry and siliceous gold	18,551		11,303	30,742	41,700	3,200	
Dry and siliceous gold-silver	31,367	322	6,886	474,878	12,600	161,100	4,100
Dry silver	16,826	26	564	209,073	8,100	171,100	2,000
Copper	57,401		1,035	255,846	[1] 13,559,600	713,900	89,800
Lead	9,214	6,408	1,403	261,762	45,400	3,530,900	158,000
Lead-copper	7			44	600	2,200	
Zinc	2,375		14	693	5,400	52,500	1,185,300
Zinc-lead	535		7	711	300	97,800	197,700
	136,276	6,756	21,212	1,233,749	[1] 13,673,700	4,732,700	1,636,900

[1] Includes 6,172,600 pounds of copper from precipitates.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1942, 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					
Churchill County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Alpine	1		15	7		7	3				$247
Broken Hills	1		1	5		5	4				178
Desert	1		25	1		1	3				37
Eastgate	2		896	270		270	2,513				11,237
Fairview	2		1,304	163		163	17,062		30,000		19,848
Holy Cross	1		14				350				249
Wonder	2		1,818	202		202	17,993				19,865
Clark County:											
Eldorado Canyon	6		99,826	7,121		7,121	198,090		1,000		390,166
Searchlight	10		1,017	897		897	2,205		200		32,976
Yellow Pine	11		1,266	17		17	1,267		168,800	456,000	55,214
Douglas County: Silver Glance	1		4	1		1	1,066				793
Elko County:											
Centennial	2		367	150		150	363		1,600		5,615
Contact	3		629	11		11	966	58,200			8,114
Cope	3	2	116,757	347	42	389	18,883	14,148,600			1,739,024
Delano	2		547	2		2	8,435	2,400	114,700	1,800	14,210
Ferber	1		6				11	500			69
Gold Circle	4		377	248		248	2,132				10,196
Island Mountain		1			34	34	3				1,192
Jarbidge	7		1,063	350		350	2,569	100			14,089
Lime Mountain	1		686	173		173	824	21,500			9,243
Mardis	1		43	150		150	100	600	200		5,407
Merrimac	1		12,416	28		28	168,694	24,300	1,455,600	829,800	298,576
Mud Springs	1		1				4		600		43
Railroad	2		1,371	10		10	4,843	15,000	217,800	1,900	20,379
Rock Creek	1		5	2		2	703				570
Spruce Mountain	4		198	2		2	2,004	2,400	53,500	2,000	5,556
Tecoma	1		53	1		1	236		15,400		1,235
Warm Creek	2		313				20		300	60,500	5,661
Esmeralda County:											
Desert	1		57	144		144	94				5,107
Divide	5		858	439		439	6,580				20,044
Dyer	1		46				2,496	100	1,800		1,908
Goldfield	7		2,736	1,736		1,736	944	1,000	200		61,565
Hornsilver	9		3,067	1,633		1,633	36,511	200	4,300		83,430
Klondyke	2		78	16		16	742	200	8,000		1,648
Lida	1	3	2	1	57	58	62				2,074

Lone Mountain	1		35	1		1	278	500	5,900		689
Palmetto	1		1	3		3					105
Silver Peak	12		79,544	8,459		8,459	649,206		1,800		757,844
Sylvania		1			2	2					70
Tonopah [4]	1		56,600	230		230	17,767				20,684
Eureka County:											
Cortez	2		1,077	451		451	6,598	2,000	15,400		21,751
Eureka	15		1,044	382		382	11,291		14,600		22,377
Lynn		5			206	206	14				7,220
Humboldt County:											
Awakening	5		1,594	297		297	198				10,536
Barrett Springs	5		8,782	1,472		1,472	106,678	13,000	204,100		142,628
Battle Mountain [4]	2		26	11		11	4				388
Gold Run	5	2	92,437	4,831	45	4,876	136,837	400	11,700	8,000	269,542
Paradise Valley	3		50	86		86	21				3,025
Potosi	1		295,624	46,625		46,625	8,442	2,600	6,200		1,638,608
Lander County:											
Battle Mountain [4]	12	2	92,857	6,126	106	6,232	105,962	1,196,500	188,700		450,891
Bullion	6	1	86,235	12,987	2	12,989	15,013	75,100	1,200		474,458
Hilltop	1		25	190		190	516				7,017
McCoy	1		500	69		69	200				2,557
New Pass	2		1,412	497		497	83				17,454
Reese River	4		80	8		8	2,243	400	6,100	2,000	2,518
Lincoln County:											
Comet	1		50	7		7	191		100		388
Eagle Valley	2		98	101		101	578				3,946
Ferguson	1		202	317		317	1,028				11,826
Groom	1		4,085	2		2	5,549	1,800	382,600		29,868
Jack Rabbit	3		17,394	141		141	242,644	1,372,900	713,300	89,800	399,745
Pahranagat	1		139				1,017	400	15,400		1,803
Pennsylvania	3		101	78		78	1,014	300	300		3,507
Pioche	11		132,817	2,047		2,047	487,253	4,600	5,528,300	17,914,200	2,455,110
Lyon County:											
Buckskin	1		187	63		63	58	1,400			2,415
Cambridge	1		62	2		2	1				71
Palmyra	3		242	132		132	1,198				5,472
Silver City	14	2	5,942	2,365	21,660	24,025	19,973				855,078
Talapoosa	3		768	378		378	5,268				16,976
Yerington	6		576	11		11	170	106,500			13,393
Mineral County:											
Aurora	2		9	12		12	52				457
Bell	2		1,765	102		102	9,381	16,000	194,600	146,000	38,793
Columbus	3		957	294		294	12,139	2,000	92,700		25,375
East Walker	1		3	2		2	7				75
Garfield	2		2,379	343		343	22,974		13,800		29,267
Hawthorne	5		317	60		60	5,251		11,900		6,631
Marietta	3		18	12		12	330		3,000		862
Rand	2		19	11		11	14				395
Regent	2	2	73	12	21	33	52				1,192

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1942, 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					
Nye County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Athens	1		138	53		53	35				$1,880
Bellehelen	1		7	3		3	73				157
Belmont	1		22				245				174
Bruner	1		14	17		17	44				626
Bullfrog	6		831	398		398	1,762	400			15,231
Currant Creek	1		17	15		15	11				533
Eden	1		2	3		3	54				143
Golden Arrow	1		53	49		49	201				1,858
Hannapah	2		21	179		179	495				6,617
Jackson	2		75	70		70	384				2,723
Johnnie	1	1	90	3	15	18	3				632
Mammoth	3		37	16		16	367		400		848
Manhattan	17	8	3,024	1,808	24,589	26,397	9,873				930,916
Morey	1		287	17		17	6,868		2,700		5,660
Northumberland	1		79,445	10,145		10,145	8,577				361,174
Phonolite	1		71	37		37	411				1,587
Quartz Mountain	1		149	18		18	2,043	600	35,400		4,528
Reveille	1		2				21		300		35
Round Mountain	2	2	3,911	931	41	972	2,492				35,792
San Antone	2		528	17		17	6,179				4,989
Silver Bow	3		550	33		33	7,851				6,738
Tonopah [4]	5		11,555	3,480		3,480	316,945	500			347,244
Troy	1		1	5		5	8				181
Tybo	5		8,991	786		786	43,689	2,200	945,900		122,219
Union	2		5,729	2		2	40,251	2,300	87,300		34,820
Pershing County:											
Antelope	4	(6)	233	70	31	101	921	12,800	2,200	8,200	6,649
Central	2		195	8		8	6,822	300	17,400		6,333
Imlay	1	3	118,733	8,306	36	8,342	5,697				296,021
Jersey	1		96	5		5	2,395	700	33,400	7,800	4,926
Kennedy	3		161	63		63	1,925	4,200	700		4,129
Rochester	2	4	258	93	34	127	464		200		4,788
Rosebud	1	(6)	750	130	27	157	963				6,180
Sawtooth		2			14	14					490
Seven Troughs	7		2,449	1,852		1,852	1,797				66,098
Sierra	3		61	65		65	35				2,300
Staggs	1		40	68		68	976		7,300		3,563
Trinity	1		6	1		1	86		2,800		284
Unionville		2			10	10					350
Washiki	2		60	50		50	3				1,752
Willow Creek		2			326	326	170				11,531

Storey County: Comstock	24	1	281,616	33,150	12	33,162	298,654				1,373,046
Washoe County:											
Galena	1		39	1		1	83	1,000	200		228
Jumbo	1		24	6		6	3				212
Peavine	1		183	44		44	6,830	5,000	1,800		7,123
White Horse	7		261	249		249	104				8,789
White Pine County:											
Aurum	3		337				214	1,700	19,000	97,700	10,717
Bald Mountain	1		290	43		43	596	10,900			3,248
Cherry Creek	5		3,569	313		313	36,436				36,865
Eagle	1		12	1		1	177		4,900		489
Ellison	1		46	2		2	273	5,400			917
Granite	1		51	87		87	24				3,062
Newark	1		4				138				98
Osceola	2	3	3,412	3,367	44	3,411	1,233				120,262
Piermont	1		147	6		6	1,339				1,162
Robinson	23		7,692,785	74,609		74,609	273,939	[7] 150,126,400	80,100	768,300	21,048,229
Taylor	5		9,084	208		208	90,544				71,667
Ward	2		61	1		1	641	1,000	4,800		934
White Pine	3		3,307	1		1	2,472	600	19,200		3,152
Other districts [8]	8		15,571	3,530		3,530	162,322	78,500	300		248,497
Total Nevada	434	49	9,383,379	247,758	47,354	295,112	3,723,435	[7] 167,326,000	10,752,000	20,394,000	35,840,168

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 8 and 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: 3,703,455 ounces from lode mines and 19,980 ounces from placers.

[4] Tonopah district lies in both Esmeralda and Nye Counties.

[5] Battle Mountain district lies in both Humboldt and Lander Counties.

[6] Output from property not classed as a "mine."

[7] Includes 6,172,600 pounds of copper from precipitates.

[8] Includes following districts: Dixie Valley and Sand Springs in Churchill County; Dolly Varden in Elko County; National and Varyville in Humboldt County; Pine Grove in Lyon County; and Millett in Nye County.

CHURCHILL COUNTY

The Silver State Milling Corporation, reorganized successor to the Westgate Mining & Milling Corporation, discontinued its custom-cyanide-mill operations at Westgate early in 1942. Thus, the operators of a number of local properties in Churchill County were left without a profitable market for their ores.

Fairview district.—Lessees shipped lead ore to a smelter from the Chalk Mountain mine during 1942. Several groups of lessees worked the Nevada Hills mine; 1,253 tons of gold-silver ore shipped to custom cyanide mills yielded 159 ounces of gold and 15,366 ounces of silver.

Wonder district.—Erwin & Wauchope operated the Nevada Wonder mine from January 1 to June 30, 1942; 1,671 tons of gold-silver ore shipped to a custom-cyanide mill yielded 199 ounces of gold and 14,993 ounces of silver.

CLARK COUNTY

Eldorado Canyon district.—The El Dorado-Rover Mining Co. operated the Quaker City, Magnolia, Crown, and Nevada Eagle claims from January 1 to December 8, 1942; 25,587 tons of gold-silver ore and 530 tons of old tailings were treated in the company 150-ton cyanide mill; cyanide precipitates contained 2,641 ounces of gold and 123,482 ounces of silver, and 33 tons of concentrates shipped to a smelter contained 281 ounces of gold, 7,103 ounces of silver, and 963 pounds of lead. The Diamond Gold Mining Co. operated the Techatticup and Jubilee mines from January 1 to December 1; ore was treated in a 200-ton cyanide mill. W. W. Hartman operated the Wall Street mine throughout the year; gold ore was treated in a 60-ton amalgamation-flotation mill, and the resulting concentrates were shipped to a smelter.

Yellow Pine (Goodsprings) district.—J. Jacobson shipped oxidized zinc ore from the Green Monster mine to a smelter during 1942. The Defense Metals Co. shipped lead and zinc-lead ores from the Hoosier mine. Hammons & Reed and the Ingomar Mining Co., Inc., operated the Ingomar group; 176 tons of zinc-lead ore containing 27,637 pounds of lead and 106,738 pounds of zinc were shipped to a smelter. The Defense Metals Co. and R. K. Hamilton worked the Root Zinc mine during 1942; shipments consisted of 89 tons of lead ore containing 770 ounces of silver and 50,308 pounds of lead; 102 tons of zinc ore containing 10,248 pounds of lead and 82,170 pounds of zinc; and 29 tons of zinc-lead ore containing 8,193 pounds of lead and 7,501 pounds of zinc. L. F. Jacobson shipped 169 tons of zinc-lead ore containing 28,606 pounds of lead and 85,754 pounds of zinc from the Sultan mine between May 20 and October 1, when the smelting company ceased buying the ore and the operation was discontinued. H. C. Kennedy operated the Whale mine from March 19 to December 31; 44 tons of zinc ore shipped to a smelter contained 1,580 pounds of lead and 30,099 pounds of zinc. The principal product of the mine, however, was vanadium. The Yellow Pine Lease shipped zinc ore from the Yellow Pine mine to a smelter.

ELKO COUNTY

Contact district.—The Marshall Mining Co. operated the Delano and Allen mines as a unit from April 1 to December 31, 1942; 605

tons of copper ore containing 10 ounces of gold, 895 ounces of silver, and 56,997 pounds of copper were shipped to a smelter.

Cope (Mountain City) district.—The Mountain City Copper Co. (third-largest copper producer in Nevada) was active throughout 1942; part of the ore was treated in the company 400-ton flotation mill, and high-grade copper ore was shipped for direct smelting.

Delano district.—Lessees on the Cleveland mine shipped 192 tons of lead ore containing 1 ounce of gold, 4,655 ounces of silver, 1,592 pounds of copper, 58,823 pounds of lead, and 1,198 pounds of zinc during 1942. Lead ore was produced at the Net mine.

Dolly Varden district.—The International Smelting & Refining Co. carried on development at the Victoria mine from July to December, 1942; copper ore produced during this work and by a lessee was shipped to a smelter.

Gold Circle district.—Percy Collins operated the Miners Gold mine from July 1 to November 1, 1942; 205 tons of gold-silver ore were shipped to a custom cyanide mill, where 101 ounces of gold and 1,890 ounces of silver were recovered.

Jarbidge district.—A. M. Ross recovered 97 ounces of gold and 75 ounces of silver from the treatment of 350 tons of ore mined at the O. K. mine in 1942.

Lime Mountain district.—Lime Mountain Consolidated operated the Lime Mountain mine from May 4 to September 30, 1942; 686 tons of ore shipped to a smelter contained 173 ounces of gold, 824 ounces of silver, 22,186 pounds of copper, and 28,319 pounds of zinc.

Merrimac (Lone Mountain) district.—The Rip Van Winkle Consolidated Mining Co. treated 12,416 tons of lead ore in the company flotation mill and shipped to a smelter 1,137 tons of lead concentrates (containing 23 ounces of gold, 162,322 ounces of silver, 20,745 pounds of copper, and 1,505,103 pounds of lead) and 938 tons of zinc concentrates (containing 5 ounces of gold, 6,372 ounces of silver, 8,352 pounds of copper, 17,874 pounds of lead, and 932,347 pounds of zinc).

Spruce Mountain (Black Forest) district.—Lessees operated the Black Forest mine from January 1 to July 1, 1942; 141 tons of lead ore containing 1 ounce of gold, 1,710 ounces of silver, and 41,176 pounds of lead were shipped to a smelter. E. Parker worked the Humbug mine from January 1 to July 1 and shipped to a smelter 44 tons of lead ore containing 1 ounce of gold, 201 ounces of silver, 509 pounds of copper, and 13,160 pounds of lead.

Warm Creek (Polar Star) district.—Turner & Stoddard shipped to a smelter 312 tons of oxidized zinc ore (containing 6 ounces of silver and 85,034 pounds of zinc) from the dumps of the Polar Star mine between May 2 and June 22, 1942.

ESMERALDA COUNTY

Divide district.—Various lessees on the Divide mine shipped 812 tons of ore containing 430 ounces of gold and 5,929 ounces of silver during 1942.

Dyer district.—J. A. Molini & Son operated the Green Monster mine from March 1 to October 31, 1942; 46 tons of silver ore shipped to a smelter contained 2,496 ounces of silver and 2,996 pounds of lead.

Goldfield district.—Gold ore produced by various sets of lessees on the Goldfield Consolidated Mines Co. property was shipped to a

smelter during 1942; 2,269 tons of gold ore contained 1,192 ounces of gold, 503 ounces of silver, and 1,414 pounds of copper.

Hornsilver (Gold Point) district.—The Ohio Mines Corporation suspended operations of the Ohio group mine and the custom cyanide mill at the property during 1942.

Silver Peak district.—Price & Kunde worked the Francis mine and shipped ore to a smelter. E. L. Cord, operating as the Prescott Lease, worked the Mary mine from January to April 1942, when the lease was quit-claimed; 24,943 tons of ore treated in the company 350-ton flotation-cyanidation-leaching plant yielded bullion containing 5,213 ounces of gold and 1,674 ounces of silver, and 354 tons of ore shipped to a smelter contained 482 ounces of gold, 285 ounces of silver, and 1,109 pounds of copper; a small part of the production was the result of lease operation. Desert Silver, Inc., worked the Nivloc mine, leading silver producer in the State since 1938; the ore was treated in the company 175-ton cyanide mill.

Tonopah district.—In 1942 the Bradshaw Syndicate, Inc., completed construction of a 1,000-ton cyanide plant, designed to treat tailings at Millers. Operations began March 6 and were continued by the company until June, when Willow Creek Mines, Inc., took over the management. In all, 56,600 tons of old tailings yielding 230 ounces of gold and 17,767 ounces of silver were treated; work was stopped before the end of the year.

EUREKA COUNTY

Cortez district.—Lessees operated the Roberts group in 1942; 694 tons of gold-silver ore shipped to a smelter contained 158 ounces of gold, 5,993 ounces of silver, 1,135 pounds of copper, and 24,763 pounds of lead. Lessees operating the Ventura and Maid Queen mines shipped to a smelter 383 tons of ore containing 293 ounces of gold and 605 ounces of silver.

Eureka district.—Eureka Corporation, Ltd., operated the Oswego mine intermittently between January and October 1942; 342 tons of ore shipped to a smelter yielded 157 ounces of gold and 155 ounces of silver. Silver Rock Mines, Inc., worked the Wynona mine from January 1 to October 2 and shipped to a smelter 220 tons of silver ore containing 5 ounces of gold and 7,829 ounces of silver.

Lynn district.—C. E. and I. H. Lee operated the Gold Coin No. 1 mine on Sheep Creek from March 10 to July 27, 1942; 1,200 cubic yards of gravel treated by ground sluicing yielded 116 ounces of gold and 7 ounces of silver.

HUMBOLDT COUNTY

Awakening (Slumbering Hills) district.—Lessees operated the Alabama mine during 1942; 339 tons of ore treated by amalgamation yielded 58 ounces of gold and 15 ounces of silver, and 59 tons of ore shipped to a custom cyanide mill yielded 19 ounces of gold and 33 ounces of silver. Austin Bros. Gold Mining Co. worked the Jumbo mine from May 17 to November 11; 1,135 tons of ore treated in the company 25-ton amalgamation mill yielded 206 ounces of gold and 144 ounces of silver.

Barrett Springs (Ten-mile) district.—West Coast Mines, Inc., operated the Pansy Lee mine during the early months of 1942; gold-

silver ore was treated in the company 150-ton flotation mill, and the resulting lead concentrates were shipped to a smelter. The King Gold mine was active.

Gold Run (Adelaide) district.—Adelaide Crown Mines operated the Adelaide Crown mine from January 1 to December 7, 1942; in addition to treating ore from this mine, the company treated 1,556 tons of custom ore from 12 shippers.

Potosi district.—Getchell Mine, Inc., operated the Getchell mine throughout 1942. Oxidized ores (treated by cyanidation without roasting) were exhausted in September, and thereafter all ore was given a roast before cyanidation; additions were made to the roasting plant for the recovery of arsenic. In addition, a 250-ton scheelite flotation plant was installed, operation of which began in September.

LANDER COUNTY

Battle Mountain district.—Symanzik & Wrobel worked the Armour mine from March 1 to December 16, 1942; 2,864 tons of silver ore shipped to a smelter contained 185 ounces of gold, 30,262 ounces of silver, and 217,323 pounds of lead. The International Smelting & Refining Co. started operation of its newly constructed 350-ton flotation mill at the Copper Canyon mine early in 1942 and shipped copper ore and copper concentrates to a smelter. Broyles & Wilson worked the Independence mine the entire year and shipped to a smelter 555 tons of gold-silver ore containing 404 ounces of gold and 10,889 ounces of silver. Franzini & Macdonald worked the Palisades-Pinnacle group of claims from June 1 to November 15 and shipped to a smelter 226 tons of gold-silver ore containing 26 ounces of gold, 2,588 ounces of silver, and 8,895 pounds of lead.

Bullion district.—Willow Creek Mines, Inc., acting as manager for the Consolidated Goldacres Co., operated the Goldacres mine from March 7 to December 31, 1942, except for a short shut-down caused by War Production Board Order L–208; ore was treated by cyanidation. S. Dunham operated the Gold Quartz mine. The Little Gem Operating Co. shipped copper ore and flotation copper concentrates from the Little Gem mine.

New Pass district.—New Pass Mines worked the New Pass mine from January 1 to July 1, 1942; ore was treated in a 25-ton amalgamation mill. W. H. Smith worked the Thomas W. mine from January 1 to December 15; 315 tons of ore treated in a 5-stamp mill yielded 146 ounces of gold and 23 ounces of silver.

LINCOLN COUNTY

Groom district.—The I. M. C. Corporation and D. Sheahan operated the Groom mine during 1942; a 50-ton concentration-flotation mill was constructed, and lead ore and lead concentrates were shipped to a smelter.

Jack Rabbit (Bristol) district.—The Bristol Silver Mines Co. operated the Bristol Silver mine throughout 1942 and shipped ore to a smelter.

Pennsylvania district.—Crowe, Phelps & Johnston worked the Pennsylvania mine from January 1 to June 20, 1942; 46 tons of ore shipped to a smelter contained 54 ounces of gold and 564 ounces of silver.

Pioche district.—Amalgamated Pioche Mining & Smelting Corporation and a lessee shipped to a smelter silver ore, lead ore, and gold-silver old tailings from the Amalgamated Pioche mine. The Salt Lake-Pioche Mining Co. Apex and Financier mines were worked by lessees, who shipped lead ore to smelters; C. E. Bleak operated the Apex and W. A. Free the Financier. Ely Valley Mine worked the Ely Valley mine throughout 1942 and shipped zinc ore to the Combined Metals Reduction Co. custom mill at Pioche. Lessees worked the Nevada Volcano mine and shipped lead ore to a smelter. The Combined Metals Reduction Co. worked the Pioche Nos. 1 and 2 mines and treated the zinc-lead ore in the company mill at Pioche, except for a small quantity that was shipped to the company mill at Bauer, Utah. The Prince Consolidated Mining Co. shipped zinc ore to the Pioche custom mill of the Combined Metals Reduction Co. throughout the year and a small quantity of lead ore to a smelter. Hall Bros. Co., Inc., shipped gold-silver ore from the Raymond Ely mine to a smelter during January and February; 1,406 tons of ore yielded 57 ounces of gold and 6,366 ounces of silver. Pioche Mines Consolidated, Inc., operated the Wide Awake mine through lessees from January 1 to September 30; lead ore was shipped to a smelter.

LYON COUNTY

Silver City district.—The Dayton Consolidated Mines Co. operated the Dayton mine from January 1 to October 15, 1942, and treated, in the company cyanide plant, 5,050 tons of ore which yielded 1,526 ounces of gold and 8,067 ounces of silver. Ore from nearby mines operated by this company and 5,973 tons of ore received from 94 shippers upon a custom basis were treated at the mill. T. S. Franklin shipped ore from the Haywood mine to a custom cyanide mill. The Gold Rock Mining Co. shipped ore from the Silver King mine to a custom cyanide mill.

Yerington district.—Lessees worked the Mason Valley mine throughout 1942 and shipped to a smelter 551 tons of copper ore containing 3 ounces of gold, 113 ounces of silver, and 109,072 pounds of copper.

MINERAL COUNTY

Bell (Simon) district.—Lessees worked the Olympic mine from January 1 to July 1, 1942, and shipped 88 tons of ore to a custom cyanide mill; 83 ounces of gold and 68 ounces of silver were recovered. Costa & Evansen worked the Simon Lead mine and shipped to a smelter 1,677 tons of lead ore containing 19 ounces of gold, 9,313 ounces of silver, 24,110 pounds of copper, 217,926 pounds of lead, and 199,924 pounds of zinc.

Garfield district.—The Mabel mine was operated by lessees in 1942; 23 tons of gold-silver ore shipped to a custom cyanide mill yielded 4 ounces of gold and 105 ounces of silver, and 1,434 tons of gold-silver ore shipped to a smelter contained 130 ounces of gold and 5,124 ounces of silver.

NYE COUNTY

Manhattan district—E. J. Hyde operated the Big Four mine in 1942; 100 tons of ore treated by amalgamation yielded 128 ounces of gold and 58 ounces of silver. J. L. Sullivan worked the Pathfinder

mine from January 1 to October 31 and panned 500 pounds of ore yielding 58 ounces of gold and 23 ounces of silver. J. Farrell and R. Graham shipped several lots of ore for treatment by amalgamation, cyanidation, and smelting; 128 tons of ore amalgamated yielded 134 ounces of gold and 56 ounces of silver, 12 tons of gold ore cyanided yielded 10 ounces of gold and 3 ounces of silver, and 8 tons of gold ore smelted yielded 12 ounces of gold and 25 ounces of silver. The Manhattan Gold Dredging Co. (largest producer of placer gold in the State since 1939) operated throughout 1942; its electric connected-bucket dredge was equipped with 108 9½-cubic foot buckets. This company was granted limited permission to operate after the issuance of War Production Board Order L–208 because the dredge was situated in a narrow canyon and subject to danger of cloudburst floods.

Morey district.—V. J. Barndt worked the Morey mine from January 1 to June 30, 1942, and shipped ore to smelters; 279 tons of silver ore yielded 15 ounces of gold and 5,441 ounces of silver, and 8 tons of lead ore contained 2 ounces of gold, 1,427 ounces of silver, and 2,839 pounds of lead.

Northumberland district.—The Northumberland Mining Co. operated the Northumberland mine from January 1 to October 15, 1942; 79,445 tons of ore treated in the company 300-ton cyanide mill yielded 10,145 ounces of gold and 8,577 ounces of silver.

Tonopah district.—The Tonopah Belmont Syndicate operated the Tonopah Belmont mine from January 1 to October 7, 1942; 177 tons of gold-silver ore containing 55 ounces of gold and 5,209 ounces of silver were shipped to a smelter. A shipment of 16 tons of gold-silver ore from the Tonopah Extension mine to a smelter contained 54 ounces of gold and 5,506 ounces of silver; the long-idle 500-ton cyanide plant at the property was totally destroyed by fire October 23. Several sets of lessees worked parts of the Tonopah Mining Co. of Nevada property throughout 1942 and shipped gold-silver ore to a smelter. Gold-silver ore containing 572 ounces of gold and 50,388 ounces of silver was shipped to a smelter from the West End mine.

Tybo district.—Hall Bros. Co., Inc., and J. C. Jepson worked the Tybo mine during 1942 and shipped ore and old tailings to a smelter; 104 tons of gold-silver ore contained 7 ounces of gold, 823 ounces of silver, and 8,539 pounds of lead; 210 tons of silver ore contained 9 ounces of gold and 1,619 ounces of silver; and 6,408 tons of lead old tailings contained 612 ounces of gold, 22,389 ounces of silver, and 1,042,524 pounds of lead.

PERSHING COUNTY

Imlay district.—The Standard Cyaniding Co. worked the Gold Standard and Lally mines in 1942 until operations were suspended as a result of War Production Board Order L–208.

Jersey district.—I. D. Kelly worked the Rex mine from June 1 until the end of 1942; 96 tons of lead ore containing 5 ounces of gold, 2,395 ounces of silver, 789 pounds of copper, 34,313 pounds of lead, and 10,892 pounds of zinc were shipped to a smelter.

Staggs district.—The Twin Buttes Mining Syndicate constructed a 15-ton gravity-concentration mill between January 1 and May 10,1942, after which production was carried on until the end of the year.

STOREY COUNTY

Comstock district.—Lessees shipped 152 tons of gold ore from the Chollar mine to a custom cyanide mill in 1942; 113 ounces of gold and 1,435 ounces of silver were recovered. A large quantity of company gold ore was treated in the 100-ton flotation mill at the Consolidated Virginia mine between January 1 and October 24; the concentrates were shipped to a custom cyanide mill. Sutro Tunnel Coalition, Inc., worked the Crown Point and Yellow Jacket mines the entire year. The Dayton Consolidated Mines Co. and lessees shipped gold ore from the Justice mine to the company custom cyanide mill at Silver City; the same company operated the Keystone and New York mines from January 1 to October 8 and treated ore in its cyanide mill. The Consolidated Chollar Gould & Savage Mining Co. operated its open pit at the Overman mine from January 1 to December 7; 141,505 tons of ore treated by cyanidation yielded 11,752 ounces of gold and 94,017 ounces of silver.

WHITE PINE COUNTY

Aurum district.—The Grand Deposit Mining Co. worked the Grand Deposit mine from June 15 to December 31, 1942; 280 tons of oxidized zinc ore containing 137,614 pounds of zinc were shipped to a zinc slag-fuming plant. The company received a $10,000 development loan from the Reconstruction Finance Corporation in November.

Bald Mountain district.—E. R. Wagner shipped 290 tons of gold ore, containing 43 ounces of gold, 596 ounces of silver, and 11,148 pounds of copper, from the Pioneer mine to a smelter in 1942.

Granite district.—Lessees worked the Stinson mine during 1942; 4 tons of ore treated by amalgamation yielded 10 ounces of gold and 2 ounces of silver, and 47 tons of ore shipped to a smelter contained 77 ounces of gold and 22 ounces of silver.

Osceola district.—The Gilded Age Mining Co. worked the Gilded Age mine from January 1 to October 15, 1942; 3,388 tons of ore containing 3,359 ounces of gold and 1,220 ounces of silver were shipped to a smelter.

Robinson district.—The Nevada Consolidated Copper Corporation, which had been the operating subsidiary of the Kennecott Copper Corporation in Nevada for many years, merged with the parent corporation and became known as the Kennecott Copper Corporation, Nevada Mines Division, at the end of 1942. This corporation, which operated the Ruth mine at Ruth, the open pit at Copper Flat, the McGill flotation concentrator (daily capacity, 20,000 tons) and the McGill copper smelter, both at McGill, was the largest industrial organization in Nevada. As well as being the State's leading copper producer, the company stood second in gold and eighth in silver output. The Consolidated Coppermines Corporation, second-largest copper producer and third-largest gold producer in the State in 1942, was active throughout the year; copper ore mined on company account was shipped to the McGill concentrator, and small quantities of high-grade copper ore and zinc-lead ore were shipped for direct smelting. C. Caviglia shipped gold ore from the Chainman mine to a smelter. S. M. Robison shipped zinc-lead ore and zinc ore from the Columbia mine to smelters during the year. Lessees on the Cuba mine shipped 4,440 tons of gold-silver ore containing 362 ounces of gold and 18,669 ounces of silver to a smelter during 1942. Benson Bros. shipped 30

tons of lead ore, containing 1 ounce of gold, 334 ounces of silver, and 21,667 pounds of lead, from the Goldenrod mine to a smelter. Gold ore from the Hayes mine was shipped to a smelter. A lessee worked the Jupiter mine from January 1 to November 16 and shipped gold ore to a smelter. Lessees worked the Phoenix mine from July 1 to December 31; 536 tons of ore shipped to a smelter contained 134 ounces of gold and 1,048 ounces of silver. The Ely Gold Mining Co. shipped gold-silver ore and zinc ore from the Revenue mine to a smelter. The Willard Leasing Co. worked the Willard mine from May to the end of the year; 675 tons of oxidized ore containing 694,913 pounds of zinc were shipped for treatment.

Taylor district.—Lessees worked the Gore mine; 5,711 tons of silver ore containing 113 ounces of gold and 62,709 ounces of silver were shipped to a smelter. Lessees worked the Mineral Farm No. 1 mine and shipped to a smelter 394 tons of silver ore containing 9 ounces of gold and 4,742 ounces of silver.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY OUTLINE

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SUMMARY

Production of both copper and zinc in New Mexico in 1942 was larger in quantity than in any previous year; that of lead was slightly

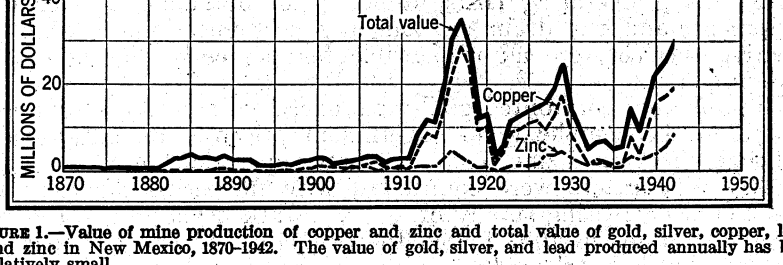

FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1942. The value of gold, silver, and lead produced annually has been relatively small.

less than in 1941 but greater than in 1940. The output of gold decreased 57 percent and that of silver 49 percent, in both quantity and value. The total value of the recovered output of the five metals was $29,542,885 in 1942, compared with $25,471,416 in 1941. Copper represented 66 percent and zinc 29 percent of the total value in 1942.

Production of gold, silver, copper, lead, and, more particularly, zinc in 1942 was affected by several factors, all precipitated by the war. In an effort to stimulate the production of copper, lead, and zinc the Government, through its agency, the Metals Reserve Co., announced that effective February 1, 1942, premium prices of 5 cents per pound for copper and 2¾ cents per pound for both lead and zinc would be paid for these metals produced in excess of fixed basic quotas. The ceiling prices for these metals on that date (and they have so remained through June 1943) were: Copper, electrolytic, 11.775 cents per pound f. o. b. Atlantic seaboard refineries; lead, 6.50 cents (New York); zinc, 8.25 cents (St. Louis). The quota for each mining company or mine was based upon the 1941 output. Some of the mines in New Mexico that received basic quotas on their 1941 production have since received, by negotiation with the Metals Reserve Co., a reduction in the quota tonnage. On December 1,

1942, arrangements for additional premium payments for over-quota metal output were announced by the Metals Reserve Co. Operators who could argue their inability to maintain present rate of production without loss of money or who could assure additional output were eligible for these additional Government subsidies for copper in several steps of 5 cents a pound for each step, or for lead and zinc in steps of 2¾ cents a pound.

War Production Board Gold Mining Limitation Order L–208, issued October 8, 1942, has been widely assigned in the Western States as the outstanding single cause for the marked decrease in production of gold in 1942. An analysis of gold lode and placer operations in New Mexico in 1942 disclaims this conception for New Mexico. All gold lode operations that would have been affected by this order ceased operations during the first 6 months of 1942. Of the three producing dredging operations in New Mexico in 1942, two were forced to cease operating by the order; the other stopped production in April 1942. Factors forcing the closure of these gold properties were many, and their effect was not confined to 1942. Many operators began to feel the acute scarcity of skilled labor in 1941. Higher wages in war-material factories and at army cantonments, rising operating costs, difficulty of obtaining replacement equipment, and the drain on company personnel imposed by the selective service were all responsible for the early closing of the gold properties.

These factors confronted gold-mine operators as early as January 1941, and the complexity of government priorities regulations also had their effect upon zinc, lead, and copper operations in New Mexico in 1942. Operators were confronted with increasing demands for metals and decreasing supply of labor. Marked absenteeism at the larger operations in 1942 forced the companies to carry 30 percent more employees on the rolls to insure a near complement of men for each shift. At the end of 1942 the mine operators in New Mexico found themselves facing the problem of meeting increasing demand with insufficient labor in 1943.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.

[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.

[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.

[5] $0.64646464. [6] $0.67878787. [7] $0.7111111.

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 1938 to 1942; also the total production from 1848 to 1942. 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, 1938–42, and total, 1848–1942, 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
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
1941	145	103	7,530,226	27,845	974,575	1,328,317	944,581
1942	78	48	8,221,512	11,961	418,635	676,170	480,832
1848–1942			[1]	2,160,741	48,960,128	65,952,746	51,631,038

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	146,956,000	17,340,808	9,336,000	532,152	75,724,000	5,679,300	25,471,416
1942	160,200,000	19,384,200	9,216,000	617,472	92,922,000	8,641,746	29,542,885
1848–1942	[2] 1,097,544	328,263,183	[2] 249,292	24,149,203	[2] 658,291	83,528,270	536,531,822

[1] Figures not available.

[2] Short tons.

Gold and silver produced at placer mines in New Mexico, 1938–42, 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	
1938	2,626	$91,910	167	$108	$92,018	1941	2,488	$87,080	284	$202	$87,282
1939	3,474	121,590	209	142	121,732	1942	1,247	43,645	135	96	43,741
1940	2,928	102,480	263	187	102,667						

Gold.—Mine production of gold in New Mexico decreased from 27,845 fine ounces in 1941 to 11,961 ounces in 1942. The principal gold-producing districts in 1942 were: Central, Grant County, which contributed 34 percent of the State output of recovered gold; Mogollon, Catron County, 28 percent; Steeple Rock, Grant County, 12 percent; Lordsburg, Hidalgo County, 11 percent; Las Animas, Sierra County, 5 percent; and Pinos Altos, Grant County, 3 percent. Dry and siliceous ores yielded 45 percent of the State total gold; copper ore, 40 percent; lead, zinc, zinc-lead, and lead-copper ores, over 4 percent; and placers, over 10 percent.

Silver.—Mine production of silver in New Mexico was 676,170 fine ounces in 1942 compared with 1,328,317 ounces in 1941. The Central district contributed 33 percent of the State total in 1942, Mogollon 31 percent, Lordsburg 13 percent, Steeple Rock 9 percent, San Simon 7 percent, Magdalena 4 percent, and Swartz 1 percent. Dry and siliceous ores yielded 47 percent of the total silver; zinc and zinc-lead ore 29 percent; copper ore 23 percent; and lead ore, lead-copper ore, and a little silver from placer operations, 1 percent.

Copper.—The output of recovered copper from mines in New Mexico in 1942 was 160,200,000 pounds, a 9-percent increase over the former record annual production in 1941. The Chino open-pit mine of the Kennecott Copper Corporation at Santa Rita, Grant County, continued to be by far the largest producer in the State. The capacity of the concentrator at Hurley is 18,000 tons at the desired grind and optimum metallurgy; however, the daily average quantity treated in 1942 was 20,363 tons. Copper concentrates are treated in the reverberatory furnace and converters at the company smelter at Hurley. Beginning in May 1942, part of the product was fire-refined at Hurley to 99.92-percent purity, and part continued to be cast into blister-copper anodes (99.46-percent purity) for electrolytic refining at Baltimore, Md. Other substantial copper producers in 1942 were the Burro Mountain group of the Phelps Dodge Corporation at Tyrone, Grant County; the Bonney-Anita group near Lordsburg, Hidalgo County; the Stauber mine near Pastura, Guadalupe 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; virtually all the remainder was recovered from concentrates produced by milling zinc and zinc-lead ores.

Lead.—Most of the lead produced from New Mexico mines in 1942 came from the American Smelting & Refining Co. Ground Hog mine and Hanover mill units in the Central district, Grant County. The total State output of lead was 9,216,000 pounds in 1942, compared with 9,336,000 pounds in 1941. Zinc and zinc-lead ore yielded 93 percent of the total lead, lead and lead-copper ore 4 percent, copper ore 2 percent, and dry and siliceous ore 1 percent.

Zinc.—The output of recoverable zinc from mines in New Mexico increased 23 percent in quantity in 1942 over 1941. A substantial gain in production in the Central district, Grant County, was largely responsible for the increase. The principal producers in 1942 were the Peru Mining Co. (Pewabic and Copper Flat mines), Empire Zinc Co. (Hanover mine group), and American Smelting & Refining Co. (Ground Hog Unit), all in the Central district, Grant County; and the Ozark Smelting & Mining Co. (Waldo mine) and the Empire Zinc Co. (Kelly group), both in the Magdalena district, Socorro County. Other major zinc-producing districts were the Swartz and Pinos Altos, in Grant County; Organ, in Dona Ana County; and Lordsburg and San Simon in Hidalgo County.

Zinc concentrates produced in 1942 amounted to 99,722 tons containing, as shipped, 263 ounces of gold, 48,924 ounces of silver, 569,373 pounds of copper, 1,214,821 pounds of lead, and 107,419,144 pounds of zinc. The average zinc content was therefore 53.86 percent. The zinc and zinc-lead ores (1,049 tons) from New Mexico shipped crude

to the Ozark pigment plant at Coffeyville, Kans., averaged 19.28 percent zinc and 9.85 percent lead.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1942, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Catron	7		3,327	$116,445	210,243	$149,506
Colfax	1	1	302	10,570	38	27
Dona Ana	3		92	3,220		
Grant	36	21	5,854	204,890	298,323	212,141
Guadalupe	1				789	561
Hidalgo	6		1,374	48,090	135,045	96,032
Lincoln		8	36	1,260	4	3
Luna	5		14	490	339	241
Otero	1				10	7
Santa Fe	4	6	273	9,555	242	172
Sierra	8	12	612	21,420	1,139	810
Socorro	6		77	2,695	29,998	21,332
Total, 1941	78	48	11,961	418,635	676,170	480,832
	145	103	27,845	974,575	1,328,317	944,581

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron	1,700	$206	200	$13			$266,170
Colfax							10,597
Dona Ana	6,200	750			211,000	$19,623	23,593
Grant	152,837,000	18,493,277	7,134,000	477,978	86,086,000	8,005,998	27,394,284
Guadalupe	611,000	73,931					74,492
Hidalgo	6,716,000	812,636	292,000	19,564	197,000	18,321	994,643
Lincoln							1,263
Luna			32,000	2,144	32,000	2,976	5,851
Otero	1,400	169	4,000	268			444
Santa Fe	300	36	11,800	791	14,000	1,302	11,856
Sierra	3,600	436	14,000	938	12,000	1,116	24,720
Socorro	22,800	2,759	1,728,000	115,776	6,370,000	592,410	734,972
Total, 1941	160,200,000	19,384,200	9,216,000	617,472	92,922,000	8,641,746	29,542,385
	146,956,000	17,340,808	9,336,000	532,152	75,724,000	5,679,300	25,471,416

Gold and silver produced at lode mines in New Mexico in 1942, 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)
Catron	23,987	3,327	210,243	Otero	41		10
Colfax	1,652	12	7	Santa Fe	515	159	239
Dona Ana	880	92		Sierra	131	14	1,094
Grant	8,020,719	5,645	298,271	Socorro	39,950	77	29,998
Guadalupe	7,498		789				
Hidalgo	126,017	1,374	135,045		8,221,512	10,714	676,035
Luna	122	14	339	Total, 1941	7,530,226	25,357	1,328,033

Gold and silver produced at placer mines in New Mexico in 1942, 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			290	31	290	31
Grant	97	30	112	22	209	52
Lincoln	36	4			36	4
Santa Fe	114	3			114	3
Sierra	39	13	559	32	598	45
	286	50	961	85	1,247	135
Total, 1941	486	49	2,002	235	2,488	284

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The production of ore from New Mexico mines producing gold, silver, copper, lead, and zinc totaled 8,221,512 tons in 1942, the largest in any year on record and 691,286 tons more than in 1941. Most of the output in 1942, as in 1941, was copper ore mined with power shovels from the Chino open-pit mine at Santa Rita, Grant County. 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 1942, 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	5,718	1,155	4,378	24,828	85,713	
Dry and siliceous gold-silver ore	29,997	4,112	267,298	8,338	8,193	
Dry and siliceous silver ore	2,116	114	43,459			
	37,831	5,381	315,135	33,166	93,906	
Copper ore	7,631,752	4,815	156,613	[1] 159,037,787	233,207	
Lead ore	694	145	3,653	4,769	208,896	
Lead-copper ore	618	4	3,565	42,303	133,420	
Zinc ore	330,239	238	144,792	965,684	5,991,636	59,813,725
Zinc-lead ore	220,378	131	52,277	116,291	2,554,935	33,108,275
	8,183,681	5,333	360,900	[1] 160,166,834	9,122,094	92,922,000
Total, lode mines	8,221,512	10,714	676,035	[1] 160,200,000	9,216,000	92,922,000
Total, placers		1,247	135			
	8,221,512	11,961	676,170	[1] 160,200,000	9,216,000	92,922,000
Total, 1941	7,530,226	27,845	1,328,317	[2] 146,956,000	9,336,000	75,724,000

[1] Includes 26,042,745 pounds of copper recovered from precipitates from mine water and leached dumps.
[2] Includes 16,818,294 pounds of copper recovered from precipitates from mine water and leached dumps.

METALLURGIC INDUSTRY

The following eight flotation mills treated 98.62 percent of the total New Mexico output of ore in 1942: Chino at Hurley, Empire Zinc at Hanover, Banner at Lordsburg, Peru near Deming, Hanover Unit near Hanover, Waldo near Magdalena, Calumet near Pinos Altos, and Southwestern near Duncan, Ariz. (operated on ore from the Carlisle group at Steeple Rock, N. Mex.). Ore shipped crude to smelters comprised 1.03 percent of the State total; and ore treated by the Little Fanney cyanidation mill at Mogollon, the East Camp cyanidation mill at Steeple Rock, and several small concentration and amalgamation mills scattered throughout the State constituted only 0.35 percent of the total. The Chino reverberatory copper smelter of the Kennecott Copper Corporation at Hurley was operated throughout 1942 on company copper concentrates, siliceous carbonate copper ore, and copper precipitates recovered by leaching of waste dumps. A substantial part of the copper production was marketed for the first time in fire-refined form. The production of copper in this form has tremendously shortened the time of refinement when compared with the time interval of shipment to Baltimore for the refining of blister copper by the electrolytic process. The gold and silver contained in the charge to the fire-refining furnace is not recovered in the operation, as would be the case in electrolytic refining. By sacrificing the gold and silver and shipping marketable refined copper direct to war material-fabricating plants (closer to New Mexico by railroad than Baltimore) much time is saved. The destination and treatment of concentrates and ore produced by other operators in the State and shipped to smelters in other States are discussed in the following review by counties and districts. About 155,400 cubic yards of gravel were treated at three placer mines using dry-land dredges, and a quantity of gravel for which figures are not obtainable was handled at small placers worked by hand methods.

Mine production of metals in New Mexico in 1942, 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	500	170	42			
Ore cyanided [1]	28,802	3,195	226,787			
Concentrates smelted	337,736	5,652	341,552	[2]157,754,551	8,614,813	92,594,946
Ore smelted	84,352	1,697	107,654	2,445,449	601,187	327,054
Placer		1,247	135			
Total, 1941		11,961	676,170	160,200,000	9,216,000	92,922,000
		27,845	1,328,317	146,956,000	9,336,000	75,724,000

[1] Cyanide used was approximately 151,013 pounds of Aero Brand calcium cyanide (approximately 48 to 49 percent NaCN).

[2] Includes 26,042,745 pounds of copper recovered from smelting of precipitates from mine water and leached dumps.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in New Mexico in 1942, 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	22,256	2,675	184,888					
Colfax	1,652	12	7					
Grant	4,944	520	41,896					
Santa Fe	450	158	38					
	29,302	3,365	226,829					
Total, 1941	90,519	11,067	690,466	84	198	780	9,363	878

Gross metal content of concentrates (all produced at concentrating mills) from ores mined in New Mexico in 1942, 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	10	34	72	302	543	
Copper	229,599	8,110	187,689	[1] 160,012,157	224,815	
Lead	2,101	84	38,221	43,480	2,289,706	232,648
Lead-copper	6,304	556	129,752	780,002	6,368,080	1,358,227
Zinc	99,722	263	48,924	569,373	1,214,821	107,419,144
	337,736	9,047	404,658	[1] 161,405,314	10,097,965	109,010,019
Total, 1941 [2]	313,725	10,759	518,210	[3] 147,911,036	9,480,715	89,017,520

[1] Includes 26,596,797 pounds of copper contained in precipitates from mine water and leached dumps.
[2] Includes 84 tons of concentrates from gold and silver mills containing 198 ounces of gold, 780 ounces of silver, 9,550 pounds of copper, and 1,617 pounds of lead.
[3] Includes 17,185,932 pounds of copper contained in precipitates from mine water and leached dumps.

Mine production of metals from concentrating mills in New Mexico in 1942, in terms of recovered metals

BY COUNTIES

	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)
Dona Ana	880	213	92		6,200		211,000
Grant	7,944,342	315,982	4,260	220,678	[1] 151,014,644	6,844,747	86,086,000
Hidalgo	123,762	13,350	1,251	90,763	6,714,339	254,505	144,976
Santa Fe	43	23		152	300	8,354	14,000
Sierra	99	19	1	831	3,600	7,600	12,000
Socorro	38,732	8,149	48	29,128	15,468	1,499,607	6,126,970
	8,107,858	337,736	5,652	341,552	[1] 157,754,551	8,614,813	92,594,946
Total, 1941	7,352,950	313,641	10,559	517,333	[2] 144,271,949	8,172,659	75,179,301

BY CLASSES OF ORE CONCENTRATED

Dry and siliceous gold	3,130	211	477	2,656	22,406	75,378	
Copper	7,555,055	229,599	4,806	141,705	[1] 156,650,170	123,186	
Lead	105	15		122		14,323	
Zinc	330,089	71,029	238	144,792	965,684	5,985,302	59,729,701
Zinc-lead	219,479	36,882	131	52,277	116,291	2,416,624	32,865,245
	8,107,858	337,736	5,652	341,552	[1] 157,754,551	8,614,813	92,594,946

[1] Includes 26,042,745 pounds of copper recovered from precipitates from mine water and leached dumps.
[2] Includes 16,818,294 pounds of copper recovered from precipitates from mine water and leached dumps.

Gross metal content of New Mexico crude ore shipped to smelters in 1942, 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	436	496	1,673	2,946	17,645	----------
Dry and siliceous gold-silver	2,847	929	40,518	9,133	14,899	208
Dry and siliceous silver	2,116	114	43,459	----------	986	----------
Copper	76,697	9	14,908	2,454,970	200,037	----------
Lead	589	145	3,531	5,890	216,203	----------
Lead-copper	618	4	3,565	52,879	148,244	----------
Total to copper and lead plants	83,303	1,697	107,654	2,525,818	598,014	208
Zinc	150	----------	----------	----------	9,049	100,771
Zinc-lead	899	----------	----------	----------	197,588	303,696
Total to zinc plants	1,049	----------	----------	----------	206,637	404,467
	84,352	1,697	107,654	2,525,818	804,651	404,675
Total, 1941	86,757	3,533	119,454	2,759,095	1,662,961	762,205

Mine production of metals from New Mexico crude ore shipped to smelters in 1942, by counties, in terms of recovered metals

County	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Catron	1,731	652	25,355	1,700	200	----------
Grant	71,433	865	35,697	1,822,356	289,253	----------
Guadalupe	7,498	----------	789	611,000	----------	----------
Hidalgo	2,255	123	44,282	1,661	37,495	52,024
Luna	122	14	339	----------	32,000	32,000
Otero	41	----------	10	1,400	4,000	----------
Santa Fe	22	1	49	----------	3,446	----------
Sierra	32	13	263	----------	6,400	----------
Socorro	1,218	29	870	7,332	228,393	243,030
	84,352	1,697	107,654	2,445,449	601,187	327,054
Total, 1941	86,757	3,533	119,454	2,674,688	1,162,463	544,699

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1942, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Catron County: Mogollon	7		23,987	3,327		3,327	210,243		210,243	1,700	200		$266,170
Colfax County: Mount Baldy	1	1	1,652	12	290	302	7	31	38				10,597
Dona Ana County: Organ	3		880	92		92				6,200		211,000	23,593
Grant County:													
Burro Mountain	4	1	736	8	2	10	1,101		1,101	7,312,800	47,000	62,600	894,953
Central	11	4	8,001,808	4,050	42	4,092	224,900	14	224,914	145,448,900	6,411,000	84,747,200	26,213,503
Eureka	3		48				1,194		1,194	200	12,300		1,697
Pinos Altos	6	16	720	178	165	343	2,382	38	2,420	11,000	31,000	79,400	24,518
Red Rock	1		3				4		4	400			51
Steeple Rock	5		9,426	1,390		1,390	60,220		60,220	29,000	86,700		100,791
Swartz	3		7,838	9		9	8,301		8,301	24,600	546,000	1,196,800	157,079
White Signal	3		140	10		10	169		169	10,100			1,692
Guadalupe County	1		7,498				789		789	611,000			74,492
Hidalgo County:													
Apache	1		30									14,300	1,330
Lordsburg	2		123,397	1,257		1,257	90,803		90,803	6,715,100	224,400	113,600	946,693
San Simon	3		2,590	117		117	44,242		44,242	900	67,600	69,100	46,620
Lincoln County: Jicarilla		8			36	36		4	4				1,263
Luna County:													
Cooks Peak	4		17	14		14	97		97		11,000		1,296
Tres Hermanas	1		105				242		242		21,000	32,000	4,555
Otero County: Sacramento	1		41				10		10	1,400	4,000		444
Santa Fe County:													
Ortiz Mountains (Cerrillos)	2	5	65	1	112	113	201	3	204	300	11,800	14,000	6,229
San Pedro	2	1	450	158	2	160	38		38				5,627
Sierra County:													
Chloride	2		14	2		2	159		159		2,600		357
Hermosa	1		6				55		55		3,700		287
Kingston	1		99	1		1	831		831	3,600	7,600	12,000	2,687
Las Animas (Hillsboro)	3	3	11	11	582	593	35	44	79				20,811
Pittsburg and Caballos Mountains		9			16	16		1	1				561
Tierra Blanca	1		1				14		14		100		17
Socorro County: Magdalena	6		39,950	77		77	29,998		29,998	22,800	1,728,000	6,370,000	734,972
Total New Mexico	78	48	8,221,512	10,714	1,247	11,961	676,035	135	676,170	160,200,000	9,216,000	92,922,000	29,542,885

CATRON COUNTY

Mogollon district.—The Black Hawk Consolidated Mines Co. operated the Consolidated group and the Little Fanney 200-ton cyanide mill near Mogollon, both under lease from the Lehigh Metals Co. Operations were continuous in 1942 until June 18, at which time the Black Hawk Consolidated Mines Co. relinquished its lease on the property and disposed of all mining equipment but did not remove the mill or its equipment. In addition to ore from the Consolidated group, the mill treated custom ore from the Maude S, Champion, Little Fanney, Deep Down, and Bearup claims. Company and custom ore treated in 1942 totaled 22,256 tons, from which 2,675 fine ounces of gold and 184,888 fine ounces of silver were recovered in cyanide precipitates and refined into bullion, which was shipped to the Denver Mint. Part of the ore produced from the Bearup and Deep Down properties was shipped crude to the El Paso smelter and Ira L. Wright (ore buyer) at Silver City.

COLFAX COUNTY

Mount Baldy district (*Baldy, Elizabethtown, Eagle Nest*).—Only one lode mine and one placer mine in the Mount Baldy district produced in 1942. Fullroe, Inc., worked the Grouse Gulch placer from April 1 until October 15, using a 1¼-cubic yard dragline and portable screening and sluicing plant; this operation yielded most of the gold and silver produced in the district in 1942. The 50-ton cyanide plant at the Moreno-Red Bandana group, 2 miles northeast of Elizabethtown, was operated on a small scale from May 16 until November 16 by Merco, Inc. Mill feed consisted of a small tonnage of crude ore mixed with old tailings. Cyanide precipitates were shipped to the Arkansas Valley smelter at Leadville, Colo. A dragline and other equipment were installed, and a permanent sluice and jig plant was built, with accompanying water-pipe installation, during 1942 on Willow Creek near Therma, for treatment of placer gold-tungsten deposits.

DONA ANA COUNTY

Organ district.—The quantity of ore mined and sold from the Organ district increased from 47 tons in 1941 to 880 tons in 1942. Small-scale operations at the Big Buck property produced 42 tons of crude ore, which was treated in the Hanover custom mill of the American Smelting & Refining Co. Operations at the Merrimak mine, largest producing property in the district, began in July 1942, and thereafter regular shipments of zinc-copper-lead-silver ore averaging 15 percent zinc were made to the American Smelting & Refining Co. selective-flotation zinc-lead custom mill at Hanover, Grant County. Five tons of zinc ore from the Pagoda mine also were treated in the Hanover custom mill.

GRANT COUNTY

Burro Mountain district (*Tyrone*).—Throughout 1942 the Phelps Dodge Corporation continued leaching the old mine workings *in situ*, by percolating water and precipitating copper from the resulting copper-bearing water, at its Burro Mountain mine, 13 miles southwest of Silver City. During the year the capacity of the precipitation plant

was increased, and additional pumping facilities were installed. L. Yacomo and Marvin Fuller unwatered the Full Moon mine in March and began shipping zinc-lead ore to the custom mill at Hanover; small but continuous production was maintained at the property for the remainder of the year. A lessee on the Copper Sulphite claim shipped 123 tons of zinc-lead-silver ore to the Hanover custom mill for treatment. The Burro Mountain Leasing Co. worked the Thompson group of claims, beginning in August, and shipped 87 tons of oxidized copper ore to the El Paso smelter. A small-scale sluicing operation on the Paymaster placer recovered gold which was shipped to the Denver Mint.

Central district (Bayard, Fierro, Georgetown, Hanover, Santa Rita).—The Kennecott 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 at over capacity throughout 1942. The output of copper was the largest in the history of the operation. Considerable copper was also recovered from leaching operations and from siliceous carbonate copper ore used in the converters as a flux. Additional grinding equipment was installed in the 20,000-ton concentration mill, making it possible for the mill to operate at over optimum metallurgical capacity throughout the year. Molybdenum, gold, and silver are recovered in the mill as byproducts. A substantial part of the copper was marketed for the first time in fire-refined form. Installation of a 230-foot-diameter Dorr thickening tank and a new lime-burning plant was completed, and they were put into operation early in 1942. Although drought conditions prevailed throughout the year, enough water for plant requirements was obtained through drilling additional wells and from water reclaimed from the Dorr-thickener installation.

Zinc production in the Central district in 1942 was the greatest in the history of the district. In spite of difficulties caused by governmental priorities, critical labor shortages, and marked absenteeism, which prevented maximum production, the output of recovered zinc increased 22.30 percent over 1941. Production of recovered lead, however, decreased 17.86 percent from 1941. The Peru Mining Co. expanded operations at its Copper Flat and Pewabic mines and shipped by railroad nearly 50 percent greater tonnage of ore to the company 500-ton flotation mill at Deming. Besides ore from the company properties in the Central district, the mill treated custom ore from two zinc properties in Arizona. Concentrates produced were shipped to the zinc retort plant at Dumas, Tex. Late in 1942 the company began development and search for ore in the Kearny property, which resulted favorably, and output of zinc ore began in March 1943. The Empire Zinc Co. operated its Hanover mine group and selective-flotation mill continuously in 1942 with an output virtually the same as that maintained in 1941. Maintenance of full capacity of the mill was assured only by shipment of additional ore from the company Lynchburg mine at Kelly, Socorro County. Such shipments and treatment represented a money loss. Most of the zinc concentrates produced were shipped to the New Jersey Zinc Co. plant at Depue, Ill. (Mineral Point Zinc Division); byproduct lead concentrates made were shipped to the El Paso smelter. Production of zinc concentrates from the Hanover milling unit (formerly Combination-Black Hawk mill), operated under lease by the American

Smelting & Refining Co., was nearly two-thirds greater than in 1941. Most of the ore treated came from the company Ground Hog-San Jose group, which produced in addition to zinc-lead-copper-silver milling ore a small tonnage of lead-copper-silver-gold ore, which was shipped crude to the El Paso smelter. About 22 percent of the total ore milled was custom ore from the Combination, Hobo, Free Gold, Barringer, and Peerless properties in the Central district; the Columbia, Grandview, and Royal John claims in the Swartz (Carpenter) district; the Manhattan and Baldback mines in the Pinos Altos district; the Copper Sulphite and Full Moon properties in the Burro Mountain (Tyrone) district; the Big Buck, Merrimak, and Pagoda mines near Organ; the Ruth mine near Lordsburg; the Silver Hill property near Steins; the Percha mine near Kingston; and the Nitt and El Tigre properties near Magdalena. Several small shipments of crude ore were made to the El Paso smelter from the Little Goat and the Georgetown Extension group at Hanover.

Late in 1941 the United States Smelting, Refining & Mining Co. began acquiring, under lease and option, a number of claims in the vicinity of Vanadium, which it later consolidated into what is now known as the Bullfrog mine. Development and exploration at this mine were carried on throughout the year and consisted of a new 626-foot shaft, 2,938 feet of drifts, 23,618 feet of diamond-drill holes, construction of a steel headframe, shops, office, and warehouse. In July 1942 a contract was let for the construction of a 250-ton selective-flotation mill adjacent to the mine. Difficulty in obtaining equipment and carpenters retarded the normal construction progress, so that the mill was not completed and put into operation until March 1943. Mill feed for the first few months of operation consisted of ore (from development and exploration) that had been stock-piled at the mine. It is expected that this operation will add materially to the production of zinc in the Central district.

Ground sluicing of dry-wash gravels in Gold Gulch by prospectors and vacationists recovered a little placer gold.

Eureka district.—Intermittent small-scale operations at the Hornet and Bonanza properties produced small lots of lead ore, which were shipped crude to the El Paso smelter or sold to Ira L. Wright, ore sampler and purchaser, at Silver City.

Pinos Altos district.—A lessee operating intermittently the 20-ton Calumet mill 1 mile south of Pinos Altos treated zinc-lead-bearing tailings reported from the Cleveland dump and shipped zinc and lead concentrates to the Amarillo and El Paso smelters. Lessees on the Baldback and Manhattan mines shipped crude zinc-lead-copper-gold-silver ore to the Hanover custom mill. Gold-silver-copper-lead and gold-silver-copper ores were shipped in small lots to the El Paso smelter and Ira L. Wright from the Blue Jay, Buckhorn, and Langston prospects in the Pinos Altos district. Virtually all the placer gold from the district in 1942 was recovered by Cooperative Placers, which operated a dragline land dredge in Santo Domingo Gulch until April. Numerous small placers, usually operated after flash showers and cloudbursts that reworked the gulch gravels, were continued throughout the year by residents of the community.

Red Rock district.—Three tons of copper-silver ore were shipped in 1942 from the Fence claim in the Red Rock district.

Steeple Rock district.—The Southwestern Mineral Co. worked the Center claim and Carlisle dump in 1942 from January 1 until June 30 and produced 3,459 tons of gold-silver-copper-lead ore, of which 3,130 tons were concentrated in the company 100-ton flotation mill at Duncan, Ariz., and 329 tons were shipped crude to the El Paso smelter. Plans were being made early in 1943 to reopen the property for the production of zinc and lead. Reserves are estimated at 100,000 tons of 5-percent zinc, 2-percent lead, and 4½-percent copper. The Exploration Syndicate, Inc., continued to operate the East Camp group until April 1942. All the ore produced was treated in the company 75-ton cyanide mill at the mine; the gold-silver bullion recovered was shipped to the Denver Mint. Flotation cells were added to the mill late in 1942, and the company plans to produce zinc concentrates from East Camp ore in 1943. Small shipments of crude ore were made to the International Smelting & Refining Co. smelter at Miami, Ariz., from the Laura, Norman King, and Ontario properties.

Swartz (or Carpenter or Camp Monarch) district.—The Black Range Development Co. reopened the Grandview and Columbia properties in February 1942 and produced 6,893 tons of zinc-lead-silver ore, which was trucked to the Hanover custom mill. A. L. Owen shipped zinc-lead-silver ore regularly from the Royal John mine to the Hanover custom mill.

White Signal district.—A shipment of 128 tons of crude smelting ore reported to be from the True Blue claim was made in 1942. Other activities in the White Signal district consisted of two one-man operations that produced small lots of crude ore which were sold to Ira L. Wright at Silver City. Production came from the Big Chief and Combination prospects.

GUADALUPE COUNTY

The Stauber mine near Pastura was operated under lease in 1942 from January to June 31 by Alex Bonnyman, Jr., and the remainder of the year by the Guadalupe Mining Co. Shipments to the El Paso smelter for the year amounted to 7,498 tons of siliceous copper ore averaging 4.24 percent copper and 0.105 ounce of silver to the ton.

HIDALGO COUNTY

Apache district.—A lessee operating the Apache group shipped 1 carload of zinc smelting ore averaging 30 percent zinc to the Ozark Smelting & Mining Co. leaded-zinc pigment plant at Coffeyville, Kans.

Lordsburg district.—The Banner Mining Co., second-largest producer of copper in New Mexico, operated the Bonney and Anita No. 1 mines and a 500-ton flotation mill, 6 miles south of Lordsburg, continuously throughout 1942. Ore produced from the various levels of the mine is hoisted through a 1,475-foot, vertical, three-compartment main shaft situated 100 feet from the mill. Copper-gold-silver concentrates were sold to the El Paso smelter. Production from the old Anita mine, 5 miles south of Lordsburg, was started early in 1942 following an intensive rehabilitation and development program, which consisted in unwatering the mine, reconditioning the 800-foot shaft, diamond drilling 297 feet of exploratory drill holes, and driving 130

feet of raise and 43 feet of winze. The ore was trucked to the Banner mill at the Bonney mine for treatment. Development at the Bonney mine consisted of 2,744 feet of exploratory diamond drilling, sinking 126 feet of shaft, and driving 2,607 feet of drift. The National Zinc Corporation obtained a lease on the Ruth property and began shipping crude zinc-lead sulfide ore on April 4 to the Hanover custom mill (Grant County). Operations were continued throughout the year. Exploration and development comprised sinking 165 feet of shaft and driving 585 feet of drift. In 1943 an experimental 50-ton gravity-concentration pilot plant was installed on the Ruth property. If the metallurgical results of the pilot plant are satisfactory, the National Zinc Corporation plans to construct a larger mill for treating the Ruth ore.

The Federal Bureau of Mines late in 1942 and early in 1943 explored by diamond drilling at the Atwood group of claims on Atwood Hill near Valedon, 4 miles south of Lordsburg, in addition to rehabilitating the Henry Clay shaft on the property. If Bureau findings are satisfactory, active mining probably will be done on this property in 1943.

San Simon (Steins) district.—The Byrd Mining Co. operated, under lease, the Silver Hill property 9 miles south of Steins and began regular carload shipments of zinc-lead sulfide ore to the Hanover custom mill (Grant County) in May. Ore shipped averaged 8.14 percent lead, 3.26 percent zinc, and 1.86 ounces of silver to the ton. The Shattuck-Denn Mining Co. acquired the McGhee mine under a long-term lease late in November and began renovating equipment and buildings preparatory to production of ore. It is planned to treat the ore in the Shattuck-Denn custom mill at Bisbee, Ariz. The Diamond Mining Co. operated the Volcano group, 6 miles north of Steins, from April 1 to November 1 and shipped 2,115 tons of dry silver ore to the Miami (Ariz.) smelter. Small lots of crude smelting ore were shipped from the Carbon Hill and Central mines.

LINCOLN COUNTY

Jicarilla district.—All the output from the Jicarilla district and Lincoln County in 1942 was in small lots of placer gold recovered from stream gravels in the Jicarilla Mountains southeast of Ancho. The gold produced was sold to merchants in Ancho and Jicarilla.

LUNA COUNTY

Cooks Peak district.—Small tonnages of lead-silver ore were shipped through Ira L. Wright at Silver City in 1942 from the "85"–Ethel group, Lookout, Mickey, Surprise, and Mahoney Shaft No. 1 properties.

Deming district.—The Peru Mining Co. operated continuously in 1942, at slightly over capacity, its 500-ton selective-flotation mill at Wemple, near Deming. Most of the ore treated was moved by railroad from the company-operated Pewabic and Copper Flat mines in the Central district (Grant County). Some custom ore from two zinc properties in Arizona also was treated. The output of zinc concentrates increased nearly 50 percent over 1941.

OTERO COUNTY

Sacramento district.—I. W. Morrison shipped 41 tons of lead-copper-silver ore to the El Paso smelter from the Warwick claim in 1942.

SANTA FE COUNTY

Ortiz Mountains (Cerrillos) district.—Development and exploration on the Mina de Tira property 2½ miles north of Cerrillos produced 22 tons of lead-silver-copper-gold ore, which was shipped to the El Paso smelter. The Cerrillos Lead & Zinc Co. operated under lease the Pennsylvania mine, 12 miles northwest of Cerrillos, during the last 3 months of 1942 and shipped 43 tons of zinc-lead-silver ore to the Hanover custom mill (Grant County). Sluicing stream gravels on the Ortiz Grant southeast of Cerrillos recovered small lots of placer gold.

San Pedro or New Placers district.—A lessee worked the Candelari mine on a small scale and trucked the ore produced 4 miles to his 10-ton amalgamation mill at Golden for treatment. At the Old Timer mine, near Golden, 100 tons of ore were mined and treated in a Huntington mill. Several individuals continued to sluice placer gravels in the vicinity of Golden.

SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) district.—The only producing properties in the Chloride district in 1942 were the Apache group and the Minnehaha claim, from which small lots of smelting ore were shipped direct to the El Paso smelter or through Ira L. Wright at Silver City.

Hermosa district.—The only output from the Hermosa district in 1942 was 6 tons of lead-silver ore from the Pelican group.

Kingston district.—A lessee on the Percha mine in the Black Range west of Kingston operated part of 1942 and shipped 99 tons of zinc-lead-copper-silver ore to the Hanover custom mill in Grant County for treatment.

Las Animas district (Hillsboro).—Intermittent small-scale operations on the Tresness, Nicolds, and Wicks claims in the Las Animas district produced several lots of smelting ore, which were shipped to the El Paso smelter or to Ira L. Wright at Silver City.

The John I. Hallett Construction Co. continued operations in 1942 until November 15 at the leased Gold Dust, Graf Von Luxemburg, Bunker Hill, and other placers in a group about 8 miles east of Hillsboro. The equipment consists of two gasoline-powered dragline excavators of 1- and 1¼-cubic yard capacity, a Coulter-Ainlay bowl recovery plant mounted on wheels, water-storage tanks, and pumps. Sluicing and panning at other placers in the Las Animas district recovered small lots of gold.

Pittsburg and Caballos Mountains district.—Itinerant prospectors panned for gold in 1942 on the stream gravels of the Pittsburg and Caballos Mountains district and sold what gold they recovered to the Myers Co. store at Hatch.

Tierra Blanca district.—L. E. Cleveland shipped 1 ton of lead-silver smelting ore from his Silver Bell claim through Ira L. Wright, ore buyer, at Silver City.

SOCORRO COUNTY

Magdalena district.—Production of recoverable zinc from the Magdalena district increased from 5,159,000 pounds in 1941 to 6,370,000 pounds in 1942, or 23.47 percent; the output of recovered lead increased from 847,400 to 1,728,000 pounds, or 103.92 percent. Raskob Mining Interests, Inc., continued to operate, under lease and option, the Waldo mine and 200-ton flotation mill until July 1, when it relinquished the lease and the property reverted to the owners, the Sherwin-Williams Co. The property remained idle until October 1942, when the Ozark Smelting & Mining Co., (subsidiary of the Sherwin-Williams Co.) resumed production and continued to operate the mine and mill the remainder of the year. Ore milled during 1942 by both operators totaled 29,118 tons, yielding 4,012 tons of zinc concentrates and 291 tons of lead concentrates. The ore milled contained traces of gold, silver, and copper and averaged 2.8 percent lead and 12.7 percent zinc. The concentrates produced were shipped to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans., the El Paso smelter, and the Dumas smelter of the American Zinc Co. of Illinois. On April 10, 1943, the Waldo property (mine and mill) was purchased by the American Smelting & Refining Co., which continued operations. The Kelly Unit (Lynchburg and Kelly mines) of the Empire Zinc Co. was worked by lessees, who shipped zinc-lead ore to the Empire Zinc Co. flotation mill at Hanover and to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans. Victor Papa shipped 267 tons of lead-copper-silver-gold ore from the West Star property to the El Paso smelter. J. A. McDonald began operations on the Nitt claim in August and shipped crude zinc-lead-silver ore to the Hanover custom mill (Grant County) in addition to making several shipments of copper-silver ore to the El Paso smelter. A lessee on the El Tigre mine shipped 1 carload of zinc-lead ore to the Hanover custom mill.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By CHARLES WHITE MERRILL AND H. M. GAYLORD

SUMMARY OUTLINE

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SUMMARY

The gold-mining industry of Oregon collapsed during 1942. In 1940 gold production reached an all-time high, but by the end of 1942 the few mines with substantial gold output in the earlier months of the year had suspended operations. Silver and lead production also decreased in both quantity and value, and the small rise in copper output was not significant in the State total for the four metals.

The total value of the gold, silver, copper, and lead (in terms of recovered metals) produced in Oregon was $1,708,297 in 1942 compared with $3,602,468 in 1941. It was divided among the metals as follows: Gold, 95 percent; silver, 4 percent; and copper and lead combined, 1 percent. No recovery of zinc has been reported since 1937. Baker County continued to be the leading metal producer and contributed 40 percent of the State total value; Grant County yielded 27 percent, Jackson County 18 percent, Josephine County 7 percent, and the other eight producing counties 8 percent. Distribution of production, by counties, was much the same as in 1941.

Rising wages, enlistment of miners in the armed forces, migration of miners to war industries, rising costs of supplies and equipment and the difficulties of obtaining them, higher taxes, and a fixed price for gold and silver (principal metals produced in the State) were factors that continued to crush the industry in 1942 as in 1941. When the War Production Board issued Order L–208 October 8, production, which had already sunk to approximately one-third of its 1940 level, quickly collapsed. The five leading gold producers for the year 1942 suspended operations between October 7 and 31; they supplied 50 percent of the State output.

Lode mines were affected sooner than placers, so that only 17 percent of the total gold in 1942 came from lodes. For a number of years lode mines had produced about one-third and placers two-thirds of the gold 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

556250—43——30

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1938–42, and total, 1852–1942, 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
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
1941	91	153	98,160	96,565	3,379,775	276,158	196,379
1942	48	83	31,728	46,233	1,618,155	87,376	62,134
1852–1942			[2]	5,667,021	126,308,778	5,177,158	4,759,521

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	166,000	19,588	118,000	6,726			3,602,468
1942	206,000	24,926	46,000	3,082			1,708,297
1852–1942	[3] 12,326	4,635,655	[3] 737	74,933	[3] 140	$13,846	135,792,733

[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, 1938–42, by classes of mines and by methods of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges:					
1938	5	7,258,000	29,006	$1,015,210	$0.140
1939	5	6,267,000	25,028	875,980	.140
1940	6	7,580,000	24,951	873,285	.115
1941	7	6,670,000	24,131	844,585	.127
1942	6	4,725,000	21,641	757,435	.160
Dragline dredges: [2]					
1938	11	2,891,000	15,939	557,865	.193
1939	10	5,964,000	26,257	918,995	.154
1940	23	7,361,000	35,216	1,232,560	.167
1941	25	6,256,000	28,395	993,825	.159
1942	14	2,852,000	13,383	468,405	.164
Suction dredges: [3]					
1941	1	27,000	191	6,685	.248
1942					
Nonfloating washing plants: [4]					
1938	5	136,000	1,768	61,880	.455
1939	13	346,000	2,169	75,915	.219
1940	29	638,000	4,092	143,220	.224
1941	17	567,000	2,757	96,495	.170
1942	6	45,000	380	13,300	.296
Gravel hydraulically handled:					
Hydraulic:					
1938	66	731,000	3,261	114,135	.156
1939	76	440,000	2,585	90,475	.206
1940	82	599,000	2,731	95,585	.160
1941	63	683,000	2,306	80,710	.118
1942	41	306,000	1,420	49,700	.162
Small-scale hand methods: [5]					
Wet:					
1938	57	332,800	3,874	135,590	.407
1939	83	299,200	4,398	153,930	.514
1940	44	499,300	4,279	149,765	.300
1941	33	438,300	2,553	89,355	.204
1942	12	220,500	1,462	51,170	.232
Dry:					
1938	2	800	16	560	.700
1939	1	400	13	455	1.138
1940	1	500	21	735	1.470
1941	1	100	3	105	1.050
1942					
Underground placers:					
Drift:					
1938	11	5,400	467	16,345	3.027
1939	13	5,400	329	11,515	2.132
1940	10	6,200	287	10,045	1.620
1941	6	4,600	94	3,290	.715
1942	4	1,500	50	1,750	1.167
Grand total placer:					
1938	157	11,355,000	54,331	1,901,585	.167
1939	201	13,322,000	60,779	2,127,265	.160
1940	[6] 192	16,684,000	71,577	2,505,195	.150
1941	153	14,646,000	60,430	2,115,050	.144
1942	83	8,150,000	38,336	1,341,760	.165

[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 suction pump for delivering gravel to floating washing plant, except those producing less than 100 ounces of gold, which are included under "Small-scale hand methods"; no suction dredges reported for 1938–40, inclusive, and 1942.

[4] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."

[5] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.

[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 1942 decreased 52 percent compared with 1941—the output from placers 37 percent and that from lode mines 78 percent. Of the total placer gold, connected-bucket dredges recovered 56 percent, dragline dredges 35 percent, hydraulicking and small-scale hand methods 4 percent each, and nonfloating washing plants (with mechanical excavators) and drift mines 1 percent. Virtually all the lode gold was derived from dry ores and most (96 percent) of it from dry gold ore. Although 131 properties produced in 1942, the bulk of the gold came from relatively few mines; the following 10 properties, listed in order of output, supplied 71 percent of the State total: Sumpter Valley Dredging Co. (connected-bucket dredge), Porter & Co. (connected-bucket dredge), Stearns & Owens (Kubli operation) (dragline dredge), Ferris Mining Co. (dragline dredge), Sunshine Mining Co. (Burnt River Division) (connected-bucket dredge), Timms Gold Dredging Co. (connected-bucket dredge), Ellis Mining Co. (gold ore), Stearns & Owens (Alaska of Oregon operation) (dragline dredge), Western Gold Dredging Co. (connected-bucket dredge), and Consuelo Oregon Mines (dragline dredge). Only one of the 10 is a lode mine.

Silver.—Silver production in Oregon in 1942 decreased 68 percent compared with 1941. Of the State total, Jefferson County yielded almost two-thirds, and most of the remainder came from Lane and Baker Counties; dry silver ore yielded 45 percent, dry gold ore 27 percent, dry gold-silver ore 20 percent, and placer gravels almost all the rest. Smelting of crude ore accounted for 59 percent of the total lode silver and smelting of concentrates for virtually all the rest.

Copper, lead, and zinc.—Most of the copper output of Oregon in 1942 was a byproduct of ores worked primarily for their gold content. The lead output of the State, which totaled only 46,000 pounds, was derived entirely from precious-metal ores. No zinc was reported recovered.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, and lead in Oregon in 1942, by counties, in terms of recovered metals

County	Mines producing [1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	11	11	2,731	$95,585	16,455	$575,925	19,186	$671,510
Coos		(2)			17	595	17	595
Curry		2			28	980	28	980
Douglas	1	5	13	455	97	3,395	110	3,850
Grant	7	15	1,502	52,570	11,541	403,935	13,043	456,505
Harney		(2)			6	210	6	210
Jackson	14	17	354	12,390	8,423	294,805	8,777	307,195
Josephine	12	29	1,859	65,065	1,521	53,235	3,380	118,300
Malheur		3			247	8,645	247	8,645
Union		1			1	35	1	35
Other counties [3]	3		1,438	50,330			1,438	50,330
Total, 1941	48	83	7,897	276,395	38,336	1,341,760	46,233	1,618,155
	91	153	36,135	1,264,725	60,430	2,115,050	96,565	3,379,775

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1942, by counties, in terms of recovered metals—Continued

County	Silver (lode and placer)[4]		Copper		Lead		Total value
	Fine ounces	Value	Pounds	Value	Pounds	Value	
Baker	10,959	$7,793	6,000	$726			$680,029
Coos	7	5					600
Curry	7	5					985
Douglas	24	17					3,867
Grant	4,936	3,510	4,000	484			460,499
Harney							210
Jackson	1,336	950			2,000	$134	308,279
Josephine	526	374	16,000	1,936			120,610
Malheur	38	27					8,672
Union							35
Other counties[3]	69,543	49,453	180,000	21,780	44,000	2,948	124,511
Total, 1941	87,376	62,134	206,000	24,926	46,000	3,082	1,708,297
	276,158	196,379	166,000	19,588	118,000	6,726	3,602,468

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Output from property not classed as a "mine."
[3] Jefferson and Lane Counties.
[4] Sources of total silver as follows—1942: 80,235 ounces from lode mines and 7,141 ounces from placers; 1941: 264,953 ounces from lode mines and 11,205 ounces from placers.

MINING INDUSTRY

Of the 31,728 tons of ore (including 3,075 tons of old tailings) sold or treated in Oregon in 1942, Lane County produced 12,442 tons or 39 percent, Baker County 6,623 tons (including 2,500 tons of old tailings) or 21 percent, Josephine County 4,795 tons or 15 percent, Grant County 4,721 tons or 15 percent, and Jefferson County 2,615 tons (including 400 tons of old tailings) or 8 percent. Almost 92 percent of the ore (including old tailings) was dry gold ore, and virtually all the remainder was dry gold-silver and silver ore.

The six properties worked by connected-bucket dredges had one dredge each, none of which worked at more than one property in 1942; at the end of the year all operations had been suspended. Ten dragline dredges washed gravel at 14 Oregon properties, but none was in operation at the close of the year; the dragline excavators were equipped as follows: 3 each with 2- and 1¼-cubic yard buckets and 1 each with a 3-, 2½-, 1¾-, and 1½-cubic yard bucket.

Reports on the use of quicksilver at Oregon placer mines indicate that 867 pounds were consumed during 1942. The placer operators reporting on quicksilver consumption furnished 1942 data from which the following quantities of gold recovered per pound of quicksilver consumed have been calculated (1941 figures in parentheses): Connected-bucket dredges, 37 ounces of gold per pound of quicksilver (none in 1941); dragline dredges, 76 ounces (55); hydraulic mines, 30 ounces (21); and small-scale hand operations, 27 ounces (6).

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 1942, 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	26,380	2,675	7,562	23,421	176,600	26,000
Dry and siliceous gold-silver ore	1,180	400	131	17,338	5,500	10,300
Dry and siliceous silver ore	1,035		202	39,459	8,500	9,700
Copper ore	58		2	17	15,400	
Total, lode mines	28,653	3,075	7,897	80,235	206,000	46,000
Total, placers			38,336	7,141		
	28,653	3,075	46,233	87,376	206,000	46,000
Total, 1941	96,975	1,185	96,565	276,158	166,000	118,000

METALLURGIC INDUSTRY

Of the State total ore and old tailings (31,728 tons), 58 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 19 percent was shipped crude to smelters. Ultimate recovery of 50 percent of the total lode gold was from the smelting of ore; 29 percent from the smelting of concentrates; 16 percent as bullion from cyanidation of ore and old tailings; and 5 percent as bullion from amalgamation of ore. All material requiring smelting was shipped out of the State, as Oregon has no smelters.

Data furnished by operators of some of the gold and silver mills show that 4,003 pounds of 91-percent sodium cyanide were consumed in recovering 1,235 ounces of gold and 198 ounces of silver from 4,213 tons of ore and 2,500 tons of old tailings, and that 21 pounds of quicksilver were used in recovering 170 ounces of gold and 44 ounces of silver from 278 tons of ore.

Mine production of metals in Oregon in 1942, 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	565	437	95		
Ore and old tailings cyanided	6,838	1,246	204		
Concentrates smelted:					
Flotation	1,420	2,246	32,421	172,400	36,300
Gravity	4	17	10		
Ore smelted	5,977	3,951	47,505	33,600	9,700
Total, lode mines		7,897	80,235	206,000	46,000
Total, placers		38,336	7,141		
		46,233	87,376	206,000	46,000
Total, 1941		96,565	276,158	166,000	118,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1942, 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
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*
Baker	190		112	29	1	2	1
Grant	54		56	12			
Jackson	90	50	116	32			
Josephine	181		153	22	2	11	
Total, 1941	515	50	437	95	3	13	1
	1,440		971	222	12	62	21

CYANIDATION MILLS

Baker, Jackson, Josephine	4,213	2,625	1,246	204			
Total, 1941	4,213	2,625	1,246	204			
	21,617	1,185	4,056	513			
Grand total: 1942	4,728	2,675	1,683	299	3	13	1
1941	23,057	1,185	5,027	735	12	62	21

[1] Figures under "Ore" for cyanidation mills include both raw ore and concentrates cyanided but not raw ore concentrated before cyanidation of concentrates.

Mine production of metals from concentrating mills in Oregon in 1942, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal				
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	12		1	4	9		
Grant	4,090		468	990	2,234	900	
Other counties [1]	13,846	400	952	1,256	30,187	171,500	36,300
Total, 1941	17,948	400	1,421	2,250	32,430	172,400	36,300
	65,130		6,363	25,534	161,305	112,200	84,000

[1] Jackson, Jefferson, and Lane Counties.

Gross metal content of concentrates produced from ores mined in Oregon in 1942, 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	472	1,007	2,244	1,402	1,022	
Dry gold-silver	261	131	17,338	5,815	14,185	18,103
Copper	659	771	12,291	169,419	35,656	
Lead	32	354	558	1,667	6,925	
Total, 1941	1,424	2,263	32,431	178,303	57,788	18,103
	6,375	25,596	161,326	117,114	109,295	79,429

Mine production of metals from Oregon concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	2	6	10		
Grant	468	990	2,234	900	
Jackson	11	40	156		2,000
Josephine	2	11			
Other counties [1]	941	1,216	30,031	171,500	34,300
	1,424	2,263	32,431	172,400	36,300
Total, 1941	6,375	25,596	161,326	112,200	84,000

BY CLASSES OF CONCENTRATES

Dry gold	472	1,007	2,244	900	
Dry gold-silver	261	131	17,338	5,500	10,300
Copper	659	771	12,291	165,000	19,600
Lead	32	354	558	1,000	6,400
	1,424	2,263	32,431	172,400	36,300

[1] Jefferson and Lane Counties.

Gross metal content of Oregon crude ore shipped to smelters in 1942, 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	4,884	3,747	8,029	10,734	1,419
Dry and siliceous silver	1,035	202	39,459	9,742	17,566
Copper	58	2	17	16,014	
	5,977	3,951	47,505	36,490	18,985
Total, 1941	8,896	5,512	102,892	58,265	64,936

Mine production of metals from Oregon crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	3,921	2,414	6,969	6,000	
Douglas	8	13	10		
Grant	577	456	679	3,100	
Josephine	401	659	297	16,000	
Other counties [1]	1,070	409	39,550	8,500	9,700
	5,977	3,951	47,505	33,600	9,700
Total, 1941	8,896	5,512	102,892	53,800	34,000

BY CLASSES OF ORE

Dry and siliceous gold	4,884	3,747	8,029	9,700	
Dry and siliceous silver	1,035	202	39,459	8,500	9,700
Copper	58	2	17	15,400	
	5,977	3,951	47,505	33,600	9,700

[1] Jackson, Jefferson, and Lane Counties.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, and lead in Oregon in 1942, 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				
Baker County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Baker	2	(4)	257	120	(4)	[5] 120	[5] 661			[5] $4,670
Connor Creek		1			72	72	7			2,525
Cracker Creek	3		3,548	2,206		2,206	6,151	6,000		82,310
Greenhorn [6]		3			2,925	2,925	578			102,786
Mormon Basin [7]		2			104	104	31			3,662
Sparta	2		72	17		17	14			605
Sumpter		3			13,087	13,087	3,143			460,280
Upper Burnt River		1			54	54	7			1,895
Virtue	3		2,725	331		331	308			11,804
Weatherby	1	(8)	21	57	39	96	21			3,375
Coos County:										
Coos Bay		(8)			9	9	3			317
Coquille		(8)			8	8	4			283
Curry County:										
Chetco		1			4	4				140
Gold Beach		(8)			10	10	3			352
Sixes		1			14	14	4			493
Douglas County:										
Riddle		5			97	97	14			3,405
Tiller-Drew	1		8	13		13	10			462
Grant County:										
Canyon	1	5	3	3	4,912	4,915	488			172,372
Granite	2	(4)	4,551	1,291	(4)	[5] 1,291	[5] 2,423	1,600		[5] 47,102
Greenhorn [6]	3	2	166	206	2,442	2,648	959	2,400		93,652
North Fork John Day		2			126	126	28			4,430
Quartzburg	1	1	1	2	13	15	3			527
Susanville		3			31	31	7			1,090
Harney County: Idol City		(8)			6	6				210
Jackson County:										
Ashland	2		2	6		6				210
Gold Hill	5	6	191	92	4,046	4,138	526			145,204
Jacksonville	3	3	57	8	310	318	52			11,167
Upper Applegate	2	8	16	26	4,067	4,093	564			143,656

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1942, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total				
Josephine County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Galice	5	8	4,644	1,806	180	1,986	363	600		$69,841
Grants Pass	1	4	2	1	207	208	21			7,295
Greenback [9]	4	5	90	21	487	508	69			17,829
Illinois River	1	9	1	29	217	246	28			8,630
Lower Applegate		1			25	25	4			878
Waldo	1	2	58	2	405	407	41	15,400		16,137
Malheur County: Mormon Basin [7]		3			247	247	38			8,672
Union County: Camp Carson		1			1	1				35
Combined counties and districts [10]	5	3	15,315	1,660	4,191	5,851	70,803	180,000	46,000	279,996
Total Oregon	48	83	31,728	7,897	38,336	46,233	87,376	206,000	46,000	1,708,297

[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: 80,235 ounces from lode mines and 7,141 ounces from placers.

[4] Included under "Combined counties and districts."

[5] Exclusive of placer output, which is included under "Combined counties and districts."

[6] Greenhorn district lies in both Baker and Grant Counties.

[7] Mormon Basin district lies in both Baker and Malheur Counties.

[8] Output from a property not classed as a "mine."

[9] Greenback district lies in both Jackson and Josephine Counties.

[10] Includes following districts: Baker (placer) in Baker County; Granite (placer) in Grant County; Elk Creek and Greenback in Jackson County; Ashwood in Jefferson County; and Bohemia in Lane County.

BAKER COUNTY

Baker district.—The Midas mine in the Pocahontas section of the Baker district was worked by drifting and hydraulicking during 1942. The Alec Johnson mine shipped gold ore to a smelter.

Cracker Creek district.—The Argonaut mine shipped gold ore to a smelter during 1942. The Bald Mountain mine was worked by lessees; 2 tons of high-grade ore treated by amalgamation yielded 7 ounces of gold and 5 ounces of silver, and 26 tons of gold ore shipped to a smelter contained 14 ounces of gold and 144 ounces of silver. The Ellis Mining Co. remodeled the E & E mill in 1942; the company holdings, which include the Eureka & Excelsior, Tabor Fraction, and Columbia mines, were operated by lessees, who shipped to a smelter 3,472 tons of ore containing 2,156 ounces of gold, 5,980 ounces of silver, and 6,196 pounds of copper.

Greenhorn district.—The Sunshine Mining Co. (Burnt River Division) operated a connected-bucket dredge in 1942 until War Production Board Order L–208 resulted in suspension of operations in October. The Oroplata Mining Co. operated a dragline dredge near Whitney from January 25 until March 11, when operations were suspended for the duration of the war; the dragline excavator was equipped with a 2½-cubic yard bucket.

Mormon Basin district.—G. W. Cartwright hydraulicked at the Rye Valley placers during 1942. J. W. Frisco worked the Webber mine by hydraulicking from June 1 until September 30 and recovered 19 ounces of gold and 14 ounces of silver.

Sparta district.—Lessees worked the Macy mine from January 1 to February 21, 1942, when the lease was terminated; 60 tons of ore treated by amalgamation yielded bullion, containing 11 ounces of gold and 4 ounces of silver, and 1 ton of gravity concentrate, containing 2 ounces of gold and 1 ounce of silver.

Sumpter district.—The Sumpter Valley Dredging Co., largest producer of gold in Oregon in 1942, washed 2,704,734 cubic yards of gravel and recovered 10,259 ounces of gold and 2,360 ounces of silver; the dredge (Yuba type) had seventy-two 9-cubic foot buckets. Operations were suspended October 31 because of War Production Board Order L–208. Consuelo Oregon Mines operated a dragline dredge during the first 6 months, and the Northwest Development Co. operated a dragline dredge on Powder River during the first 7 months of the year.

Upper Burnt River district.—G. W. Elliott worked the Elliott drift mine from January 1 to August 1, 1942; 800 cubic yards of gravel yielded 25 ounces of gold and 4 ounces of silver.

Virtue district.—K. Grabner operated the Cliff mine from January 1 to July 1, 1942; 100 tons of ore treated by amalgamation yielded 32 ounces of gold and 5 ounces of silver; 48 tons of gold ore shipped to a smelter contained 42 ounces of gold and 7 ounces of silver. Old tailings at the Gold Center mine were treated by cyanide leaching between June 1 and October 1.

Weatherby district.—Lovejoy Mines, in the Chicken Creek section of the Weatherby district, produced a small quantity of gold by amalgamation in 1942.

GRANT COUNTY

Canyon district.—Hydraulicking at the Quartz Gulch mine from February 15 to July 5, 1942, resulted in the recovery of 20 ounces of

gold and 4 ounces of silver from 8,000 cubic yards of gravel. Hydraulicking was carried on at the Tracy mine from March 5 to May 5. The Ferris Mining Co. operated a dragline dredge from January 1 until operations were suspended October 26; the dragline excavator was equipped with a 3-cubic yard bucket. The Western Gold Dredging Co. operated a connected-bucket dredge on John Day River from January 1 to October 13; the dredge had seventy-two 6-cubic foot buckets.

Granite district.—Porter & Co. operated a connected-bucket dredge with sixty-two 4½-cubic foot buckets on Granite, Clear, Olive, and Crane Creeks from January 1 until October 16, 1942. Bruce Dennis operated the Constitution mine; gold ore was treated by flotation, and gold concentrates were shipped to a smelter. The Cougar-Independence Mining Co. shipped gold ore and gold concentrates from the Cougar Independence mine; operations were suspended when repair parts for the company mill became unobtainable.

Greenhorn district.—The Timms Gold Dredging Co. during 1942 operated a connected-bucket dredge on the DeWitt ranch situated in that part of the Greenhorn district extending into Grant County from Baker County. Klein & Manley amalgamated 16 tons of ore from the Golden Gate mine and recovered 30 ounces of gold and 5 ounces of silver. W. Gardner shipped gold ore from the Morning mine to a smelter. James & Hay carried on development work at the Rabbit mine from January 1 to December 1; gold ore was treated by amalgamation.

North Fork John Day district.—A gold shipment was made from the North Fork placer in 1942 as a result of the final clean-up of the dragline dredge which had suspended operations in 1941.

JACKSON COUNTY

Elk Creek district.—A small quantity of lead concentrates resulted from test work carried on during 1942 by Al Sarena Mines, Inc., at the Al Sarena mine in the Buzzard section of the Elk Creek district; the concentrates were shipped to a smelter.

Gold Hill district.—Stearns & Owens operated a dragline dredge on the Kubli ranch from January 1 until October 7, 1942; the dragline excavator was equipped with a 2-cubic yard bucket. Lance Bros. hydraulicked 1,000 cubic yards of gravel between January 1 and April 1, recovering 20 ounces of gold and 3 ounces of silver. The Pleasant Creek Mining Corporation operated a connected-bucket dredge on Pleasant Creek from January 1 to June 1; the dredge was equipped with fifty-six 3-cubic foot buckets. H. H. McClung recovered 16 ounces of gold and 3 ounces of silver by hydraulicking on Wards Creek. Sandry & Whipple operated the Gold Chloride mine from January 1 to June 20; 38 ounces of gold and 9 ounces of silver were recovered from 36 tons of ore. J. T. Breeding worked the Lucky Bart group during the year.

Greenback district.—H. B. Warner shipped high-grade gold ore from intermittent operations at the Warner mine to a smelter during 1942.

Jacksonville district.—The Jackson Mining Co. operated a nonfloating washing plant, to which gravel was delivered by mechanical means, on the George Wendt ranch from January 1 until March 1, 1942. The C. & D. Mining Co. operated a dragline dredge with a dragline excavator, having a 1¼-cubic yard bucket, from January 1 to April 25;

20,000 cubic yards of gravel yielded 170 ounces of gold and 27 ounces of silver.

Upper Applegate district.—Stearns & Owens operated a dragline dredge on the Alaska of Oregon and B–H properties during 1942. The B–H Co. operated a dragline dredge with a dragline excavator, having a 1½-cubic yard bucket, from January 1 to May 7; 177,500 cubic yards of gravel yielded 843 ounces of gold and 131 ounces of silver. F. L. Smith carried on intermittent hydraulicking on the Federal mine throughout the year. The Crescent Pacific Mining Co. operated a dragline dredge with a dragline excavator equipped with a 1¾-cubic yard bucket from January 1 to 28, and 45,850 cubic yards of gravel yielded 174 ounces of gold and 22 ounces of silver; a caterpillar and carry-all was used for resoiling the dredge area. The Southern Oregon Mining Co., Ltd., operated a dragline dredge on the McDonough and the Smith-McDonough ranches from January 1 to May 5; the dragline excavator was equipped with a 1¼-cubic yard bucket. Hydraulicking was carried on at the Sterling property during the season.

JEFFERSON COUNTY

Ashwood district.—Oregon King Mines, Inc., operated the Oregon King mine from January until October 1942, when work was continued by Fenton & Silbaugh under the name of Oregon King Mines; 1,180 tons of gold-silver ore and 400 tons of old tailings were treated in the company 50-ton flotation mill; 261 tons of resulting gold-silver concentrates and 1,035 tons of silver ore were shipped to a smelter. The concentrates contained 131 ounces of gold, 17,338 ounces of silver, 5,815 pounds of copper, 14,185 pounds of lead, and 18,103 pounds of zinc; the ore shipped direct to the smelter contained 202 ounces of gold, 39,459 ounces of silver, 9,742 pounds of copper, 17,566 pounds of lead, and 37,351 pounds of zinc.

JOSEPHINE COUNTY [1]

Galice district.—S. Alderson carried on hydraulicking operations at the Klum mine from February 2 to April 13, 1942. Young & Vandeventer hydraulicked at the Lewis mine. The Lewis Investment Co. operated the Benton mine from January 1 to April 8, when work was suspended because of rising costs of supplies and shortage of labor; gold ore was treated in the company 60-ton countercurrent cyanidation plant. Gold ore was shipped from the Almeda mine.

Grants Pass district.—R. Heller operated the Sunset mine on Jump-off Joe Creek during 1942; 4,000 cubic yards of gravel yielded 17 ounces of gold and 2 ounces of silver. The Yewwood mine was also worked by hydraulicking.

Greenback district.—Hydraulicking was carried on at the Blue Channel mine from January 1 to May 1, 1942. The Little Artie mine was worked. Gold was produced by hydraulicking at the Goff mine during the year.

Illinois River district.—Laguna Mines hydraulicked during 1942. N. W. Cole worked the Eureka mine from January 1 to August 1.

Waldo district.—Hydraulicking at the Esterly mine in 1942 yielded 373 ounces of gold and 21 ounces of silver from the washing of 63,700

[1] *See also* State of Oregon Department of Geology and Mineral Industries, Oregon Metal Mines Handbook: Bull. 14–C, 1942, 229 pp.

cubic yards of gravel. A small shipment of copper ore from the Cow Boy mine was sent to a smelter.

LANE COUNTY

Bohemia district.—H. & H. Mines completed construction of a mill and power plant at the Champion mine in 1942; gold ore was treated in a 100-ton flotation plant, and copper and lead concentrates were shipped to a smelter. High cost of materials and shortage of labor caused suspension of operations in August.

MALHEUR COUNTY

Mormon Basin district.—Whitney & Boydstun operated a non-floating washing plant, to which gravel was delivered by a carry-all, from March 10 to July 10, 1942; 16,000 cubic yards of gravel yielded 240 ounces of gold and 38 ounces of silver.

OTHER COUNTIES

Small outputs in 1942 were reported from Coos, Curry, Douglas, Harney, and Union Counties.

Details of production by counties and districts are given in the preceding table.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN SOUTH DAKOTA

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY OUTLINE

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SUMMARY

Metal mining in South Dakota is confined to a small area comprising parts of Custer, Lawrence, and Pennington Counties in the mountain group known as the Black Hills. Gold is the chief metal produced, and gold mining is the principal mineral industry of the State. Such minor minerals as columbo-tantalite, tin, beryllium, and lithium minerals have been produced. An extensive deposit of manganese-bearing shales near Chamberlain, Brule County, was mined experimentally by the International Minerals & Chemical Corporation under a War Production Board contract. Development of this project was halted early in 1943 by the War Production Board because the expenditure of manpower and equipment was not deemed advisable at that time. The Federal Bureau of Mines for a number of years has been developing the metallurgy of this deposit so that economic beneficiation may be made possible. In 1942 the recovered output of gold in the State was 522,098 fine ounces valued at $18,273,430, a 13-percent decrease from 1941. Factors contributing to the decline in gold production were: The difficulty that gold-mine operators experienced in securing adequate labor and essential supplies and the issuance of the War Production Board Gold-Mining Limitation Order in October 1942. By September 10 all but three gold mines had closed, and the order compelled another mine to close on November 26, leaving but two in operation and those only because of a reprieve. Besides gold, South Dakota in 1942 produced 186,937 fine ounces of recovered silver valued at $132,933 and 2,000 pounds of recovered copper as byproduct metals. In addition, 230,000 pounds of recovered zinc and 170,000 pounds of recovered lead were produced; this output came from a well-known zinc-lead deposit unprofitable to mine were it not for the premium prices for these metals.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

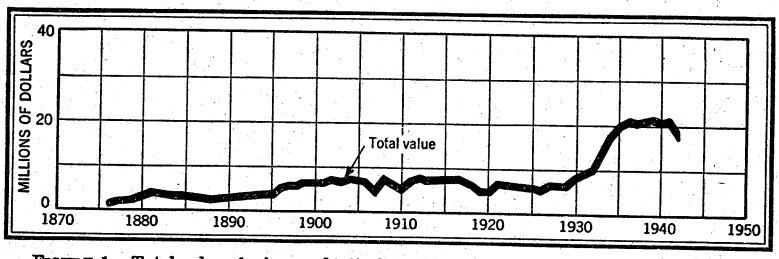

FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876–1942.

Mine production of gold, silver, copper, lead, and zinc in South Dakota, 1938–42, and total, 1876–1942, 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
1938	11	71	1,586,181	594,847	$20,819,645	162,295	$104,918
1939	18	80	1,632,778	618,536	21,648,760	167,584	113,754
1940	11	81	1,667,370	586,662	20,533,170	175,514	124,810
1941	10	41	1,711,744	600,637	21,022,295	170,771	121,437
1942	5	13	1,464,384	522,098	18,273,430	186,937	132,933
1876–1942			[2]	20,560,041	501,198,644	9,533,213	6,781,561

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1938							$20,924,563
1939							21,762,514
1940	12,000	$1,356	14,000	$700			20,660,036
1941							21,143,732
1942	2,000	242	170,000	11,390	230,000	$21,390	18,439,385
1876–1942	[3] 105	36,196	[3] 380	46,910	[3] 115	21,390	508,084,701

[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, 1938–42, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1938	1,069	$37,415	82	$53	$37,468
1939	622	21,770	47	32	21,802
1940	229	8,015	21	15	8,030
1941	93	3,255	7	5	3,260
1942	33	1,155	3	2	1,157

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in South Dakota in 1942, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Lawrence	4	10	1,446,770	520,006	$18,200,210	186,480	$132,608
Pennington	1	3	17,614	2,092	73,220	457	325
	5	13	1,464,384	522,098	18,273,430	186,937	132,933
Total, 1941	10	41	1,711,744	600,637	21,022,295	170,771	121,437

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Lawrence	2,000	$242	170,000	$11,390	230,000	$21,390	$18,365,840
Pennington							73,545
	2,000	242	170,000	11,390	230,000	21,390	18,439,385
Total, 1941							21,143,732

MINING AND METALLURGIC INDUSTRY

Producers of lode gold and silver in South Dakota in 1942 mined and sold or treated 1,464,384 short tons of ore yielding, in recovered metals, 522,065 fine ounces of gold, 186,934 fine ounces of silver, 2,000 pounds of copper, 170,000 pounds of lead, and 230,000 pounds of zinc. An analysis of methods of treatment shows 1,275,138 tons treated by amalgamation followed by cyanidation of sands and slimes; 179,249 tons treated by cyanidation only or by roasting followed by cyanidation; 17,614 tons (included in 179,249 tons above) treated by table and jig concentration (some of the gold concentrates were shipped to smelter and some cyanided by countercurrent-decantation cyanidation); and 9,997 tons treated by flotation concentration.

METALLURGIC RECOVERY

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1938–42

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
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
1941	1,506,183	328,166.44	62,423	6,537
1942	1,275,138	276,298.00	56,852	3,561

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1938–42

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*
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	883,849
1941	205,356	----------	1,499,000	1,704,356	270,989.89	106,437	903,680
1942	161,635	[3] 366	1,271,305	1,433,306	244,421.00	122,312	[4] 801,478

[1] In terms of 96- to 98-percent strength.
[2] From 1,143 tons of ore treated by flotation.
[3] From 17,614 tons of crude ore treated by table and jig concentration.
[4] Actually 1,602,955 pounds of calcium cyanide (48- to 49-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

There were no mining operations in Custer County in 1942 other than a small amount of development work on several placer properties along French Creek. The inactivity in this district is due largely to the fact that relatively little virgin placer ground remains, and most of the residents who formerly mined have taken more lucrative jobs in war industries.

LAWRENCE COUNTY

Homestake mine.—The Homestake mine has been producing almost continuously since 1876 and has been operated since 1877 by the Homestake Mining Co. This company at first owned only the Homestake and Golden Star claims but has since acquired and consolidated into one group numerous other claims which, with the first two, constitute the Homestake mine. The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1942, says—

Operations during 1942 were seriously affected by war conditions and by orders of the War Production Board. Difficulties began in March, when priority ratings for gold mines were lowered and culminated with the drastic order issued October 8, 1942, suspending operations of gold mines. An appeal from this order was filed with the War Production Board and modification obtained to permit hoisting and milling of broken ore for an additional period of 6 months or until June 8, 1943.

Ore production from the mine during 1942 was 1,275,138 tons which is a decrease of 14.99 percent from that for 1941. The gross income for gold and silver produced was 12.63 percent lower than in 1941. The average realization per ton was $13.39 as compared to $13.02 in 1941.

Total taxes were $4,269,162.87, which is $108,828.26 more than in 1941.

The reserve of developed ore is 19,183,683 tons, which includes 270,092 tons of broken ore remaining in the shrinkage stopes.

The mine and plant are in excellent condition and, unless circumstances arise beyond our control, this condition will be maintained in order that production can be resumed when present Government restrictions are withdrawn.

All construction was completed early in the year. The new mine and engineering office was completed and occupied in May. The Yates shaft was sunk to a depth of 145 feet below the 4,100-foot level and a skip loading station excavated below that level.

Machine shops and foundry are engaged in a variety of war production jobs.

The sawmill at Spearfish is continuing to operate at capacity. Its production of lumber is being sold largely for army bases and other construction for military purposes.

Early in the year investigation of properties that might yield metals necessary to the war effort was begun. In July an option was taken on a manganese property in Lower California. Plans for a mill are under consideration. In October, the development and operation of a deposit in Wyoming containing a strategic mineral was undertaken through an agency contract made by your subsidiary, the Wyodak Coal & Mfg. Co., with the Metals Reserve Co. Performance is guaranteed by the Homestake Mining Co. Only nominal profits at best may be expected from these operations undertaken as part of the war effort.

With the order of the War Production Board as it now stands it is expected that production from ore previously broken will continue at approximately 1,000 tons per day for the first 5 months of 1943. Expenses during the period of curtailed production and subsequent period without any production will be reduced to the minimum consistent with proper maintenance of the properties.

As a result of war conditions and the order of the War Production Board, the total number of our employees has been reduced from 2,200 to 800. This has brought distress to many and great damage to our communities. It has been with deep regret that we have been forced to release a large number of employees with long and faithful service with our company. * * * 385 former members of our staff are now with the armed forces.

Ore milled, receipts, and dividends, Homestake mine, 1938–42 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
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
1941	1,499,988	19,529,080.70	13.0195	9,041,760
1942	1,275,138	17,068,437.84	13.3856	7,534,800

[1] From 1876 to 1942, inclusive, this mine yielded bullion and concentrates that brought a net return of $435,610,266 and paid $149,805,802 in dividends.

Other mines.—The Bald Mountain Mining Co., second-largest producer of gold and silver in South Dakota in 1942, operated continuously throughout the year its consolidated group of mines and 370-ton cyanide mill at Trojan at an average rate of 302 tons of ore daily. Ore was produced in 1942 from the Portland, Two Johns, Dakota, Trojan, Clinton, and Empire claims. Development work done on these claims in 1942 totaled 1,932 feet of drifts and 325 feet of raises. The mill treated 131,152 tons of dry gold ore, from which 22,787 fine ounces of gold and 66,184 fine ounces of silver were recovered. About 16 percent of the ore produced was sulfide (locally known as "blue ore"), and 75 percent was oxide (locally known as "brown ore"). Following primary crushing, the refractory sulfide ores not amenable to treatment by straight cyanidation are roasted in the 110-ton gas-fired rotary hearth furnace and then returned to the mill circuit and mixed with the oxide ores for cyanidation. The net return from metals produced in 1942 after transportation and mint and smelter charges were deducted was $842,320.

At the Maitland group of claims 5½ miles northwest of Deadwood the Canyon Corporation continued operations of its 120-ton roast-cyanide mill until November 26, 1942, when the corporation closed the mine, removed the pumps, and dismantled surface buildings. Total dry gold ore treated in the mill was 30,483 tons from which 10,295 fine ounces of gold and 1,668 fine ounces of silver were recovered. Besides gold and silver, the ores contain pyrite, marcasite, fluorite, and traces of arsenic. The mine is opened by a vertical shaft 600 feet deep and by drifts and winzes.

The Belle Eldridge Gold Mines, Inc., began production of zinc-lead ore, milled on the property to make zinc and lead concentrates, from its group of claims in the Whitewood district March 12, 1942, and continued operations throughout the remainder of the year. The new 75-ton selective-flotation mill completed in March 1942 converted 9,997 tons of crude ore into 216 tons of lead concentrates and 290 tons of zinc concentrates which, combined, contained 174 fine ounces of gold, 7,946 fine ounces of silver, 2,842 pounds of copper, 193,286 pounds of lead, and 259,196 pounds of zinc. Development work in 1942 consisted of 1,020 feet of drifts, 500 feet of tunnel, and 500 feet of diamond drilling. Production came solely from the Helen Gould claim.

Placer activity in Lawrence County in 1942 was very small. The Driskill Co. handled about 2,800 cubic yards of gravel on the Little Tom placers on Potato Creek 2 miles east of Tinton with a ⅜-cubic yard power shovel and land dredge and recovered 14.5 fine ounces of gold and 1 fine ounce of silver. Other placer activity, chiefly on Bear Butte Creek in the Bear Butte district and Whitewood Creek in the Whitewood district, consisted of nine small hand-sluicing and panning operations which produced a total of only 13.5 fine ounces of gold and 2 fine ounces of silver.

PENNINGTON COUNTY

The Holy Terror Mining Co. operated its Holy Terror-Keystone mine and 100-ton cyanide mill in the Keystone district continuously until September 10, 1942, treating 17,614 tons of dry gold ore. A jig and table in the ball-mill circuit produced concentrates, part of which were shipped to the Helena (Mont.) smelter of the American Smelting & Refining Co. Most of the concentrates produced were treated in the countercurrent-decantation cyanidation circuit of the mill. Development work completed in 1942 consisted of unwatering 200 feet of shaft and driving 960 feet of drift.

Only three small hand-sluicing or panning placer operations were conducted in Pennington County in 1942—the Gold Run in the Hill City district and the Rockerville and Golden Rule in the Rapid Creek district. These placers yielded a total of only 5 fine ounces of gold.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY OUTLINE

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SUMMARY

Texas mines produced gold, silver, copper, and lead in 1942 valued at $534,894, in terms of recovered metals; this value, compared with $812,727 in 1941, represents a decline of 34 percent, due largely to the 39-percent slump in silver output. Gold declined slightly, and lead remained virtually at the 1941 figure; but copper increased more than 1500 percent in quantity. No zinc has been recovered from ores mined in Texas since 1917.

Silver, the principal metal produced in Texas, was first found in 1880 at the Presidio mine at Shafter, Presidio County, but shipments of bullion were not begun until 1885. From that date until September 1942 this mine was by far the outstanding producer of the State—chiefly of silver but also of gold and lead. Other mines producing more than 1,000 ounces of silver in 1942 were the Bird mine in Brewster County, the Hazel mine in Culberson County, and the Sancho Panza mine in Hudspeth County. The American Metal Co. of Texas operated the Presidio mine and 400-ton cyanidation mill at Shafter continuously until September 6, 1942, when the company ceased operations. About 3,500 tons of silver-smelting ore, carrying some copper, were shipped from the Sancho Panza mine near Allamoore to the El Paso smelter. About 470 tons of copper ore from the Hazel mine, 23 tons of silver ore from the Needle Peak mine, and 139 tons of lead ore (containing silver) from the Bird mine were shipped to the El Paso smelter.

Prices of gold, silver, copper, lead, and zinc, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

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 prices in the preceding table.

MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1938 to 1942, as well as the total metal production from 1885 to 1942.

Mine production of gold, silver, copper, lead, and zinc in Texas, 1938–42, and total, 1885–1942, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver		Copper		Lead		Zinc		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1938	131,002	439	$15,365	1,433,008	$926,389	32,000	$3,136	684,000	$31,464			$976,354
1939	141,795	324	11,340	1,341,945	910,896	68,000	7,072	454,000	21,338			950,646
1940	146,936	312	10,920	1,326,150	943,040	60,000	6,780	410,000	20,500			981,240
1941	140,818	306	10,710	1,096,027	779,397	12,000	1,416	372,000	21,204			812,727
1942	100,698	236	8,260	672,781	478,422	198,000	23,958	362,000	24,254			534,894
1885–1942	(1)	8,277	223,640	33,186,537	23,352,715	[2] 1,055	302,111	[2] 4,775	487,499	[2] 744	$106,491	24,472,456

[1] Figures not available. [2] Short tons.

Mine production of gold, silver, copper, and lead in Texas in 1942, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Brewster	1	139		3,230	200	69,000
Culberson	2	492	1	2,496	28,000	
Hudspeth	2	3,549		2,343	166,600	1,000
Presidio	2	96,518	235	664,712	3,200	292,000
Total, 1941	7	100,698	236	672,781	198,000	362,000
	9	140,818	306	1,096,027	12,000	372,000

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 1942, 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	3	100,052	235	667,454	167,562	292,000
Copper ore	2	506	1	2,089	30,238	
Lead ore	2	140		3,238	200	70,000
Total, 1941	7	100,698	236	672,781	198,000	362,000
	9	140,818	306	1,096,027	12,000	372,000

SMELTING AND REFINING PLANTS IN TEXAS

In 1942 two zinc retort smelters (one of which has a cadmium-recovery plant), one copper smelter, one lead smelter, one antimony smelter, one tin smelter, one electrolytic plant for extraction of magnesium from sea water, and one electrolytic copper refinery were operating in Texas; a new electrolytic zinc smelter was completed and set in operation.

The American Smelting & Refining Co. continued to operate its copper and lead smelters at El Paso in 1942, treating ores purchased from operators in Arizona, New Mexico, Texas, and Utah and in Mexico. Ores from Canada, South America, Africa, and many other foreign sources continued to be received (as in 1941) at El Paso after their original destinations had fallen into enemy hands. The El Paso plant contains a unit for recovering arsenic in addition to the lead and copper furnaces.

The American Smelting & Refining Co. gas-retort zinc smelter at Amarillo was operated virtually at capacity throughout the year, treating zinc concentrates purchased from operators in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and South Dakota and in Mexico. The electrolytic zinc plant recently completed by the company at Corpus Christi, designed to operate on zinc concentrates from Buchans, Newfoundland, was opened on stored Buchans concentrates and Mexican concentrates.

The Machovec gas-retort zinc smelter of the American Zinc, Lead & Smelting Co. at Dumas, purchased from the Illinois Zinc Co., was operated at maximum capacity throughout the year on zinc concentrates from operators in New Mexico, Utah, Mexico, and Newfoundland. Operation of the cadmium plant was entirely satisfactory, and production of cadmium will be substantially increased during the second quarter of 1943. According to the contract with the Defense Plant Corporation, as of July 1942, the American Zinc, Lead & Smelting Co. installed additional slab zinc-producing facilities at the Dumas plant, some of which were in production before the end of 1942.

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 plant was operated at capacity throughout the year.

MINES REVIEW BY COUNTIES

Brewster County.—The Bird mine 5 miles northwest of Altuda was operated throughout 1942 by the Bird Mining Co., Inc., and regular shipments began on March 10, 1942, to the smelter at El Paso. Lead ore totaling 139 tons, containing 3,230 ounces of silver, 296 pounds of copper, and 77,107 pounds of lead, was shipped during 1942. Development work in 1942 comprised 700 feet of drifts and 64 feet of winze.

Culberson County.—Copper ore totaling 469 tons, containing 2,081 ounces of silver and 28,242 pounds of copper, was shipped from the Hazel mine 14 miles northwest of Van Horn to the El Paso smelter. The mine was operated by J. P. Witherspoon, lessee, with A. P. Williams as mine superintendent; it is opened by a vertical shaft 320 feet deep. A small lot (23 tons) of dry silver ore containing 415 ounces of silver and 1,002 pounds of copper was shipped from the Needle Peak open-cut near Van Horn to the El Paso smelter.

Hudspeth County.—Lessees on the Sancho Panza mine 7 miles northeast of Allamoore shipped 3,548 tons of silver smelting ore containing 2,335 ounces of silver and 172,801 pounds of copper to the smelter at El Paso. One ton of lead ore containing 1,139 pounds of lead was shipped from Sierra Blanca to the El Paso smelter by the Lancaster Lead Co.

Presidio County.—Two small lots—34 tons and 3 tons of copper ore containing 3,206 and 332 pounds of copper, respectively—were shipped from Shafter to the smelter at El Paso.

The American Metal Co. of Texas operated its Presidio mine at Shafter continuously until September 6, 1942, when the company ceased all operations; shortly afterward all the equipment of the property was dismantled and shipped. Labor difficulties, excessive water in the lower levels, lowering of the grade of ore, and depletion of ore reserves were contributory factors to closing of the property. The quantity of ore treated was 96,481 tons compared with 140,503 tons in 1941. Development work in 1942 comprised 2,124 feet of drifts and 12,421 feet of diamond drilling. The ore minerals are argentite, anglesite, cerussite, cerargyrite, and galena. In 1942 the mill produced 545,360 ounces of silver and 213 ounces of gold in cyanide precipitates, and 396 tons of table concentrates containing 22 ounces of gold, 119,344 ounces of silver, and 283,628 pounds of lead. The cyanide precipitates carried 14,852 pounds of lead dissolved by the cyanide. The concentrates and precipitates were shipped to the Carteret (N. J.) smelter.

Production of silver from the Presidio mine,[1] *1885–1942* [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
1941	140,503	9.39	1,319,323	82.90	1,093,748
1942	96,481	8.36	806,581	82.41	664,704
Total, 1885–1942	2,328,882	15.41	35,881,799	84.43	30,293,606

[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

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SUMMARY

Ores and gravels from Utah mines yielded gold, silver, copper, lead, and zinc valued, in terms of recoverable metal, at $113,552,848 in 1942 compared with $97,796,623 in 1941. The increase in output of recoverable copper accounted for most of the gain, although increases were noted in output of all metals except silver. The total gain in value of the State metal output can be credited largely to the Bingham district, although the Park City region showed a gain in gold production and the Tintic district in lead and zinc production. The Utah Copper Co. in 1942 surpassed by far its outstanding production record established in 1941 and contributed over 70 percent of the value of the total metal output of the State. The output of zinc from Tooele County increased in 1942, whereas the output of each of the other metals decreased.

The production of copper, and more particularly that of lead and zinc, in 1942 was affected by several factors. The Metals Reserve Company announced that, effective February 1, 1942, premiums of 5 cents a pound for copper and 2¾ cents a pound for both lead and zinc would be paid for these metals produced in excess of certain fixed basic quotas. Each mine or company had its basic quota fixed according to the previous year's production or through direct negotiation with the Government agency. Most mines in Utah, which were granted basic quotas under the original principle of premium payments, have since received downward adjustment favorable to the company. To broaden the scope of the premium payments for over-quota metal further, the Metals Reserve Company announced that, effective December 1, 1942, at the opening of business it would allow an additional premium for lead and two additional premiums for zinc. Eligibility for these additional premiums was based primarily on the ability of the producer to maintain the present rate of output or to insure additional output. Each case was to be considered independently by the Quota Committee, Premium Price Plan for Copper, Lead, and Zinc (War Production Board—OPA).

Although the Government stimulated the production of copper, lead, and zinc by price manipulation, the full effect of the program was not realized because of the critical shortage of suitable mine, mill, and smelter labor. The labor supply became critically low during July, August, September, and part of October. In October the Army fur-

loughed 4,000 soldiers for service in mines. Of this number, Utah mines and smelters received approximately 700. This action tended to relieve the severity of the shortage but did not insure adequate labor for operations consistent with the present demand for metals. Thus, the majority of Utah mines at the close of 1942 faced the problem of either securing additional labor or endeavoring to maintain the present personnel at levels sufficient to meet production demands.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.
[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Company for over-quota production but excludes value of foreign copper delivered to Metals Reserve Company for domestic consumption.
[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Company for over-quota production.
[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1938–42, and total, 1864–1942, 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
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
1941	167	12	31,952,817	356,501	12,477,535	11,395,485	8,103,456
1942	123	6	34,981,655	391,544	13,704,040	10,574,955	7,519,968
1864–1942			(1)	9,449,773	230,967,095	691,875,106	504,275,236

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	533,676,000	62,973,768	139,202,000	7,934,514	84,098,000	6,307,350	97,796,623
1942	613,382,000	74,219,222	143,860,000	9,638,620	91,086,000	8,470,998	113,552,848
1864–1942	[2] 3,953,217	1,113,708,563	[2] 4,229,736	457,350,462	[2] 835,199	104,313,625	2,410,614,981

[1] 1864–1901: Figures not available; 1902–42: 456,347,638 tons produced.
[2] Short tons.

Gold.—Utah mines in 1942 produced 391,544 ounces of recoverable gold—the greatest output in any year in the history of the State. By far the largest portion of Utah gold is recovered as a byproduct of the recovery of base metals; as a consequence, the gold order issued by the Government in October 1942 did not affect the State output greatly. Most mines producing siliceous ores were allowed to continue operation, so that an adequate supply of fluxing material might be available to smelters in the Salt Lake Valley. Copper

ore yielded 75 percent of the total gold and siliceous ore 10 percent; the remainder came from zinc-lead ore and slag, lead ore, lead-copper ore, zinc ore, zinc-lead-copper ore, and placers. The placer output of fine gold in 1942 was only 32 ounces. Ores of all classes treated in concentrating mills yielded 86 percent of the State total, ores shipped direct to smelters 12 percent, and ores treated by amalgamation and cyanidation, placers, and slag fumed 2 percent. Ore of the West Mountain (Bingham) district was by far the most important source of gold and in 1942 yielded 327,258 ounces (nearly 85 percent of the State total), a gain of 52,139 ounces over 1941. Gold produced from the Tintic district was slightly less than in 1941, owing to the smaller output of siliceous ores. The recoverable gold pro-

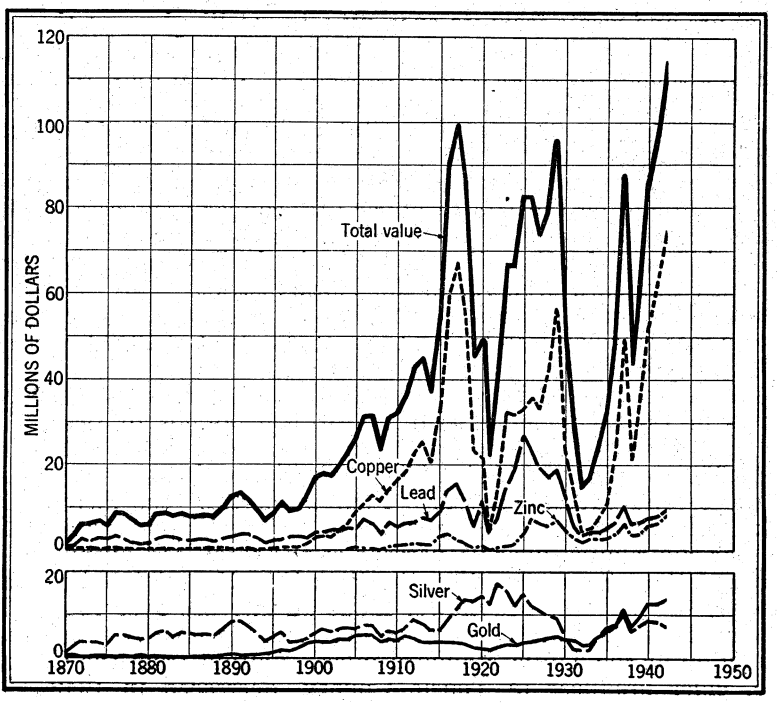

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Utah, 1870–1942.

duction from the Park City region increased 3,188 ounces, owing to increases at the New Park Mining Co. Gold output from Tooele County decreased 18,523 ounces. The Utah Copper Co. produced 73 percent of the State output of gold and was followed by the United States & Lark, Mayflower, Tintic Bullion, Snyder Mines, Inc. (at Mercur), Sacramento, Mammoth, and Boston Consolidated mines; these eight properties produced 91 percent of the total gold output of Utah.

Silver.—The output of recoverable silver in Utah in 1942 was 10,574,955 ounces, of which 82 percent was derived from base-metal ore. Zinc-lead, zinc-lead-copper, and zinc ore yielded 49 percent of the State total, copper ore 26 percent, siliceous ore 18 percent, and lead and lead-copper ores 7 percent. Ore concentrated yielded 74

percent of the total and ore shipped crude to smelters virtually all the remainder. The Bingham district—chief source of silver in Utah—was followed by the Park City region, Tintic district, and Tooele County. The Utah Copper Co. was again the chief silver producer in the State; it was followed by the United States & Lark, Tintic Standard, Silver King Coalition, Park City Consolidated properties, Mayflower, Park Utah Consolidated group of properties, and Calumet; and these eight properties produced 82 percent of the silver output of Utah in 1942.

Copper.—Production of recoverable copper in Utah in 1942 was 613,382,000 pounds and completely eclipsed the former record of 533,676,000 pounds in 1941. The Utah Copper Co., by far the largest copper producer in the United States, mined about 75,000,000 tons of ore and waste from its open-pit mine at Bingham at the ratio of 1¼ tons of waste to 1 ton of ore. The company mills at Arthur and Magna, although rated at a daily capacity of 78,000 tons, treated an average of over 91,000 tons a day and continued to show very high recoveries. Copper ore mined in Utah amounted to 33,611,061 tons in 1942 compared with 30,444,402 tons in 1941. Copper ore and mine-water precipitates yielded virtually the entire State output of copper. Following the Utah Copper Co., copper producers in Utah in 1942 included the Ohio Copper Co., United States & Lark, and National Tunnel & Mines Co. properties in the Bingham district and the Tintic Standard property in the Tintic district.

During the first 3 months of 1943, Utah mines were producing copper at a rate calculated to exceed the record output of 1942 by at least 15,000,000 pounds.

Lead.—Mine production of recoverable lead in Utah was 143,860,000 pounds in 1942, compared with 139,202,000 pounds in 1941. The Bingham district was again the chief source of lead and gained 10,967,300 pounds over 1941. The Park City region output declined for the second successive year. Four properties—the Silver King, Park Utah Consolidated, Mayflower, and Park City Consolidated—together contributed over 95 percent of the total lead output of the region; of these four properties, the Park City Consolidated closed in October, and only the Mayflower made an increase over 1941. The lead output of the Tintic district gained, owing primarily to increased production at the Tintic Standard mine. Output from the Calumet mine, chief producer in Tooele County, decreased in 1942. The United States & Lark properties in the Bingham district continued to be the largest source of lead in the State, followed by the Silver King Coalition, Tintic Standard, Park Utah Consolidated, Calumet, Mayflower, and Chief Consolidated; these seven producers supplied 85 percent of the State total output of lead.

Production reports during the first 3 months of 1943 indicate that the recoverable lead output of Utah will be higher in the year 1943 than it was in 1942.

Zinc.—Output of recoverable zinc from Utah ores and slags amounted to 91,086,000 pounds in 1942 compared with 84,098,000 in 1941. Zinc recovered from old and current slag fumed accounted for the gain, as zinc recovered from zinc-lead ore declined. As in former years, the bulk of the recovered zinc came from ores of the Bingham district and Park City region, and although there was a gain in zinc output in the Bingham district it was more than

offset by losses in the Park City region. Substantial gains were noted in the output of zinc from the Tintic district in 1942, but the district is still of minor importance compared with the Bingham and Park City areas. All the zinc and zinc-lead concentrates produced in Utah in 1942 were treated at plants of the Anaconda Copper Mining Co. at Anaconda and Great Falls, Mont. Zinc fume derived from the fuming of current slag, old slag, and a small quantity of zinc ore was first deleaded and then shipped to Hillsboro, Ill., and Bartlesville, Okla., for further treatment. The zinc recovered from the fuming of current slag has not been credited entirely to Utah; the zinc ultimately recovered in the fuming operation, which originates in ores and concentrates containing at least 10 percent zinc, has been credited to the State of origin. The principal producers of zinc in Utah in 1942, named in order of output, were: United States & Lark mines, Tooele slag-fuming plant, Silver King Coalition, Park Utah Consolidated Mining Co., Mayflower, Calumet, Chief Consolidated properties, Park City Consolidated Mining Co. (closed in October 1942), and Butterfield group; these nine properties produced 97 percent of the State total zinc output.

According to calculations based on reports received during the first 3 months of 1943, the recoverable zinc output of Utah in 1943 will exceed that in 1942 by about 6,000,000 pounds.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1942, 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	10		12,653	365	$12,775	44,571	$31,695
Box Elder	2		102	3	105	45	32
Grand		2		7	245		
Iron	2		1,558	210	7,350	1,108	788
Juab	18		166,193	10,437	365,295	720,834	512,593
Millard	3	1	434	84	2,940	1,028	731
Morgan	1		1				
Piute	3		964	291	10,185	10,066	7,158
Salt Lake	23		34,088,363	327,390	11,458,650	5,416,671	3,851,855
San Juan	1	1	69	8	280	24	17
Sevier	1		10	22	770	914	650
Summit	11		182,124	5,104	178,640	1,293,255	919,648
Tooele	26		259,164	16,349	572,215	399,247	283,909
Uintah		2		14	490		
Utah	15		171,756	13,422	469,770	1,346,729	957,674
Wasatch	4		97,624	17,831	624,085	1,338,854	952,074
Washington	2		636	7	245	1,585	1,127
Wayne	1		4			24	17
Total, 1941	123	6	34,981,655	[1] 391,544	13,704,040	10,574,955	7,519,968
	167	12	31,952,817	[2] 356,501	12,477,535	11,395,485	8,103,456

[1] Includes 32 ounces of placer gold distributed as follows: Grand County, 7 ounces; Millard County, 3 ounces; San Juan County, 8 ounces; and Uintah County, 14 ounces.

[2] Includes 629 ounces of placer gold distributed as follows: Garfield County, 4 ounces; Grand County, 252 ounces; Millard County, 21 ounces; San Juan County, 18 ounces; and Uintah County, 334 ounces.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1942, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	107,800	$13,044	627,000	$42,009	291,700	$27,128	$126,651
Box Elder	1,000	121	17,300	1,159	16,000	1,488	2,905
Grand							245
Iron	300	36	25,300	1,695			9,869
Juab	540,000	65,340	6,097,000	408,499	3,143,000	292,299	1,644,026
Millard	15,300	1,851	1,000	67	88,000	8,184	13,773
Morgan			300	20			20
Piute	2,200	266	58,300	3,906	6,000	558	22,073
Salt Lake	609,420,000	73,739,820	80,121,000	5,368,107	45,358,000	4,218,294	98,636,726
San Juan	5,700	690					987
Sevier							1,420
Summit	756,700	91,561	22,516,400	1,508,599	18,624,700	1,732,097	4,430,545
Tooele	477,000	57,717	11,973,400	802,218	15,735,000	1,463,355	3,179,414
Uintah							490
Utah	1,168,000	141,328	14,342,000	960,914	396,600	36,884	2,566,570
Wasatch	698,000	84,458	8,040,400	538,707	7,427,000	690,711	2,890,035
Washington	190,000	22,990	40,600	2,720			27,082
Wayne							17
	613,382,000	74,219,222	143,860,000	9,638,620	91,086,000	8,470,998	113,552,848
Total, 1941	533,676,000	62,973,768	139,202,000	7,934,514	84,098,000	6,307,350	97,796,623

MINING INDUSTRY

The production of copper ore (96 percent of the State total ore) dominated the mining industry in Utah in 1942. The Bingham district produced ore of all classes, representing 97 percent of the State total. Of the 34,087,179 tons of ore produced in the Bingham district in 1942, copper ore constituted 99 percent; virtually all the remainder was zinc-lead ore and lead ore. The grade of the copper ore and zinc-lead ore was about the same as in 1941. The bulk of the ore mined in the Park City region in 1942 was zinc-lead ore; this ore showed a lowering of zinc, lead, and silver content compared with 1941. The Tintic district again made a large gain in output of zinc-lead ore, but almost all was mined from the lower workings of the Chief Consolidated properties. The output and grade of zinc-lead ore mined in Tooele County decreased. Production of siliceous ore declined from 1941, and much of the output came from old mine and tailings dumps; the largest decline was noted in gold ore from Tooele County. The Camp Floyd district in Tooele County and the Tintic district in Juab and Utah Counties supplied 87 percent of the siliceous ore of 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 Utah in 1942, 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	19	[1]126,405	20,588	35,814	60,200	276,976	
Dry and siliceous gold-silver ore	27	224,420	15,933	879,892	1,569,845	5,867,295	
Dry and siliceous silver ore	21	83,409	3,059	960,006	612,238	3,233,304	
	67	434,234	39,580	1,875,712	2,242,283	9,377,575	
Copper ore	16	33,611,061	291,806	2,698,515	[1]606,444,452	118,779	
Lead ore	40	75,758	9,727	786,550	668,374	18,627,328	
Lead-copper ore	1	41		421	1,813	9,842	
Zinc ore	7	16,710	6	2,278	5,655	13,552	340,100
Zinc-lead ore	38	[2]841,837	50,378	5,190,257	3,915,253	115,289,671	90,372,500
Zinc-lead-copper ore	3	2,014	15	21,222	104,170	423,253	373,400
Total, lode mines	[3]123	34,981,655	391,512	10,574,955	[1]613,382,000	143,860,000	91,086,000
Total, placers	6		32				
	129	34,981,655	391,544	10,574,955	[1]613,382,000	143,860,000	91,086,000
Total, 1941	179	31,952,817	256,501	11,395,485	[4]533,676,000	139,202,000	84,098,000

[1] Includes 32,062,916 pounds recovered from mine-water precipitates.
[2] Includes 87,831 tons of zinc-lead slag.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 13,418,668 pounds recovered from mine-water precipitates.

METALLURGIC INDUSTRY

In 1942, mines in Utah produced 34,981,655 tons of ore—the greatest quantity in the history of the State—surpassing the former record of 1941 by 3,028,838 tons. This total was treated as follows: 34,336,812 tons at concentrating mills compared with 31,205,481 tons in 1941; 94,827 tons at cyanide mills compared with 252,080 tons in 1941; 1,475 tons at amalgamation mills compared with 515 tons in 1941; 460,710 tons shipped crude to smelters compared with 465,083 tons in 1941; and 87,831 tons (zinc-lead slag) fumed compared with 29,658 tons in 1941. A considerable tonnage of siliceous ore, included in the quantity shipped crude to smelters, came from old dumps and tailings piles and was used primarily as a flux in smelting. These tailings usually were paid for according to metal content, so that the shipper would be eligible for any premium payments allowed by the Government; however, smelters at times allowed extra payments for very high silica content.

All ore cyanided was handled by two cyanide plants at Mercur, under control of Snyder Mines, Inc., and all cyanide operations were discontinued after September 17. The total of 94,827 tons of gold ore cyanided yielded 7,426 ounces of gold and 157 ounces of silver; Snyder Mines, Inc., reported the consumption of 70,000 pounds of calcium cyanide, 7,500 pounds of zinc dust, and 634,000 pounds of lime. Eleven concentrating plants were active in Utah during 1942—four plants (Arthur, Magna, Ohio Copper, and Tooele) treated 33,565,587 tons of copper ore and old tailings; four mills (Bauer, Midvale, Silver King, and Tooele), with a combined rated capacity of 4,400 tons, treated 754,925 tons of ore mostly zinc-lead, zinc-lead-copper, and zinc; two gravity-concentration mills (Tooele County and Utah County) treated 300 tons of lead and silver ores; and one flotation mill in Summit County treated 16,000 tons of old zinc-lead tailings.

Three lead and two copper smelters were active in Utah in 1942. The combined rated capacity of the lead smelters was about 1,130,000 tons of charge a year, and that of the copper smelters was 1,900,000 tons. In 1942 the smelting capacity of Utah smelters was never

reached, but during the summer and early fall a labor shortage at the Garfield smelter caused the American Smelting & Refining Co. to ship a portion of its receipts of copper concentrates to Tooele, Tacoma, and El Paso smelters. The Murray lead smelter was down part of the year owing to lack of ore and concentrates.

The following tables give details of treatment for all the ore produced in Utah in 1942.

Mine production of metals in Utah in 1942, 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	1,475	95	61			
Ore cyanided	94,827	7,426	157			
Concentrates smelted	1,187,858	338,534	7,859,726	576,299,466	115,471,084	90,613,800
Slag fumed	87,831					
Ore smelted	460,710	45,457	2,715,011	5,019,618	28,388,916	472,200
Mine-water precipitates smelted [1]	18,813			32,062,916		
Placer		32				
Total, 1941		391,544	10,574,955	613,382,000	143,860,000	91,086,000
		356,501	11,395,485	533,676,000	139,202,000	84,098,000

[1] All from Salt Lake County.

Mine production of metals from concentrating mills in Utah in 1942, 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	3,249	699	35	11,292	3,503	201,940	270,000
Juab	26,473	6,406	459	65,682		1,570,194	3,015,000
Piute	68	33	5	712	342	13,395	6,000
Salt Lake	34,004,884	1,096,615	314,411	5,128,636	574,806,522	76,596,894	45,271,300
Summit	165,679	42,274	4,396	1,152,925	664,085	21,245,598	18,624,700
Tooele	38,464	17,686	1,441	244,757	148,118	6,097,168	4,355,900
Utah	3,201	1,031	129	9,170	6,028	376,363	395,600
Wasatch	94,794	23,107	17,498	1,237,720	663,868	7,656,432	7,427,000
Total, 1941	34,336,812	1,187,851	338,374	7,850,894	576,292,466	113,757,984	79,365,500
	31,205,481	1,073,438	286,571	7,971,032	516,363,067	108,538,218	80,906,987

Gross metal content of concentrates produced from ores mined in Utah in 1942, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold [1]	7	136	957			
Copper	894,954	288,093	2,651,763	587,015,624	34,134	19,602
Lead	88,352	14,976	3,562,277	2,616,802	97,776,393	8,390,452
Lead-copper	5,576	6,419	459,544	514,570	5,975,712	792,651
Zinc	35,803	4,201	319,299	372,950	1,855,430	40,027,965
Zinc-lead	47,492	5,069	330,324	907,281	7,139,584	48,156,359
Dry iron (from zinc-lead ore)	115,674	19,616	527,687	762,568	6,857,656	5,396,977
Total, 1941	1,187,858	338,510	7,851,851	592,189,795	119,638,909	102,784,006
	1,073,438	286,571	7,971,032	533,304,098	113,909,900	102,626,120

[1] From 1,445 tons of ore amalgamated and concentrated.

Mine production of metals from Utah concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	699	35	11,292	3,503	201,940	270,000
Iron [1]	7	136	957			
Juab	6,406	459	65,682		1,570,194	3,015,000
Piute	33	5	712	342	13,395	6,000
Salt Lake	1,096,615	314,411	5,128,636	574,806,522	76,596,894	45,271,300
Summit	42,274	4,396	1,152,925	664,085	21,245,598	18,624,700
Tooele	17,686	1,441	244,757	148,118	6,097,168	4,355,900
Utah	1,031	129	9,170	6,028	376,363	395,600
Wasatch	23,107	17,498	1,237,720	663,868	7,656,432	7,427,000
Total, 1941	1,187,858	338,510	7,851,851	576,292,466	113,757,984	79,365,500
	1,073,438	286,571	7,971,032	516,363,067	108,538,218	80,906,987

BY CLASSES OF CONCENTRATES SMELTED

Dry gold [1]	7	136	957			
Copper	894,954	288,093	2,651,763	572,317,467	18,575	
Lead	88,352	14,976	3,562,277	1,841,642	93,865,433	
Lead-copper	5,576	6,419	459,544	349,256	5,736,684	
Zinc	35,803	4,201	319,299	353,640	1,688,443	36,024,700
Zinc-lead	47,492	5,069	330,324	861,918	6,497,021	43,340,800
Dry iron (from zinc-lead ore)	115,674	19,616	527,687	568,543	5,951,828	
	1,187,858	338,510	7,851,851	576,292,466	113,757,984	79,365,500

[1] From 1,445 tons of ore amalgamated and concentrated.

Gross metal content of Utah crude ore shipped to smelters in 1942, 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	30,103	12,931	34,639	62,272	413,588	
Dry and siliceous gold-silver	224,420	15,933	879,892	1,610,322	9,700,124	
Dry and siliceous silver	83,309	3,059	959,839	629,513	5,259,228	
Copper	45,474	3,716	48,779	2,142,903	197,490	
Lead	75,489	9,724	786,026	905,838	20,241,940	
Lead-copper	41		421	2,290	11,069	
Zinc	391		187	1,813	3,139	185,491
Zinc-lead	1,207	93	3,839	2,973	277,954	395,068
Zinc-lead-copper	276	1	1,389	20,328	39,687	124,920
Total, 1941	460,710	45,457	2,715,011	5,378,252	36,144,219	705,479
	465,083	51,458	3,422,061	4,253,415	38,095,332	230,630

Mine production of metals from Utah crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	9,384	314	33,279	104,297	425,060	21,700
Box Elder	102	3	45	1,000	17,300	16,000
Iron	113	1	90	300	25,300	
Juab	139,720	9,978	655,152	540,000	4,526,806	128,000
Millard	434	81	1,028	15,300	1,000	88,000
Morgan	1				300	
Piute	896	286	9,354	1,858	44,905	
Salt Lake	83,479	12,979	288,035	2,550,562	3,524,106	86,700
San Juan	69		24	5,700		
Sevier	10	22	914			
Summit	16,445	708	140,330	92,615	1,270,802	
Tooele	38,042	7,458	146,458	321,882	4,163,132	130,800
Utah	168,555	13,293	1,337,559	1,161,972	13,965,637	1,000
Wasatch	2,830	333	101,134	34,132	383,968	
Washington	626	1	1,585	190,000	40,600	
Wayne	4		24			
Total, 1941	460,710	45,457	2,715,011	5,019,618	28,388,916	472,200
	465,083	51,458	3,422,061	3,892,765	30,306,782	177,013

BY CLASSES OF ORE

Dry and siliceous gold	30,103	12,931	34,639	60,200	276,976	
Dry and siliceous gold-silver	224,420	15,933	879,892	1,569,845	5,867,295	
Dry and siliceous silver	83,309	3,059	959,839	612,238	3,225,914	
Copper	45,474	3,716	48,779	2,088,488	118,779	
Lead	75,489	9,724	786,026	668,374	18,588,939	
Lead-copper	41		421	1,813	9,842	
Zinc	391		187	1,471	2,690	126,700
Zinc-lead	1,207	93	3,839	1,943	259,508	266,800
Zinc-lead-copper	276	1	1,389	15,246	38,973	78,700
	460,710	45,457	2,715,011	5,019,618	28,388,916	472,200

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah in 1942, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver (all lode)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver County:											
Beaver Lake	1		155	2		2	187	12,600	1,600		$1,835
Newton	1		21	17		17					595
Rocky	2		686	13		13	1,094	49,700	600		7,287
San Francisco	4		11,249	328		328	41,580	40,200	582,400	149,000	98,790
Star and North Star	2		542	5		5	1,710	5,300	42,400	142,700	18,144
Box Elder County:											
Crater Island	1		25	3		3	24	1,000			243
Promontory	1		77				21		17,300	16,000	2,662
Grand County: Colorado River		2			7	7					245
Iron County:											
Indian Peak (formerly called Calumet)	1		113	1		1	90	300	25,300		1,830
Stateline	1		1,445	209		209	1,018				8,039
Juab County:											
Detroit [1]	1		114	34		34	128	100	100		1,300
Fish Springs	1		51	1		1	4,365		32,400		5,310
Mount Nebo	1		7				31		2,600		196
Tintic [2]	14		165,980	10,402		10,402	716,251	539,900	6,061,900	3,128,000	1,635,783
Trout Creek	1		41				59			15,000	1,437
Millard County:											
Detroit [1]	2		201	81		81	1,021	15,300			5,412
House Mountain		1			3	3					105
Kanosh	1		233				7		1,000	88,000	8,256
Morgan County: Argenta	1		1						300		20
Piute County:											
Mount Baldy	1		288	242		242	5,438	400	5,600		12,760
Ohio	2		676	49		49	4,628	1,800	52,700	6,000	9,313
Salt Lake County:											
Big Cottonwood	5		989	80		80	15,006	43,300	89,700	90,900	33,174
Little Cottonwood	2		88	26		26	872	700	19,000		2,888
"Smelter"	1		107	26		26	1,049	1,100	21,000		3,196
West Mountain	15		34,087,179	327,258		327,258	5,399,744	609,374,900	79,991,300	45,267,100	98,597,468
San Juan County:											
Colorado River		1			8	8					280
La Sal	1		69				24	5,700			707

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1942, by counties and districts, in terms of recovered metals—Continue

County and district	Mines producing		Ore sold or treated	Gold			Silver (all lode)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Sevier County: Henry	1		10	22		22	914				$1,420
Summit County: Uintah	11		182,124	5,104		5,104	1,293,255	756,700	22,516,400	18,624,700	4,430,545
Tooele County:											
Camp Floyd	6		115,925	12,463		12,463	914				436,855
Clifton	1		8	4		4	59		2,400		343
Dugway	1		330	2		2	391	100	30,300	56,300	7,626
Erikson	1		21				107		9,300	2,300	913
Lakeside	2		1,059				585		175,400	11,400	13,228
North Tintic	1		109				59		12,600	8,700	1,695
Ophir	6		11,245	90		90	134,602	403,200	3,245,600	378,300	400,291
Rush Valley	5		41,494	1,915		1,915	253,523	71,000	7,976,400	15,249,300	2,208,593
"Smelter"	1		87,831								
Willow Springs	2		1,142	1,875		1,875	9,007	2,700	521,400	28,700	109,960
Uintah County: Green River		2			14	14					490
Utah County:											
American Fork	5		596	5		5	3,787	1,200	52,400	108,700	16,633
Tintic [2]	10		171,160	13,417		13,417	1,342,942	1,166,800	14,289,600	287,900	2,549,937
Wasatch County:											
Blue Ledge	2		47,596	3,419		3,419	750,531	181,000	2,210,700	2,036,300	1,012,770
Snake Creek	2		50,028	14,412		14,412	588,323	517,000	5,829,700	5,390,700	1,877,265
Washington County:											
Bull Valley	1		10	6		6					210
Tutsagubet	1		626	1		1	1,585	190,000	40,600		26,872
Wayne County: Hanksville	1		4				24				17
Total Utah	123	6	34,981,655	391,512	32	391,544	10,574,955	613,382,000	143,860,000	91,086,000	113,552,848

[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.—A shipment of silver-lead ore and copper ore from the O. K. mine comprised the only output from the Beaver Lake district in 1942.

Newton district.—Gold ore amalgamated and gold ore shipped crude to a smelter from the Walkover mine comprised the output from the Newton district in 1942.

Rocky district.—D. E. Kirk, lessee on the Montreal mine, shipped several cars of crude silver-copper ore direct to the Garfield smelter. The only other production was from the Old Hickory group, from which 4 cars of silver-copper ore were shipped direct to Garfield; the Old Hickory group is operated primarily for the tungsten in the ore.

San Francisco district.—Hall Bros. Co., Inc., largest producer in the San Francisco district, began operation on the Horn Silver mine and dump in May 1942 and continued the rest of the year. Crude gold-silver-lead ore was shipped direct to Garfield and zinc-lead ore to Bauer. Other production in the district came from the Imperial group, Mayflower, and Quad Metals mines.

Star and North Star district.—Moscow Silver Mines shipped crude zinc ore direct to the Tooele smelter and mill, and lessees shipped crude lead ore direct to Murray from the Wild Bill dump.

BOX ELDER COUNTY

Crater Island district.—A small lot of copper ore was shipped to Tooele from the Copper Blossom mine in 1942.

Promontory district.—Some crude zinc-lead ore was shipped direct to Tooele from the Lake View Carbonate mine by lessees in 1942.

IRON COUNTY

Indian Peak district (formerly called Calumet).—The New Arrowhead Mining Co. shipped crude lead ore direct to smelters in 1942 and supplied the only output from the Indian Peak district.

Stateline district.—Gold ore treated in the amalgamation-flotation mill of Etna Gold Mines, Inc., comprised the only production from the Stateline district in 1942.

JUAB COUNTY

Detroit district.—The Detroit district lies in both Juab and Millard Counties, and in 1942 the only output from the Juab County section was crude gold ore shipped to the Garfield smelter from the Clara B. and First Chance claims.

Fish Springs district.—The Utah Mine group was operated intermittently in 1942 by lessees, and the only production was a car of silver-lead ore shipped crude to Murray.

Mount Nebo district.—Lead ore shipped direct to a smelter from the Central Sultana group was the only output in the Mount Nebo district in 1942.

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 in 1942, a comparison with the total in 1941, and the grand total from 1869 to 1942.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1941–42, and total, 1869–1942, in terms of recovered metals

	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
1942		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab County	14	165,980	10,402	716,251	539,900	6,061,900	3,128,000	$1,635,783
Utah County	10	171,160	13,417	1,342,942	1,166,800	14,289,600	287,900	2,549,937
	24	337,140	23,819	2,059,193	1,706,700	20,351,500	3,415,900	4,185,720
Total, 1941	32	349,343	23,950	2,711,790	2,084,300	18,848,800	1,594,000	4,206,518
Total, 1869–1942		[1]	2,522,151	255,484,367	238,629,164	1,818,364,379	44,161,638	380,779,315

[1] Figures not available.

In 1942 the Chief Consolidated Mining Co. operated the Chief No. 1, Gemini, Eureka Hill, and Plutus mines in Juab County. Although the bulk of the production in 1942, as in 1941, came from the Chief No. 1 mine, substantial tonnages of siliceous ores were shipped to the Garfield smelter from the Gemini mine; the production from the Eureka Hill (all siliceous ore) was materially smaller than in 1941, but that from the Plutus mine was about the same. The Chief No. 1 has large bodies of zinc-lead ore, which in 1941 were under water. After the company was granted favorable quotas and assured a premium price for the recoverable zinc and lead by the Government, an extensive dewatering program was begun. According to the company printed annual report, dewatering these lower levels of the Chief No. 1 mine and equipping and opening up the connecting winzes, all in an area of 2,000 by 800 feet, comprised most of the development work in 1942. Inasmuch as mining has now begun in this area, the company anticipates that by progression it will finally reach a mined tonnage of zinc-lead ore of over 5,000 tons per month. The ore consists predominantly of sulfides and contains about 3.5 percent lead and 7.5 percent zinc. Production in 1942, says the report, comprised 38,612 tons of siliceous ore, 671 tons of silver-lead ore, and 27,093 tons of zinc-lead ore from the Chief No. 1 mine; 6,312 tons of siliceous ore and 1,118 tons of silver-lead ore from the Gemini mine; 172 tons of siliceous ore from the Eureka Hill mine; and 795 tons of siliceous ore and 59 tons of silver-lead ore from the Plutus mine—an aggregate of 74,832 tons of ore of all classes, containing 2,867 ounces of gold, 290,666 ounces of silver, 100,539 pounds of copper, 5,271,482 pounds of lead, and 4,605,698 pounds of zinc.

The Eagle & Blue Bell, Centennial-Beck, and Victoria mines, all owned or controlled by the United States Smelting, Refining & Mining Co., were operated on company account throughout 1942. The production from these properties comprised 18,573 tons of siliceous ore, 2,274 tons of lead ore, and 112 tons of zinc-lead ore, all of which was shipped crude to smelters. The Empire group, controlled by the International Smelting & Refining Co., was operated by lessees throughout the year. Production amounted to 2,229 tons of crude gold-silver ore shipped direct to a smelter. Philip P. Clark, lessee on the Godiva mine, shipped 27,056 tons of siliceous ore and tailings to Garfield and 183 tons of lead ore to Murray. A considerable quantity of siliceous tailings and crude ore was shipped direct to the Garfield smelter from the Mammoth mine in 1942, and some zinc-lead ore was shipped to the Tooele slag-fuming plant. The

remainder of the output from the Juab County section of the Tintic district was predominantly siliceous ore and tailings, all of which was shipped crude to smelters.

The Tintic Standard Mining Co. and its subsidiary companies were again the largest producers in the Utah County section of the Tintic district. The printed annual report of these companies gives the following operating details. At the Tintic Standard mines (including the Iron Blossom) production of siliceous gold-silver ore was drastically reduced from 75,744 tons in 1941 to 36,433 tons in 1942, all of which was mined on company account; lessees produced an additional 2,086 tons of siliceous ore. This reduction was necessary because no premium payments of importance would be received on these ores owing to their low content in lead and copper. Output of lead ore was increased from 31,199 to 40,379 tons, and the lead content increased from 7,794,650 to 10,234,549 pounds. Siliceous dump ore totaling 3,891 tons was shipped from the Eureka Standard mine. Lease operations were carried on throughout 1942 on the Colorado mine, and 2,176 tons of siliceous ore were shipped direct to a smelter. At the Eureka Lilly mine ore bodies developed near the Eureka Lilly shaft were mined, and further increased production from this area can be expected.

An agreement was made between the Tintic Standard Mining Co. and the North Lily Mining Co. (operating subsidiary of the International Smelting & Refining Co.) whereby a joint operation, known as the Development Unit, was carried on for the purpose of developing portions of the Twentieth Century Mining Co. ground, in which the North Lily Mining Co. is interested, and portions of the Eureka Lilly Mining Co. property, which is controlled by the Tintic Standard Mining Co. The Tintic Standard report states that the most important work carried on during the year was the joint development with the North Lily Mining Co. The work was done from the Tintic Standard 1,450-foot level and comprised 2,568 feet of drifts and 110 feet of raises. Up to February 1943 only diamond drilling had prospected the limestone area. Good ore was encountered in one drill hole and in a vein found in a crosscut from the main drift; work is progressing at this time to further the development of these deposits. During the operation in 1942 production amounted to 1,707 tons of siliceous ore and came from that portion of the Development Unit controlled by the Eureka Lilly Mining Co.

The tonnage of ore of all classes mined by the Tintic Standard Mining Co. and its subsidiary companies, including ore from the Development Unit, aggregated 93,874 tons with the following metal content: 4,436 ounces of gold, 1,130,459 ounces of silver, 1,052,259 pounds of copper, 12,677,062 pounds of lead, and 1,295 pounds of zinc. The Harold dump of the Tintic Standard Mining Co. was worked by the American Smelting & Refining Co., and 68,980 tons of siliceous ore was shipped direct to the Garfield smelter in 1942; the ore contained over 3,500,000 pounds of lead. 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 Tintic Bullion, May Day (Mountain View), Hanibal, and North Lily; these properties were operated throughout the year and produced 3,510 tons of siliceous ore and 2,606 tons of zinc-lead ore.

Trout Creek district.—The Trout Creek Mining Co. shipped a car of zinc ore to the Combined Metals Reduction Co. plant at Bauer.

MILLARD COUNTY

Detroit district.—Some copper ore was shipped crude to a smelter from the R. L. Laws and Gold Chief properties in 1942.

Kanosh district.—The Kanosh Leasing Co., operating the Blue Bell mine, shipped some crude zinc ore direct to the Tooele slag plant in 1942.

MORGAN COUNTY

Argenta district.—A test lot of lead ore was shipped crude to the Midvale smelter from the Carbonate Gem mine in 1942.

PIUTE COUNTY

Mount Baldy district.—John Pearson, lessee, operated the Deer Trail mine all of 1942 and shipped crude gold-silver ore direct to the Garfield smelter.

Ohio district.—Output from the Ohio district in 1942 was many times that in 1941 and comprised gold-silver ore and lead ore from the Bully Boy mine shipped crude to smelters and zinc-lead ore from Cascade Lot 57 shipped to the Midvale concentrator.

SALT LAKE COUNTY

Big and Little Cottonwood districts.—Base-metal ore shipped direct to smelters from the Cardiff mine supplied most of the output from the Big Cottonwood district in 1942. It included 335 tons of copper ore, 128 tons of lead ore, and 202 tons of zinc-lead ore. The Mountain Mines Co. produced 304 tons of siliceous ore which was shipped crude to the Garfield smelter. Other production in the district came from the property of the Kentucky-Utah Mining Co. and from the Richmond Teresa and Kennebec mines.

Crude lead ore from the Columbus Rexall Consolidated Mines Co. and Wasatch Mines Co. shipped direct to a smelter comprised the output from the Little Cottonwood district in 1942.

"Smelter" district.—Output from the "Smelter" district in 1942 came chiefly from the Germania dump, clean-ups at local assay offices, and clean-up of railroad yards and tracks.

West Mountain (Bingham) district.—The Bingham district, by far the most important mining region in Utah, produced over four-fifths of the gold, virtually all of the copper, and over half of the lead, silver, and zinc output of the State in 1942. The following table shows production from mines in the district in 1941 and 1942 and the total from 1865 to 1942.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1941–42, and total, 1865–1942, 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*	
1941	15	30,866,163	275,119	4,851,872	529,409,000	69,024,000	40,991,000	$82,558,340
1942	15	34,087,179	327,258	5,399,744	609,374,900	79,991,300	45,267,100	98,597,468
Total, 1865–1942	----	(1)	4,798,185	127,390,269	[2] 3,730,607	[2] 1,460,358	[2] 414,878	1,466,333,507

[1] Figures not available.

[2] Short tons.

The Utah Copper Co. easily maintained its position as the largest copper producer in the world and in 1942 surpassed by a wide margin its previous record output. The company produced over two-thirds of the State gold, about one-quarter of the State silver, and nearly all of the State copper. Ore was milled at the two flotation-concentration plants (Magna and Arthur units) at an average rate of over 91,000 tons a day compared with about 83,000 tons in 1941. The ore milled in 1942 had a slightly higher gold and silver content but a somewhat lower copper content. Mill recoveries of gold and silver were about the same as in 1941, but the average copper recovery increased about 1.5 percent. The output of molybdenum sulfide, a byproduct of the copper production, was considerably greater than in 1941. Mill recovery of byproduct molybdenum was also higher in 1942. The Magna mill was operated without a shut-down throughout the year, but the Arthur mill lost the equivalent of 6 days of operation. Copper ore and waste were mined at the open pit at Bingham, 17.5 miles from the Magna and Arthur concentrators, at the rate of 204,000 tons a day, which was about 16,000 tons greater than the rate in 1941. The waste was piled in gulches adjacent to the open pit and there leached. In addition to the huge quantity of copper contained in the copper concentrates produced in 1942, over 31,000,000 pounds of copper were contained in the copper precipitates made in the precipitating plant at Lead Mine. Owing to the vast quantities of gold, copper, and molybdenum produced in 1942, the Utah Copper Co. was the leading copper producer and the second-largest molybdenum producer in the United States and ranked high among the gold producers. According to reports received during the first 3 months of 1943, the company is again surpassing any previous output.

The Boston Consolidated property, owned by the Utah Copper Co., was operated all of 1942 by the American Smelting & Refining Co. Crude copper and lead ore was shipped direct to smelters.

Zinc and lead output of the Bingham district, which made notable gains compared with 1941, came largely from the United States & Lark property of the United States Smelting, Refining & Mining Co. In 1942 the company mined and shipped to its Midvale flotation-concentrator about 18 percent more zinc-lead ore than in 1941, of about the same gold, silver, and zinc content but of a slightly higher lead content. Crude gold-silver and lead ores shipped direct to a smelter amounted to about 26,000 tons. The mine was easily the largest producer of lead and the second-largest producer of zinc in the Western States. The gold and silver output was exceeded only by that of the Utah Copper Co. Extensive development work completed in 1942 comprised 20,911 feet of shafts, drifts, and raises and 1,464 feet of diamond drilling. Reports received during the first 3 months of 1943 indicated that in 1943 the company will produce slightly more zinc than in 1942 and about the same quantity of lead. Other properties owned or controlled by the United States Smelting, Refining & Mining Co., active in 1942, included the Niagara, the Montana-Bingham Consolidated, Bingham Metals, and Utah Metal. The total ore of all classes produced from these properties amounted to 20,378 tons in 1942.

The Apex Delaware group was operated the entire year by the National Tunnel & Mines Co. The property, worked through the

Elton tunnel completed in 1941, produced ore of several classes. Output in 1942 of zinc-lead ore was only 5,000 tons, but the rate of production paralleling the development of ore bodies had reached over 1,000 tons a month in December. Development and rehabilitation work on the copper ore bodies of the mine had reached a stage in May 1942 permitting the company to produce copper milling ore at the rate of over 6,000 tons a month; this was gradually increased until in December copper ore was produced at a rate exceeding 10,000 tons a month. In addition to the copper and zinc-lead milling ore produced, 285 tons of gold and lead ores were shipped direct to smelters.

The Ohio Copper Co. treated 410,075 tons of old gravity and flotation tailings, which contained about 8 pounds of copper per ton. From these tailings 4,368 tons of copper concentrates were made, which averaged 25 percent copper. The capacity of the combination acid leaching and flotation mill was increased from 1,000 to 1,500 tons a day. The treatment process involves sluicing the old tailings to the mill. There the pulp is conditioned for half an hour with sulfuric acid; the soluble copper is then precipitated on shredded cans in the pulp. The pulp containing the precipitated copper and sulfide copper then goes through the flotation section of the mill. The resulting concentrate is thickened and filtered.

A total of 26,754 tons of ore of all classes was shipped from the Butterfield group to the Combined Metals Reduction Co. plant at Bauer and to the International Smelting & Refining Co. at Tooele; the total output was about 5,000 tons less than in 1941.

Other producers active in the Bingham district in 1942 included the Bingham Congor, Chicago Silver, Kremlin, Kaighn, and property of the Victory Mines Co.

SAN JUAN COUNTY

The only lode production from San Juan County in 1942 came from crude copper ore shipped direct to smelter from the Lisbon mine in the La Sal district.

SEVIER COUNTY

Henry district.—A small lot of crude gold-silver ore was shipped to Garfield in 1942 from the B. W. & H. property; it comprised the output of the district.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The Park City region includes the Uintah district in Summit County and the Blue Ledge and Snake Creek districts in Wasatch County. Production of all metals except gold decreased in 1942, as indicated in the following table which gives the output from the region in 1941 and 1942 and the total since 1870.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1941–42, and total, 1870–1942, 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*	
1941	12	337,595	19,747	3,271,199	1,507,000	38,188,000	32,353,000	$7,798,348
1942	15	279,748	22,935	2,632,109	1,454,700	30,556,800	26,051,700	7,320,580
Total, 1870–1942		(1)	496,320	229,300,243	64,782,213	2,318,503,634	611,104,611	344,200,148

[1] Figures not available.

Output from the Silver King Coalition mine and its 800-ton flotation plant was substantially lower than in 1941, owing chiefly to inadequate labor supply. In one period of 1942 employment was only 55 percent of maximum. Under the premium-pay plan the company monthly quota of metal production was set at 567 tons of metallic lead and 472 tons of metallic zinc. As of August 1942 this quota was cut to 150 tons of lead and 125 tons of zinc. The company printed annual report states that mining operations produced 90,824 tons of ore (116,443 in 1941), which comprised 220 tons of crude lead ore and 90,604 tons of zinc-lead milling ore. The latter produced 9,324 tons of lead concentrates and 8,751 tons of zinc concentrates. The total metallic content of the concentrates and crude smelting ore was 1,315 ounces of gold, 854,233 ounces of silver, 452,758 pounds of copper, 12,541,423 pounds of lead, and 10,895,594 pounds of zinc. Development work during 1942 totaled 22,595 feet of drifts, raises, winzes, and shafts; 500 feet of diamond drilling were completed. Recent developments have so improved the physical condition of the property that, assuming an adequate labor supply, 1943 should prove a more productive year.

The Park Utah Consolidated Mines Co. operated the Park Utah Consolidated Mines group in Summit County and the Keetley unit in Wasatch County continuously in 1942. All the ore produced was sent to the International Smelting & Refining Co. plants at Tooele for further treatment. According to the company printed annual report, production from the Park Utah Consolidated group of mines was 60,972 tons of ore containing 3,846 ounces of gold, 371,122 ounces of silver, 11,091,618 pounds of lead, 11,425,019 pounds of zinc, and 351,425 pounds of copper. This production was materially lower than in 1941, owing primarily to the shortage of efficient labor and the low price for metals set by the Government for the first 8 months of the year. Some relief was obtained in September 1942, when the premium allowance was adjusted for lead and zinc. Immediately after this was granted, operations were changed from a 5-day two-shift to a 6-day two-shift basis, and development footage was increased. Because of the favorable response to this new development, further negotiations for premium revision were started. These new negotiations were concluded favorably to the company, and unwatering of the lower levels of the Ontario and Utah units was begun and the rate of development increased further in horizons above the water level in these two units. If a shortage of manpower does not

delay progress, it is expected that enough ore will be uncovered to increase the present rate of production. The Park City Utah Mines group (Keetley unit) in Wasatch County shipped 6,302 tons of ore of all classes to the International mill and smelter for treatment. In addition, the Park Utah Consolidated Mines Co. handled all the operations at the Daly group and shipped about 1,500 tons of zinc-lead ore to the International mill.

The Park City Consolidated Mines Co. operated in 1942 until August, when the company began closing the property; the final shipment of ore was made October 10. The company reports that during the operating period 40,944 tons of ore were shipped to Midvale and contained 2,299 ounces of gold, 674,024 ounces of silver, 128,287 pounds of copper, 1,460,935 pounds of lead, and 2,542,725 pounds of zinc. Increased operating cost was the stated reason for closing the property.

Gold-silver-copper-lead-zinc ore shipped to the Midvale concentrator by the New Park Mining Co. amounted to 49,947 tons compared with 58,600 tons in 1941. The ore shipped to Midvale in 1942 was considerably higher in grade; it contained 16,591 ounces of gold, 641,203 ounces of silver, 798,885 pounds of copper, 6,451,642 pounds of lead, and 7,333,470 pounds of zinc, an output surpassing that in 1941 by a wide margin. The company was by far the leading gold producer in the Park City region. Development work completed totaled 4,656 feet of shafts, drifts, crosscuts, and raises and 2,145 feet of diamond drilling. During 1942 ore was developed in the limestones as well as in the igneous (diorite rock) formations.

D. C. Despain operated the American Flag property under lease for 8 months in 1942; during this time 1,490 tons of gold-silver ore were shipped crude to a smelter. A car of silver ore and a car of zinc-lead ore were shipped from the property of the New Quincy Mining Co.

Old tailings shipped to smelters and old tailings remilled comprised the remaining production from the Park City region in 1942. A total of 27,363 tons of tailings was treated; of this total 16,000 tons were remilled and the zinc-lead middlings produced were shipped to the Midvale concentrator, and 11,363 tons consisted of siliceous silver tailings shipped direct to the Garfield smelter. The most important operations included those of Reuben Garbett, William Wortley, the American Smelting & Refining Co., Marion Lewis, and C. D. Clegg.

TOOELE COUNTY

Tooele County ranked fourth among the metal-producing areas in Utah in 1942. Mines in the county produced gold, silver, copper, lead, and zinc valued at $3,179,414 compared with $2,892,899 in 1941. This gain was due primarily to output from the Tooele slag-fuming plant, which more than offset losses from other districts.

Camp Floyd district.—Gold output from the Camp Floyd district, only important straight gold-producing district in Utah, was cut drastically in 1942. The total value of the output was $436,855 in 1942 compared with $1,049,610 in 1941. Snyder Mines, Inc., continued to be the largest gold producer in the district and treated over 94,000 tons of ore by cyanidation from both company and custom operations. In addition to the cyanide milling operations, over 21,000

tons of highly siliceous gold ore were shipped direct to Garfield for flux. The smelter continued to receive fluxing material from the Camp Floyd district throughout 1942. The principal producers were Snyder Mines, Inc., and the Sacramento Gold Mining Co.

Clifton district.—A small lot of crude lead ore was shipped direct to smelters from the Clifton Standard group in 1942.

Dugway district.—Crude lead ore was shipped direct to the International smelter and zinc-lead ore to the Bauer mills from Four Metals Mines, only active property in the district in 1942.

Erickson district.—The Dollar mine produced zinc-lead and lead ore in 1942, which was shipped crude to the International smelter.

Lakeside district.—Output in the Lakeside district in 1942 comprised crude lead ore from the Monarch mine and crude lead ore and zinc-lead ore from the Georgia Lyn mine shipped direct to a smelter, and lead ore milled.

North Tintic district.—Operators of the Scranton mine shipped crude lead and zinc ore direct to smelters in 1942.

Ophir district.—The total value of metal production from the Ophir district increased in 1942 compared with 1941, owing to the increased output of lead and zinc. The Hidden Treasure mine, largest producer in the district, was operated throughout 1942 by the United States Smelting, Refining & Mining Co.; ore of all classes produced amounted to 6,457 tons, an increase of about 800 tons over 1941. The Star Lease operated the Ophir Queen claim throughout 1942 and shipped lead and zinc-lead ore to the Midvale concentrator and smelter. Several other mines in the district were active in 1942, the most important being the Togo, Ophir Hill, and Mono group.

Rush Valley district.—The West Calumet (Calumet), owned and operated by the Combined Metals Reduction Co., was in 1942 again by far the largest producer in the Rush Valley district; 36,089 tons (38,455 in 1941) of zinc-lead ore were shipped to the Bauer mill, and 918 tons of crude lead ore were shipped direct to the International smelter. Gold ore was shipped direct to Garfield from the Blue Eagle mine. Other production included ore of several classes from the Silver Eagle mine, lead ore from the Bluestone mine, gold-silver and zinc-lead ores from the Honerine-Galena King, and lead ore from the Emilie mine.

"Smelter" district.—The International Smelting & Refining Co. operated its slag-fuming plant throughout 1942, and the output of lead and zinc more than trebled compared with 1941. Although the slag-fuming plant treated in all over 119,000 tons of molten slag, cold slag, and crude ore, Utah received production credit for the metal yield from only 87,831 tons; the difference represents material credited to the States in which the original slag-making material originated. The lead blast furnace of the International Smelting & Refining Co. is adjacent to and works in conjunction with the slag furnace. The plants have been thus arranged for convenience of operation as well as to allow the company to extract, with high recoveries, any gold, silver, copper, and lead that are contained in the crude ores, concentrates, old slags, etc., received before the material is treated for the recovery of zinc. The zinc fume produced averaged 71 percent zinc and the lead fume 49 percent lead.

Willow Springs district.—The production in the Willow Springs district came from rich gold ore, lead ore, and zinc-lead ore shipped direct to smelters. The Oro Del Rey mine was by far the outstanding producer.

UTAH COUNTY

American Fork district.—The Dutchman mine was again the largest producer in the American Fork district and in 1942 shipped 299 tons of high-grade zinc-lead ore to Midvale and a few tons of zinc ore to Tooele. Other producers included the Blue Rock and Pacific, Globe, and Live Yankee mines.

Tintic district.—Mines in the Utah section of the Tintic district are reviewed under Juab County.

WASHINGTON COUNTY

Bull Valley district.—A little gold ore from the Bull Run mine was amalgamated in 1942.

Tutsagubet district.—Copper ore and lead ore were shipped direct to smelters from the Apex mine in 1942.

WAYNE COUNTY

A test lot of silver ore was shipped direct to a smelter from the Copper Queen mine in the Hanksville district in 1942.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

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SUMMARY

Mines in Washington yielded gold, silver, copper, lead, and zinc valued, in terms of recoverable metal, at $8,172,609 in 1942 compared with $7,874,886 in 1941. The output of lead and zinc increased, but that of gold, silver, and copper decreased; the gain in total value of the five metals was due in part to the greater output of lead and zinc and in part to the increase in price paid per unit of recoverable copper, lead, and zinc. The gain in gold production in Chelan County more than offset losses in Ferry, Stevens, and Okanogan Counties. Silver production declined in all the larger producing counties. Almost all the State output of copper was derived, as in former years, from the Holden mine of the Howe Sound Co. in Chelan County. The gain in production of lead and zinc (recovered almost entirely from three mines in Pend Oreille County and two mines in Stevens County) resulted in large measure from the substantially increased output of zinc in Stevens County and of lead in Pend Oreille County. The Pend Oreille Mines & Metals Co. continued as the major producer of both lead and zinc in the State.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.

[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.

[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.

[5] $0.64646464. [6] $0.67878787. [7] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1938–42, and total, 1860–1942, 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
1938	77	80	901,689	74,175	$2,596,125	380,938	$246,263
1939	88	84	1,124,564	90,420	3,164,700	442,063	300,067
1940	83	88	1,166,798	82,136	2,874,760	365,175	259,680
1941	61	56	1,238,509	84,176	2,946,160	402,030	285,888
1942	37	18	1,222,937	75,396	2,638,860	369,038	262,427
1860–1942			[1]	1,957,121	47,254,558	11,591,928	8,203,574

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1941	17,372,000	2,049,896	7,806,000	444,942	28,640,000	2,148,000	7,874,886
1942	16,060,000	1,943,260	9,702,000	650,034	28,796,000	2,678,028	8,172,609
1860–1942	[2] 55,094	14,094,561	[2] 58,127	7,156,614	[2] 90,686	11,575,022	88,284,329

[1] 1860–1903: Figures not available; 1904–42: 8,387,210 tons produced.
[2] Short tons.

Gold and silver produced at placer mines in Washington, 1938–42, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1938	1,575	$55,125	218	$141	$55,266
1939	2,261	79,135	358	243	79,378
1940	2,747	96,145	720	512	96,657
1941	540	18,900	90	64	18,964
1942	356	12,460	59	42	12,502

Gold.—The output of recoverable gold from lode and placer operations in Washington declined 10 percent in 1942 from 1941. The quantity recovered from placer operations has been of minor importance compared with that from lode mines, and in 1942 placers yielded only 356 fine ounces. Several factors contributed to this decline, the more important of which were shortages of labor and supplies to maintain normal operations in gold mines and the issuance of a Government order in October 1942 which resulted in the closing or greatly curtailing of operations by several small mines. The direct result of interference with normal gold-mining operations was that much less siliceous gold ore was treated. Gold recovered by amalgamation, by cyanidation, from concentrates smelted, and from crude ore shipped direct to smelters all declined; however, gold recovered from copper concentrates smelted increased. Gold recovered in bullion from ores treated at cyanidation plants (with or without concentration equipment) declined in both Ferry and Stevens Counties; in Chelan County 940 ounces of gold came from the cyanidation of current tailings, whereas none was recovered in 1941. Gold recovered

from gold concentrates made in the concentrating sections of cyanide mills in Ferry County showed a drop in 1942. Gold recovered at amalgamation mills declined in each of the counties in which such mills were operated. Gold recovered from crude ore shipped direct to smelters declined in Ferry and Okanogan Counties but increased in Chelan County. Copper concentrates produced by the Howe Sound Co. yielded 63 percent of the State total gold, and gold concentrates produced from the Knob Hill property yielded 24 percent. Other important producers of gold were the Aurum and Valley mines in Ferry County. The total output of gold ore was 93,957 tons in 1942, compared with 178,121 tons in 1941, and was treated as follows: 71,232 tons cyanided, 125 tons amalgamated, 21,150 tons shipped crude to smelters, and 1,450 tons concentrated.

Silver.—The output of recoverable silver in Washington declined 8 percent in 1942 from 1941, and declines were noted in all the larger producing counties. The largest outputs were in Chelan, Ferry, Stevens, and Pend Oreille Counties; and mines in Chelan and Ferry produced 92 percent of the State total. Copper ore yielded 48 percent of the total silver, gold ore 45 percent, and zinc-lead ore 7 percent; the remainder came from lead ore, lead-copper ore, and placers. The Holden property of the Howe Sound Co. in Chelan County was again the largest producer of silver in the State, followed by the Knob Hill property, operated by Knob Hill Mines, Inc., in Ferry County; these two properties produced 85 percent of the State total. Other producers of silver were the Aurum and Valley properties in Ferry County; the Pend Oreille Mines & Metals Co. property in Pend Oreille County; and the Zenith Mines, Inc., and Sierra Zinc Co. properties, both in Stevens County. Placer mines yielded 59 fine ounces of silver.

Copper.—The output of recoverable copper in Washington in 1942 was 16,060,000 pounds, or less than in any year since 1938 although the tonnage of copper ore treated was greater than in any previous year. The Howe Sound Co. shipped copper concentrates rich in gold from its Holden property in Chelan County and accounted for 99 percent of the State total output of copper; the value of the recoverable gold in these concentrates was equivalent to 88 percent of the value of the copper. Among other copper producers were the Sunset mine of the Kromona Mines Corporation in Snohomish County and the Lucky Boy mine in Stevens County.

Lead and zinc.—The production of recoverable zinc in Washington in 1942 was the greatest in the history of the State, exceeding that of 1941 by 156,000 pounds; the production of recoverable lead was 1,896,000 pounds greater than in 1941 and only 87,687 pounds less than in the record year 1917, when 9,789,687 pounds were produced. Three properties in Pend Oreille County produced 94 percent of the State total lead and 95 percent of the zinc; virtually all the rest of the lead and zinc recovered came from two properties in Stevens County. The lead output from Pend Oreille County was greater than in 1941, but the zinc output declined; however, this decrease was more than offset by the increase from operations in Stevens County. Zinc-lead ore treated in the two flotation mills (Pend Oreille and Grandview) in Pend Oreille County exceeded that treated in 1941 by 36,585 tons; it averaged 1.50 percent in lead and 4.70 percent in zinc, compared with 1.39 percent in lead and 5.35 percent in zinc in 1941. Zinc-lead ore

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treated in Stevens County totaled 14,064 tons in 1942, compared with 2,051 tons in 1941; the average grade of the ore was higher than that from mines in Pend Oreille County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1942, 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		8	173	$6,055	28	$20
Benton		2	104	3,640	17	12
Chelan	2	2	48,685	1,703,975	174,790	124,295
Douglas		1	1	35		
Ferry	7		25,256	883,960	164,987	117,324
Grant		1	71	2,485	14	10
Kittitas		3	3	105		
Okanogan	6		300	10,500	457	325
Pend Oreille	5				9,630	6,848
Snohomish	2	1	36	1,260	1,582	1,125
Stevens	11		712	24,920	17,460	12,416
Whatcom	3		55	1,925	21	15
Yakima	1				52	37
Total, 1941	37	18	75,396	2,638,860	369,038	262,427
	61	56	84,176	2,946,160	402,030	285,888

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Asotin							$6,075
Benton							3,652
Chelan	15,909,000	$1,924,989					3,753,259
Douglas							35
Ferry	1,000	121					1,001,405
Grant							2,495
Kittitas							105
Okanogan	9,000	1,089	600	$40			11,954
Pend Oreille			9,106,000	610,102	27,240,000	$2,533,320	3,150,270
Snohomish	99,000	11,979					14,364
Stevens	40,000	4,840	595,400	39,892	1,556,000	144,708	226,776
Whatcom							1,940
Yakima	2,000	242					279
Total, 1941	16,060,000	1,943,260	9,702,000	650,034	28,796,000	2,678,028	8,172,609
	17,372,000	2,049,896	7,806,000	444,942	28,640,000	2,148,000	7,874,886

Gold and silver produced at lode mines in Washington in 1942, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Chelan	716,017	48,682	174,790
Ferry	88,123	25,256	164,987
Okanogan	1,641	300	457
Pend Oreille	397,630		9,630
Snohomish	1,001	35	1,582
Stevens	18,398	712	17,460
Whatcom	122	55	21
Yakima	5		52
Total, 1941	1,222,937	75,040	368,979
	1,238,509	83,636	401,940

Gold and silver produced at placer mines in Washington in 1942, 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	27	2	146	26	173	28
Benton			104	17	104	17
Chelan	3				3	
Douglas	1				1	
Grant			71	14	71	14
Kittitas	3				3	
Snohomish	1				1	
	35	2	321	57	356	59
Total, 1941	207	26	333	64	540	90

[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

Six properties in Washington produced 1,192,927 tons of ore in 1942, or 98 percent of the State output. This ore included copper ore from the Holden mine in Chelan County; zinc-lead ore from the Pend Oreille, Metaline, and Grandview properties in Pend Oreille County and the Blue Ridge property in Stevens County; and gold ore from the Knob Hill mine in Ferry County. Development work on these six properties in 1942 included completion of 19,212 feet of drifts, crosscuts, raises, shafts, and tunnels, 71,192 feet of diamond drilling, and 434 feet of churn drilling.

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 1942, 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	18	93,957	26,524	165,960	10,600	600	
Copper ore	5	717,124	[1] 48,399	[1] 176,348	16,036,400		
Lead ore	7	161		712		105,860	
Lead-copper ore	2	5		553	328	1,151	
Zinc-lead ore	6	411,690	117	25,406	12,672	9,594,389	28,796,000
Total, lode mines	[2] 37	1,222,937	75,040	368,979	16,060,000	9,702,000	28,796,000
Total, placers	18		356	59			
	55	1,222,937	75,396	369,038	16,060,000	9,702,000	28,796,000
Total, 1941	117	1,238,509	84,176	402,030	17,372,000	7,806,000	28,640,000

[1] Includes 940 ounces of gold and 2,557 ounces of silver from current tailings cyanided.
[2] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

METALLURGIC INDUSTRY

Lode mines in Washington produced 1,222,937 tons of ore in 1942, treated as follows: 1,130,075 tons in straight concentration mills, 71,232 tons in cyanide mills and a cyanide-concentration mill, 125 tons in amalgamation mills, and 21,505 tons shipped crude to smelters.

Amalgamation plants.—Five straight amalgamation plants and one amalgamation and concentration plant treated 125 tons of gold ore in 1942. The Morning Star mine in Ferry County was the chief producer.

Cyanidation mills.—The cyanide plant at the Holden mill of the Howe Sound Co. operated about 8 months in 1942, during which time 180,000 tons of current tailings from copper ore were treated. The 400-ton Knob Hill cyanide-concentration mill treated gold ore from the Knob Hill mine; the plant operated throughout 1942. The First Thought 50-ton cyanide mill was operated on ores from the First Thought property until May, when the property was closed. These three plants treated 247,732 tons of ore and current tailings (180,000 tons) and reported the consumption of 307,465 pounds of calcium cyanide, 4,000 pounds of sodium cyanide (91-percent grade), 20,775 pounds of zinc dust, 1,460 pounds of lead acetate, 2,600 pounds of lead nitrate, and 856,220 pounds of lime.

Concentration mills.—A total of 1,130,075 tons of ore was treated at 11 flotation mills, as follows: 716,928 tons of copper ore at 3 mills, 411,690 tons of zinc-lead ore at 5 mills, and 1,457 tons of gold, lead, and lead-copper ores at 3 plants.

Details of the treatment of all ore produced in Washington in 1942 are given in the following tables.

Mine production of metals in Washington in 1942, 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 [1] amalgamated	125	264	87			
Ore and tailings cyanided	[2] 247,732	3,943	18,091			
Concentrates smelted	71,492	65,422	323,029	15,991,791	9,595,622	28,796,000
Ore smelted	21,505	5,411	27,772	68,209	106,378	
Placer		356	59			
		75,396	369,038	16,060,000	9,702,000	28,796,000
Total, 1941		84,176	402,030	17,372,000	7,806,000	28,640,000

[1] See footnote 1 of following table.

[2] Comprises 180,000 tons of current tailings from copper ore concentrated in Chelan County, 63,952 tons of current tailings from 67,452 tons of gold ore first treated by concentration in Ferry County, and 3,780 tons of crude ore from Stevens County

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Washington in 1942, 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)
Ferry	(1)	[1] 217	[1] 82			
Okanogan	5	7	2			
Whatcom	120	40	3	6	14	16
	[1] 125	[1] 264	[1] 87	6	14	16
Total, 1941	694	777	363	5	3	3

CYANIDATION MILLS

Chelan	(2)	[2] 940	[2] 2,557			
Ferry	67,452	2,408	15,205	3,500	17,743	125,078
Stevens	3,780	595	329			
	71,232	3,943	18,091	3,500	17,743	125,078
Total, 1941	135,290	6,582	16,996	3,590	18,969	109,818
Grand total: 1942	71,357	4,207	18,178	3,506	17,757	125,094
1941	135,984	7,359	17,359	3,595	18,972	109,826

[1] Gold and silver from amalgamation in Ferry County came from metallics (less than half a ton) from gold ore shipped crude to smelter.
[2] Material cyanided was 180,000 tons of current tailings from copper ore.

Mine production of metals from concentrating mills in Washington in 1942, by counties, in terms of recovered metal

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	715,726	34,628	47,424	172,067	15,908,400		
Okanogan	1,450	43	116	154	6,846		
Pend Oreille	397,626	31,323		9,622		9,101,058	27,240,000
Snohomish	810	60	8	75	36,745		
Stevens	14,463	1,932	117	16,017	39,800	494,564	1,556,000
	1,130,075	67,986	47,665	197,935	15,991,791	9,595,622	28,796,000
Total, 1941	1,063,076	68,276	46,476	220,006	17,155,667	7,689,648	28,640,000

Gross metal content of concentrates produced from ores mined in Washington in 1942, 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	3,515	17,833	125,200	6,958		
Copper	34,790	47,472	172,280	16,473,023		
Lead	6,728	39	9,086	2,516	9,620,797	414,073
Lead-copper	1		117	150	470	
Zinc	26,458	78	16,346	11,054	512,935	32,089,081
	71,492	65,422	323,029	16,493,701	10,134,202	32,503,154
Total, 1941	71,871	65,448	329,832	17,685,859	8,588,909	32,495,120

Mine production of metals from Washington concentrates shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	34,628	47,424	172,067	15,908,400		
Ferry	3,500	17,743	125,078			
Okanogan	43	116	154	6,846		
Pend Oreille	31,323		9,622		9,101,058	27,240,000
Snohomish	60	8	75	36,745		
Stevens	1,932	117	16,017	39,800	494,564	1,556,000
Whatcom	6	14	16			
	71,492	65,422	323,029	15,991,791	9,595,622	28,796,000
Total, 1941	71,871	65,448	329,832	17,155,667	7,689,648	28,640,000

BY CLASSES OF CONCENTRATES

Dry gold	3,515	17,833	125,200			
Copper	34,790	47,472	172,280	15,978,991		
Lead	6,728	39	9,086	2,157	9,235,840	
Lead-copper	1		117	128	451	
Zinc	26,458	78	16,346	10,515	359,331	28,796,000
	71,492	65,422	323,029	15,991,791	9,595,622	28,796,000

Gross metal content of Washington crude ore shipped to smelters in 1942, 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	21,150	5,384	25,091	4,224	1,042
Copper	196	27	1,559	66,656	----------
Lead	156	----------	686	----------	109,752
Lead-copper	3	----------	436	323	874
Total, 1941	21,505	5,411	27,772	71,203	111,668
	39,449	10,829	54,749	226,546	121,847

Mine production of metals from Washington crude ore shipped to smelters in 1942, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Chelan	291	318	166	600	----------
Ferry	20,671	4,888	24,622	1,000	----------
Okanogan	186	177	301	2,154	600
Pend Oreille	4	----------	8	----------	4,942
Snohomish	191	27	1,507	62,255	----------
Stevens	155	----------	1,114	200	100,836
Whatcom	2	1	2	----------	----------
Yakima	5	----------	52	2,000	----------
Total, 1941	21,505	5,411	27,772	68,209	106,378
	39,449	10,829	54,749	216,333	116,352

BY CLASSES OF ORE

Dry and siliceous gold	21,150	5,384	25,091	3,754	600
Copper	196	27	1,559	64,255	----------
Lead	156	----------	686	----------	105,078
Lead-copper	3	----------	436	200	700
	21,505	5,411	27,772	68,209	106,378

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1942, 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	---	8	---	---	173	---	28	---	---	---	$6,075
Benton County:											
Columbia River	---	2	---	---	104	---	17	---	---	---	3,652
Chelan County:											
Chelan Lake	1	---	715,726	48,364	---	174,624	---	15,908,400	---	---	3,741,833
Peshastin Creek	1	1	291	318	1	166	---	600	---	---	11,356
Wenatchee River	---	1	---	---	2	---	---	---	---	---	70
Douglas County:											
Columbia River	---	1	---	---	1	---	---	---	---	---	35
Ferry County:											
Danville	1	---	124	275	---	128	---	1,000	---	---	9,837
Republic	6	---	87,999	24,981	---	164,859	---	---	---	---	991,568
Grant County:											
Columbia River	---	1	---	---	71	---	14	---	---	---	2,495
Kittitas County:											
Swauk	---	2	---	---	2	---	---	---	---	---	70
Yakima River	---	1	---	---	1	---	---	---	---	---	35
Okanogan County:											
Cascade	1	---	58	63	---	128	---	---	---	---	2,296
Conconully	1	---	5	1	---	---	---	---	---	---	35
Methow	3	---	1,554	212	---	263	---	9,000	---	---	8,696
Myers Creek and Mary Ann Creek	1	---	24	24	---	66	---	---	600	---	927
Pend Oreille County:											
Metaline	5	---	397,630	---	---	9,630	---	---	9,106,000	27,240,000	3,150,270
Snohomish County:											
Index	1	---	938	21	---	1,381	---	95,800	---	---	13,309
Sultan	1	1	63	14	1	201	---	3,200	---	---	1,055
Stevens County:											
Bossburg	1	---	100	---	---	585	---	---	52,600	---	3,940
Deer Trail	1	---	1,859	7	---	8,145	---	1,700	167,300	186,000	34,750
Kettle Falls	1	---	3	---	---	436	---	200	700	---	381
Northport	6	---	12,264	110	---	7,875	---	11,100	374,800	1,370,000	163,315
Orient	1	---	3,780	595	---	329	---	---	---	---	21,059
Springdale	1	---	392	---	---	90	---	27,000	---	---	3,331
Whatcom County:											
Mount Baker	1	---	60	32	---	---	---	---	---	---	1,120
Slate Creek	2	---	62	23	---	21	---	---	---	---	820
Yakima County:											
Bumping Lake	1	---	5	---	---	52	---	2,000	---	---	279
Total Washington	37	18	1,222,937	75,040	356	368,979	59	16,060,000	9,702,000	28,796,000	8,172,609

ASOTIN COUNTY

Most of the gold output from Asotin County in 1942 came from the operations of three small dragline dredges on Snake River. All placer operations employing mechanical equipment closed in October 1942.

BENTON COUNTY

All the gold output from Benton County in 1942 came from two dry-land dredges operating on Columbia River.

CHELAN COUNTY

Chelan Lake district.—The Holden mine of the Howe Sound Co. continued to be the leading producer in 1942 of gold, silver, and copper in Washington. The company treated 715,726 tons of copper-zinc ore, which averaged 0.083 ounce of gold and 0.308 ounce of silver to the ton, 1.21 percent copper, and 1.02 percent zinc. The quantity of ore treated was 28,383 tons greater than in 1941 but of lower copper content; as a consequence, the copper output of the State declined. The company long has been treating large tonnages of ore of about equal zinc and copper content, but it was not until 1942 that steps were taken to recover the zinc. In 1942 equipment was added to the mill whereby zinc concentrates as well as copper concentrates were to be recovered, but actual recovery of zinc concentrates did not begin until late in December of that year. The rated milling capacity of the 2,000-ton concentrator was not increased in 1942, although an average of 2,101 tons of ore a day was treated compared with 2,056 tons in 1941. The cyanide plant, added to the concentrator late in 1941, treated current tailings from the copper ore until September 6, 1942, when it was closed. During the operating period 180,000 tons of current tailings were treated and resulted in the recovery of 940 ounces of gold and 2,557 ounces of silver. Development work in 1942 included sinking 347 feet of vertical shaft, driving 8,031 feet of drifts, and 2,862 feet of raises, besides completing 19,507 feet of diamond drilling. The total footage of development work done in 1942 was equivalent to about half that completed in 1941.

Peshastin Creek district.—Gold ore shipped crude to the Tacoma smelter from the Polepick mine was the only production in the Peshastin Creek district in 1942.

FERRY COUNTY

Danville district.—The Morning Star Mining Co. operated its gold property in 1942 from January to May and in December and produced about half the quantity of metals produced in 1941. The intervening period was spent in developing an adjoining copper property.

Republic district.—Siliceous ore, from which the entire metal output of the Republic district was recovered, amounted to 87,999 tons in 1942 and comprised 67,452 tons cyanided and 20,547 tons shipped direct to smelters. Knob Hill Mines, Inc., was again the chief producer in the district but treated ore from the Knob Hill mine only; it handled 67,452 tons of gold ore in its 400-ton flotation-cyanidation mill, producing 3,500 tons of gold concentrates in addition to cyanide bullion. The company announced that development work in 1942 included 2,459 feet of diamond drilling and 434 feet of churn drilling; also, that all open-cut mining was discontinued.

The Aurum Mining Co. operated the Aurum group throughout 1942 and continued to supply most of the crude ore shipped direct to smelter from the Republic district. The Valley mine produced about 5,800 tons of highly siliceous gold ore, which was shipped direct to the Tacoma smelter. Other producers of gold ore shipped direct to smelters included the Republic group, operated by the Eureka Mining & Milling Co., and the South Penn property.

GRANT COUNTY

A dragline dredge operated by Miller Bros. at Chinaman Bar on Columbia River accounted for all the gold recovered in Grant County in 1942.

KITTITAS COUNTY

Some placer gold was recovered from sluicing and hydraulic operations in 1942 from gravels in the Swauk and Yakima River districts.

OKANOGAN COUNTY

Cascade district.—Metal from crude gold ore shipped direct to the Tacoma smelter from the Bodie group near Wauconda comprised the output from the Cascade district in 1942.

Methow district.—The Methow M & M Co. treated gold ore in a small concentrating mill in 1942 and was the largest producer in the Methow district. Other producers were the Highland Light & Hidden Treasure, Alder group, and Crystal Mountain group of properties.

PEND OREILLE COUNTY

Metaline district.—Most of the recovered lead and zinc from Washington in 1942 was derived from the zinc-lead ores of the Metaline district. The value of the recovered metals increased from $2,573,300 in 1941 to $3,150,270 in 1942 as the result of an increased output of lead and a higher unit price for lead and zinc. The Pend Oreille Mines & Metals Co., chief producer in the district, operated its Josephine group of properties throughout the year and treated an average of 642 tons (based on a 365-day year) of zinc-lead ore per day in its 700-ton flotation mill. The average grade of the ore treated in 1942 was 1.66 percent lead and 4.28 percent zinc, compared with 1.11 percent lead and 4.84 percent zinc in 1941. The lead concentrates produced averaged about 78 percent, and the zinc concentrates averaged 62 percent. Mine development, according to the company report, amounted to about 18,000 feet of diamond drilling and the driving in aggregate of about 2,700 feet of tunnel, raises, and shafts. The company also reported the opening of the 1,000-foot and 1,500-foot levels. Most of the remainder of the lead output of the district and all the zinc were contained in the high-grade lead and zinc concentrates produced at the Grandview mill of the American Zinc, Lead & Smelting Co. The capacity of this mill, which treats zinc-lead ore from the properties of the American Zinc, Lead & Smelting Co. and the Metaline Mining & Leasing Co., was increased from 450–500 tons a day to 600 tons by adding classifying capacity in 1942. The Grandview mill treated about 22,000 tons of ore more than was treated in 1941, but the average lead and zinc content of the mill ore was lower. The American Zinc, Lead & Smelting Co. reported that mine development comprised completion of 12,028 feet of diamond drilling and 1,512 feet of drifts. The Metaline Mining & Leasing Co. reported that development comprised completion of 19,131 feet of diamond drilling, 3,058 feet of drifts, and 130 feet of shaft. Other production in the district included lead ore shipped crude to a smelter from the Cliff and Velvet Lode properties.

SNOHOMISH COUNTY

Index district.—The Kromona Mines Corporation, only active producer in the Index district in 1942, shipped crude copper ore direct to a smelter and also produced some copper concentrates. The company output was substantially lower than in 1941.

Sultan district.—Some copper ore was shipped crude to a smelter from the property of the Pacific Nickel Co. A little placer gold was recovered from sluicing along Sultan River.

STEVENS COUNTY

Bossburg district.—The Bonanza mine, an old property near Evans, was reopened by Russell Parker in June; equipment was installed, and operations were begun the latter part of the month. During the remainder of the year the property produced 100 tons of lead ore, containing 585 ounces of silver and 54,994 pounds of lead. A 60-ton concentration mill is to be installed early in 1943.

Deer Trail district.—Zenith Mines, Inc., operated the Cleveland mine during 1942 and treated 1,859 tons of zinc-lead ore in a small flotation mill. The ore treated averaged about 6 percent lead and 7 percent zinc.

Kettle Falls district.—A small lot of lead-copper ore was shipped crude to a smelter from the Silver Queen mine.

Northport district.—The Sierra Zinc Co. operated throughout 1942 its 60-ton flotation mill, built late in 1941. A total of 12,123 tons of zinc-lead ore was milled, which contained about 0.01 ounce of gold and 0.6 ounce of silver to the ton, 1.59 percent lead, and 7.36 percent zinc. The mill was operated continuously except for short periods during the winter months; these temporary shut-downs were caused for the most part by weather conditions. Minor additions were made to the mill in 1942, and some adjoining property was acquired for a tailings pond and to furnish a sufficient supply of mine timber. A 40-ton flotation mill was constructed in 1942 on the property of the Frisco Standard Co. near Ione. Machinery was installed, and a test run was made on the lead-copper ore. The property was closed late in October after the tests were completed; operations are to be resumed in the spring of 1943. Among other producers in the Northport district in 1942 were the Electric Point, Gladstone Mountain, and Van Stone, all of which shipped crude lead ore direct to a smelter.

Orient district.—The only producer in the Orient district in 1942 was the First Thought Mine Corporation, which treated 3,780 tons of gold ore in its 50-ton cyanide mill. In May, operations were suspended for the duration of the war.

Springdale district.—Operations at the Lucky Boy mine began in June and continued throughout the rest of 1942. During this period, 392 tons of copper ore were treated in the Deer Trail 100-ton flotation mill.

WHATCOM COUNTY

Mount Baker district.—Gold ore from the Boundary Red Mountain mine, treated by amalgamation, comprised the output of the Mount Baker district in 1942.

Slate Creek district.—A little gold ore from the property of the Slate Creek Mining Co. was treated by amalgamation and concentration and a sample lot of ore from the Mammoth group was shipped crude to a smelter.

YAKIMA COUNTY

Bumping Lake district.—Some old clean-up of copper ore and mill cleanings was shipped direct to a smelter in 1942 from the property of the Copper Mining Co.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY OUTLINE

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SUMMARY

Lode and placer mines in Wyoming in 1942 yielded—in terms of recovered metals—23 fine ounces of gold, 52 fine ounces of silver, and 6,000 pounds of lead; the total calculated value was $1,244. Of the total metal produced, 12 ounces of gold were recovered from placer mining—the output from six properties in the Atlantic City district, Fremont County.

No large lode-mining operations were carried on in the State to recover gold, silver, copper, or lead in 1942. Six small lode mines, none of which shipped or treated over 25 tons of crude ore, yielded—in terms of recovered metals—11 fine ounces of gold, 52 fine ounces of silver, and 6,000 pounds of lead. Lead ore totaling 25 tons (yielding the bulk of the silver and all the recovered lead produced in the State in 1942) was shipped from the Black Buttes claim in Crook County to the Garfield (Utah) smelter. A total of 59 tons of crude ore was treated in five small amalgamation mills—four in Fremont County and one in Johnson County—which recovered 11 ounces of gold and 1 ounce of silver.

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, 1938–42

Year	Gold [1]	Silver [2]	Copper [3]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1938	$35.00	[5] $0.646+	$0.098	$0.046	$0.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093

[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] Treasury buying price for newly mined silver.

[3] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production but excludes value of foreign copper delivered to Metals Reserve Co. for domestic consumption.

[4] 1938–41: Yearly average weighted price of all grades of primary metal sold by producers; 1942: Price includes bonus payments by Metals Reserve Co. for over-quota production.

[5] $0.64646464.

[6] $0.67878787.

[7] $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 1938 to 1942; it also gives the total production of metals from 1867 to 1942. 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, originally in Laramie County, now in Platte County.

Mine production of gold, silver, copper, and lead in Wyoming, 1938–42, and total, 1867–1942, 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	
1938	581	798	$27,930	328	$212					$28,142
1939	57	583	20,405	75	51					20,456
1940	813	740	25,900	114	81	4,000	$452			26,433
1941	159	478	16,730	94	67	8,000	944			17,741
1942	84	23	805	52	37			6,000	$402	1,244
1867–1942	(1)	77,914	1,835,318	74,632	51,752	[2] 16,325	5,684,048	[2] 11	970	7,572,088

[1] Figures not available.
[2] Short tons.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, and lead in Wyoming in 1942, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total			
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Crook	1		25				51		51		6,000	$438
Fremont	4	6	44	10	12	22	1		1			771
Johnson	1		15	1		1						35
Total, 1941	6	6	84	11	12	23	52		52		6,000	1,244
	8	12	159	31	447	478	44	50	94	8,000		17,741

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Douglas Creek district.—Development and assessment work were the only mining operations carried on in Albany County during 1942. Ira J. Knisley, of Holmes, did assessment work on the Depression No. 1 and 2 placer ground on the west branch of Little Beaver Creek. The Independence Gold Mining Co., Inc., did development work and made tests for the treatment of ore from its Independence group of claims 3½ miles west of Centennial.

CARBON COUNTY

Encampment or Upper Platte district.—Development and assessment work were done on the Golden Clover claim, 15 miles south of Encampment, by the Golden Clover Mining Co.

CROOK COUNTY

Hurricane district.—One car of lead ore containing 51 ounces of silver and 6,977 pounds of lead was shipped to the East Helena (Mont.) plant from the Black Buttes claim south of Sundance by L. F. Fletcher of Moorcroft. Two types of ore were mined—a lead carbonate ore and a sulfide ore.

FREMONT COUNTY

Atlantic City district.—Placer mining in the Atlantic City district in 1942 yielded 12 ounces of gold valued at $420. Frank Antich, Atlantic City, operated the Miners Delight placer and treated about 2,400 cubic yards of gravel, from which 7.38 ounces of gold were recovered; the average fineness of the bullion was 0.851 in gold. This was the largest single producer of gold in the State in 1942. No other individual placer operation in the Atlantic City district produced more than 2 fine ounces of gold. Six hundred cubic yards of gravel from the Bonanza placer, yielding 1.52 ounces of gold, were treated by R. A. Swabes of Rock Springs. Joe Barbett, operating the Timba-Bah Mining Co. property about 5 miles below Atlantic City (largest single producer of gold and silver in the State in 1941), produced 1.67 ounces of gold. Individuals sluicing at the Badger-Fox-Coyote, Big Atlantic, and Sweetwater River placers near Atlantic City and South Pass City recovered small lots of placer gold, which were sold to the Smith-Sherlock Co. at South Pass City.

Roy A. Cowden, of Atlantic City, operated the Gold Leaf and Mint lode-mining claims and treated 24 tons of ore in a 5-ton Gibson amalgamation mill, producing 5¼ ounces of gold bullion, which was sold to the Denver Mint. James Cassie did development and assessment work on the Reynolds group of claims southeast of Atlantic City and treated about 20 tons of ore, producing 3½ ounces of gold bullion, which was sold to the Denver Mint. Some development work, consisting of 100 feet of tunnel, was done at the McGrath-Diana mine; the mill equipment and buildings were sold and moved to Ten Sleep, Washakie County, during the summer of 1942.

Copper Mountain district.—Charles Simerson operated the Gold Nugget mine on Copper Mountain; about 3 ounces of gold were produced.

GOSHEN COUNTY

Some development work was done on the old Michigan mine in the Hartville Uplift region, northeast of Sunrise, by Oscar Alexander, of Manville. No shipments were made.

JOHNSON COUNTY

The Powder River Exploration Syndicate treated a few tons of ore from the Powder River mine and shipped 5 ounces of gold bullion to the Denver Mint. The property is in the Big Horn Mountains southwest of Buffalo and was recently purchased by the Empire State Oil Co. of Thermopolis.

PARK COUNTY

No metal was produced from Park County in 1942. Charles F. Wolf and associates did some sampling and exploration work on the mining claims in the Kerwin camp, about 50 miles south of Cody.

PLATTE COUNTY

The only mining operations in Platte County in 1942 were those carried on by the Colorado Fuel & Iron Co. at its Sunrise iron mine. No copper ore was produced.

SECONDARY METALS—NONFERROUS

By F. H. Wright [1]

SUMMARY OUTLINE

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GENERAL SUMMARY

Although the nonferrous secondary metals industry was handicapped by a shortage of manpower and by necessary Government restrictions on uses of certain metals, the year 1942 saw several production records broken. The value of the more important nonferrous metals recovered from scrap as unalloyed metal and in alloys and chemicals totaled $425,991,475, compared with $348,377,389 in 1941. Secondary metals recovered from new or byproduct scrap that left the plant of its origin were valued at $229,126,659, and metals reclaimed from old scrap materials were worth $196,864,816.

Salient statistics of nonferrous secondary metals recovered in the United States, 1941–42

Metal	New scrap		Old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1941						
Aluminum	63,744	$20,704,051	43,113	$14,003,102	106,857	$34,707,153
Antimony	57	15,960	21,572	6,040,160	21,629	6,056,120
Copper	313,697	74,032,492	412,699	97,396,964	726,396	171,429,456
Lead	17,136	1,953,504	380,280	43,351,920	397,416	45,305,424
Magnesium	1,737	833,760	15	7,200	1,752	840,960
Nickel	3,181	2,226,700	2,134	1,493,800	5,315	3,720,500
Tin	12,427	12,926,565	29,606	30,796,161	42,033	43,722,726
Zinc	202,813	30,421,950	81,154	12,173,100	283,967	42,595,050
		143,114,982		205,262,407		348,377,389
1942						
Aluminum	154,831	45,272,585	43,661	12,766,476	198,492	58,039,061
Antimony	3	934	18,197	5,662,906	18,200	5,663,840
Copper	500,633	118,149,388	427,122	100,800,792	927,755	218,950,180
Lead	14,413	1,816,038	308,588	38,882,088	323,001	40,698,126
Magnesium	6,151	2,755,648	87	38,976	6,238	2,794,624
Nickel	2,430	1,701,000	1,712	1,198,400	4,142	2,899,400
Tin	14,057	14,619,280	23,861	24,815,440	37,918	39,434,720
Zinc	257,539	44,811,786	72,987	12,699,738	330,526	57,511,524
		229,126,659		196,864,816		425,991,475

Recovery of secondary lead, tin, antimony, and nickel (nonferrous) declined, but reclamation of secondary aluminum, copper, zinc, and magnesium broke all previous records owing to the increased volume of fabricators' scrap that flowed from war plants. The scrap-remelting facilities of primary aluminum producers and brass mills were so

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

overtaxed that part of the furnace capacity of a number of secondary smelters and refiners was brought into use to melt wrought alloy scrap. Production of secondary brass and aluminum casting alloy ingots was greater than ever before, but unusually large quantities of refined copper, tin, and zinc were required by brass-ingot makers in addition to the scrap used for production of lead-free bronze to meet rigid specifications of the Army and Navy.

SCOPE OF REPORT

The regular annual survey of nonferrous-scrap consumption and secondary-metal production was augmented in 1942 by a monthly canvass of approximately 4,500 scrap-metal dealers, and by separate monthly canvasses of consumers of zinc scrap and white-metal scrap. Annual reports of scrap use were received from 373 plants classed as secondary remelters, smelters, or refiners of one or more nonferrous metals, from 37 brass mills, 27 aluminum rolling mills and fabricators, 48 chemical works, and 1,219 foundries and other manufacturers that consumed purchased nonferrous scrap.

SECONDARY ALUMINUM

The secondary-aluminum industry operated its scrap-melting facilities more nearly at capacity levels in 1942 than in 1941. The quantity of secondary aluminum [2] recovered from scrap (198,492 short tons valued at $58,039,061) was almost double the 1941 output (106,857 short tons valued at $34,707,153). The value was computed at 14.62 cents a pound of aluminum recovered, compared with 16.24 cents a pound in 1941. Production of primary aluminum was 521,106 short tons, and the net total production in the United States consisted of primary production plus recovery from old scrap, or 564,767 tons.

Of the 14,104 tons of secondary aluminum recovered as unalloyed metal, 21 percent appeared on the market as "pure" (98.5 percent) aluminum ingot, 6 percent as aluminum powder, and 73 percent in commercial shapes produced by rolling mills.

Secondary aluminum [1] recovered in the United States, 1941–42, in short tons

Secondary aluminum recovered			Recoverable aluminum-alloy content of scrap		
Form of recovery	1941	1942	Kind of scrap processed	1941	1942
As metal	8,308	14,104	New scrap:		
Aluminum alloys	[r] 96,571	180,979	Aluminum-base [3]	63,726	154,436
In brass and bronze	334	1,268	Copper-base	12	297
In zinc-base alloys	709	473	Zinc-base	6	98
In chemical compounds	935	1,668		63,744	154,831
	106,857	198,492	Old scrap:		
			Aluminum-base [4]	43,049	43,249
			Copper-base	31	213
			Zinc-base	33	199
				43,113	43,661
				106,857	198,492

[1] In accordance with common usage, the term "aluminum" covers aluminum alloys, and the figures include all constituents of the alloys recovered from aluminum-base scrap.
[r] Revised.
[3] Aluminum content of new aluminum-base scrap was 59,097 tons in 1941 and 143,633 tons in 1942.
[4] Aluminum content of old aluminum-base scrap was 39,858 tons in 1941 and 41,221 tons in 1942.

[2] The term "secondary aluminum" is used broadly to cover aluminum and aluminum alloys, including the weight of alloy constituents, such as copper, silicon, magnesium, and others.

By far the largest proportion of secondary aluminum (180,979 tons) was recovered in aluminum alloys in the form of ingots, wrought products, and castings. The gross weight of secondary aluminum ingots produced by aluminum smelters was 144,694 short tons, of which 138,741 tons represented alloyed aluminum recovered from scrap, and the remainder represented additions of other raw materials. Secondary aluminum-ingot production represented a 72-percent gain over 1941. Increased steel production and denial of primary aluminum for deoxidation caused production of secondary aluminum steel-mill ingot and shot to increase 59 percent and provided an outlet for secondary aluminum of high iron content.

The extensive use of rolled products for airplanes together with the Government order that made it mandatory for fabricators to sell their segregated 17S, 24S, and 52S alloy scrap in solid form to the Aluminum Co. of America or Reynolds Metals Co. resulted in greater consumption of scrap at the aluminum rolling mills. These plants of primary producers recovered 53,080 tons of aluminum alloys by combining scrap and secondary "process" ingots with primary metals used for wrought products.

After aluminum scrap had been placed under strict control on January 7, 1942, only authorized remelters, smelters, and chemical works were allowed to consume it. Manufacturers and foundries produced only 848 tons of aluminum powder and 480 tons of aluminum alloy castings from scrap, mostly in the first week in January, and thereafter resold 680 tons of the purchased aluminum scrap they had on hand and reported only 205 short tons in inventory at the end of 1942.

In addition to these aluminum-base products, 686 tons of aluminum from aluminum scrap and 582 tons from aluminum bronze scrap were recovered in aluminum and manganese bronze products, and recovery of 176 tons of aluminum from aluminum scrap and 297 tons of aluminum from zinc-base alloy scrap was reported in zinc-base alloy products.

Consumption of 217,611 short tons (gross weight) of purchased aluminum scrap represented an increase of 72 percent over 1941. Approximately 73 percent of the scrap was used by 75 remelters, smelters, and refiners, 26 percent by 27 plants classed as aluminum rolling mills, and 1 percent by 281 foundries and miscellaneous manufacturers. The high rate of activity in fabrication of wrought aluminum for aircraft was reflected in the fact that 80 percent of the scrap consumed in 1942 was new scrap, compared with 64 percent in 1941 and only 43 percent in 1940. The consumption of old aluminum scrap continued on a slight downward trend in 1942, having dropped from 47,572 tons in 1940 to 45,329 tons in 1941 and to 43,248 tons in 1942.

Consumption of purchased aluminum scrap in the United States in 1942, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries				Total scrap used
			Aluminum rolling mills		Foundries and other manufacturers		
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
Pure clippings, wire, and foil	3,683	704	4,658	2	73	139	9,259
Castings and forgings	2,934	25,556	405	17	35	350	29,297
Alloy sheet	14,697	3,698	44,079		6	6	62,486
Scrap sheet and sheet utensil	1,284	11,148	6,462		10	36	18,940
Borings and turnings	77,022		7		894		77,923
Die castings	2	6	10		19	2	39
Miscellaneous aluminum and dross	17,863	1,584			220		19,667
	117,485	42,696	55,621	19	1,257	533	217,611

Dealers in nonferrous scrap metal shipped 100,796 short tons of aluminum scrap to consumers out of the 103,856 tons they collected from domestic and industrial sources during 1942. A general upward trend was noted in the monthly volume of dealers' transactions in aluminum scrap during the last 8 months of 1942 after revisions in Government regulations allowed scrap generators to sell segregated plant scrap to dealers in lots up to 5,000 pounds per month compared with the earlier limitation of 1,000 pounds. Dealers' stocks increased from 5,660 tons on hand January 1 to 8,720 tons December 31, 1942.

Consumers' stocks of purchased aluminum-base scrap in the United States at end of year, 1941–42, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1941	Dec. 31, 1942
Castings and forgings	2,004	1,690
Sheet, turnings, clippings, etc.	6,070	5,020
Miscellaneous aluminum and dross	1,521	1,915
	9,595	8,625

The aluminum industry continued under close Government control throughout 1942. The overwhelming demands of a nation at war for the available supply of aluminum required further restrictive and conservation orders to supplement or replace those already operating at the beginning of 1942. On January 26, 1942, aluminum was limited to 15 uses, most of them restricted to low-grade secondary aluminum containing more than 4 percent copper and either iron or zinc in excess of 1 percent. Aluminum was limited to 2 percent in zinc-base alloys and to a maximum of 15 percent in other alloys on August 18, 1942, but an amendment on November 20 removed all restrictions on the aluminum content of zinc-base alloys. Segregation of aluminum scrap by alloy content and form was made mandatory early in 1942. Every plant generating 1,000 pounds or more of aluminum scrap per month was ordered to segregate scrap at the machine at which it was generated.

Formal Government price ceilings established in 1941 were continued throughout 1942. The basing point of aluminum scrap prices was that of No. 1 virgin aluminum ingot, which remained at 15.00 cents a pound delivered. The average selling price of 98 percent pure secondary ingot was also 15 cents. The aluminum price schedule was broadened on August 20 to cover all secondary aluminum ingot and virtually all grades of aluminum scrap. Effective October 16, 1942, an amendment established a maximum price of 1.25 cents a pound for aluminum drosses, skimmings, grindings, etc., containing less than 15 percent by weight of metallic aluminum. Later in the year, toll agreements were exempted from scrap ceilings, and premiums were allowed on briquetted scrap and material properly prepared for briquetting.

Dealers' buying prices for cast aluminum scrap in New York averaged 8.62 cents a pound, compared with 10.76 cents in 1941. The monthly average price dropped from 9.37 cents in December 1941 to 8.73 cents in January 1942, then remained static until October 1942, when the price began to decline to the year-end level of 8.12 cents a pound.

Dealers' buying prices for new aluminum clippings in New York averaged 9.50 cents a pound, compared with 13.00 cents in 1941. The Government order in January requiring the segregation of fabricators' scrap spurred the price of new clippings from an average of 9.59 cents in January 1942 to 9.87 cents in March. Strong smelter demand for this type of graded scrap maintained the high price level through June, but the average price declined to 9.12 cents in September, where it remained for the rest of 1942.

Imports of aluminum scrap totaled 487 short tons, compared with 55 tons in 1941, and exports amounted to only 32 tons, compared with 57 tons in 1941.

SECONDARY MAGNESIUM

Expanded production of magnesium for war uses brought a proportionate increase in the generation of magnesium scrap, and recovery of secondary magnesium from purchased scrap totaled 6,238 short tons valued at $2,794,624, compared with 1,752 tons valued at $840,960 in 1941. The value was computed from the average selling price of all grades of primary magnesium, which was 22.4 cents a pound in 1942 and 24 cents in 1941. Most of the secondary magnesium was recovered in the form of magnesium alloy ingot for subsequent blending with primary magnesium or alloying with aluminum, but small quantities of magnesium scrap were consumed directly in production of aluminum, lead, and zinc alloys, for deoxidation of metals, and as a chemical catalyst in the Grignard reaction.

All but 1 percent of all the secondary magnesium was reclaimed from new scrap generated in manufacturing operations, as not enough magnesium had been used in former years to build up a backlog of obsolete magnesium objects for salvage. Purchased magnesium scrap was consumed in 39 plants representing 27 companies, but 97 percent of the secondary magnesium was recovered in 10 plants of 7 companies. Consumption of magnesium scrap totaled 7,317 short tons, compared with 2,279 tons treated in 1941.

Secondary magnesium recovered in the United States, 1941–42, in short tons

Type of product or use	1941	1942
Magnesium alloy ingot [1] (gross weight)	929	6,045
Magnesium alloy castings (gross weight)	738	93
In aluminum alloys	60	46
In lead alloys	(2)	2
In zinc alloys	(2)	1
Consumed in chemical and metallurgical processes	25	51
	1,752	6,238
From new scrap	1,737	6,151
From old scrap	15	87

[1] Includes secondary magnesium incorporated in primary magnesium ingot.
[2] Not available.

Use of magnesium, including scrap, was closely controlled by means of priorities issued to approved users according to Federal regulations in effect February 25, 1942. Magnesium scrap could be sold only to primary producers or to seven approved secondary smelters, unless otherwise authorized, but 1,877 tons of magnesium scrap found its way into scrap dealers' yards in 1942. Some of this scrap was purchased by dealers in the belief that it was aluminum, indicating that the trade had not yet become familiar with magnesium as a metal.

Although segregation of magnesium scrap from other metals was required during 1942, it was not until December 31, 1942, that the regulations were amended to require complete segregation of magnesium scrap according to types of alloy at the scrap source.

Stocks and consumption of magnesium scrap in the United States in 1942, gross weight, in short tons

	On hand—		Consumption during 1942
	Dec. 31, 1941	Dec. 31, 1942	
Cast scrap	15	9	223
Solid wrought scrap	22	8	126
Borings, grindings, drosses, etc.	202	215	6,968
	239	232	7,317

Primary magnesium ingot was quoted at 27 cents a pound at the beginning of 1942, but at the request of the Office of Price Administration producers cut the price early in February to 22.5 cents a pound, and this level was maintained for the remainder of the year. Prices of magnesium scrap and remelt ingot were covered by the General Maximum Price Regulation issued April 28, 1942, which established the ceiling price for each seller at the highest price charged during March 1942. Quotations of these prices were not available for record. Definite prices for magnesium scrap and secondary ingot were not fixed until January 20, 1943. On this date maximum prices were set at 9 cents a pound for segregated borings and turnings, 8 cents for contaminated turnings, and 21.5 cents a pound for Class A remelt magnesium ingot (A. S. T. M. specification B93–41T). Segregated plant scrap solids were exempt from the maximum price regulations.

SECONDARY COPPER AND BRASS

Copper recovered as unalloyed metal and in brass or other alloys reclaimed from purchased [3] scrap totaled 927,755 short tons valued at $218,950,180, compared with 726,396 short tons valued at $171,429,456

[3] The term "purchased scrap" includes scrap worked on toll for another and scrap transferred between plants owned by a single company, but does not include "home" scrap reused in the plant in which it originated.

in 1941. The value was computed at 11.8 cents a pound in both years. Copper recovered as a constituent of scrap aluminum, nickel, and tin alloys has been included in the secondary copper statistics since 1939, but separate figures showing the recovery from each of these sources are reported in this chapter for the first time.

Recovery of unalloyed copper from scrap continued to decrease, with 114,647 short tons recovered as metal in 1942, compared with 135,869 tons in 1941 and 170,839 tons in 1940. Secondary copper refined at primary plants dropped another 15 percent in 1942 to 85,143 short tons, the smallest production in 10 years, despite Federal encouragement of copper refining from low-grade brass.

The secondary copper content of brass and bronze reclaimed from purchased scrap rose to 779,062 short tons in 1942, an increase of 36 percent over the 574,267 tons recovered in copper-base alloys during 1941. The secondary copper content of aluminum-base alloy products was more than doubled in 1942, with 13,894 tons of copper reclaimed from scrap in this manner, compared with 5,749 tons in 1941. Unalloyed copper scrap was allocated to both primary and secondary aluminum producers in 1942 in lieu of refined copper for alloying, and the copper contained in aluminum-alloy scrap was also used to advantage in bringing total copper content of aluminum alloy ingots up to specifications.

Almost all of the increase in recovery of secondary copper in 1942 was attributed to new scrap, which rose 60 percent to 500,633 tons of recoverable copper, compared with 313,697 tons of copper in new scrap reprocessed during 1941, whereas recovery of copper from old scrap gained only 3 percent in 1942.

A total of 220,217 tons of copper was reclaimed from unalloyed copper scrap. Relatively little of this emerged in unalloyed metal products, for clean copper scrap was consumed largely in the production of brass and bronze, chemicals, and aluminum alloys.

Secondary copper recovered in the United States, 1941–42, in short tons

Secondary copper recovered			Recoverable copper content of scrap		
Form of recovery	1941	1942	Kind of scrap processed	1941	1942
As unalloyed copper:			New scrap:		
At primary plants	99,675	85,143	Copper-base	310,147	492,392
At other plants	36,194	29,504	Aluminum-base	2,805	7,389
			Nickel-base	744	851
	135,869	114,647	Tin-base	1	1
In brass and bronze	574,267	779,062		313,697	500,633
In alloy iron and steel	(1)	1,164			
In aluminum alloys	5,749	13,894			
In other alloys	707	1,533	Old scrap:		
In chemical compounds	9,804	17,455	Copper-base	409,947	424,441
			Aluminum-base	2,201	1,973
			Nickel-base	433	633
	590,527	813,108	Tin-base	118	75
	726,396	927,755		412,699	427,122
				726,396	927,755

[1] Not available.

Analysis and production of secondary copper and copper-alloy products in the United States, 1941–42

Item produced from scrap	Approximate analysis (percent)						Gross weight produced (short tons)	
	Cu	Sn	Pb	Zn	Ni	Al	1941	1942
Refined copper (electrolytic grade)	100						109,368	102,975
Casting copper	99						18,700	7,938
Copper sheet, rod, tubing, etc	99						3,855	724
Copper powder	98						2,493	1,165
Copper castings	98						1,453	1,845
Total unalloyed copper products							135,869	114,647
Brass and bronze ingots:								
Tin bronze	88	10		2			26,343	63,333
Leaded-tin bronze	88	6	1.5	4.5			29,404	59,385
Leaded red brass	85	5	5	5			91,389	98,405
Leaded semired brass	81	3	7	9			30,829	19,323
High-leaded-tin bronze	80	10	10				25,005	26,032
Do	84	6	8	2			8,658	10,329
Do	75	5	20				5,850	5,717
Leaded yellow brass	66	1	3	30			21,518	30,401
High-strength yellow brass	58			39		1	31,676	24,055
Manganese bronze	62			27		5	8,202	44,572
Aluminum bronze	89					10	4,261	10,038
Nickel silver	58	2	7	18	14		941	533
Do	65	4	3	5	22		2,205	579
Gilding metal	95			5			5,231	347
Low brass	80			20			1,129	1,310
Silicon bronze	92			4				1,979
Conductor bronze	94	2	2	2				1,529
Hardeners and special alloys	81						6,380	4,793
Total copper-alloy ingots							299,021	402,660
Brass and bronze sheet, rod, tubing, etc							[1] 308,407	[1] 531,159
Brass and bronze castings							[2] 152,637	[2] 111,631
Copper in chemical products (content)							9,804	17,455

[1] Gross weight of secondary brass and bronze in commercial shapes; included 221,492 tons of copper, 1,200 tons of nickel, 4,166 tons of lead, 236 tons of tin, and 81,313 tons of zinc in 1941, and 370,837 tons of copper, 379 tons of nickel, 5,489 tons of lead, 273 tons of tin, 154,107 tons of zinc, 72 tons of aluminum, and 2 tons of antimony in 1942.

[2] Gross weight of secondary brass and bronze castings; included 123,955 tons of copper, 1,424 tons of nickel, 9,687 tons of lead, 6,986 tons of tin, and 11,185 tons of zinc in 1941; and 95,224 tons of copper, 602 tons of nickel, 7,235 tons of lead, 5,389 tons of tin, and 3,181 tons of zinc in 1942.

Refined copper of electrolytic grade totaling 102,975 tons was produced from purchased scrap at 12 refineries, of which 10 were primary plants. "Casting copper" for foundry use was produced for sale at only 10 plants in 1942, compared with production at 21 plants in 1941.

Secondary brass and bronze ingot production in 1942 totaled 402,660 short tons, an increase of 35 percent over ingot production in 1941, although the number of producing plants dropped from 78 in 1941 to 73 in 1942. This branch of industry comprised 67 concerns in 1942. Counting secondary smelters of aluminum and lead, as well as copper refiners and brass-ingot makers, 112 smelting plants used copper-base scrap.

The types of brass and bronze casting alloys produced to fill wartime requirements in 1942 showed considerable change from 1941. Production of both lead-free and low-leaded tin bronzes more than doubled, and the manufacture of manganese "bronze" was more than 5 times that of 1941, whereas nickel silver virtually disappeared and high-strength yellow brass dropped off.

Producers' stocks of secondary-brass ingots dropped from 14,071 short tons (revised) on hand December 31, 1941, to 13,838 tons on December 31, 1942, and shipments totaled 402,894 short tons.

Consumption of purchased copper and copper-alloy scrap increased 30 percent to 1,308,782 short tons (gross weight) in 1942, compared with 1,004,170 tons used in 1941. Purchased scrap processed by brass mills increased 74 percent, and the quantity consumed by ingot makers and refiners rose 20 percent, whereas consumption by all other users, including foundries and chemical works, dropped 20 percent in 1942 compared with 1941.

Consumption of purchased copper scrap in the United States in 1942, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries				Total scrap used
			Brass mills		Foundries and other manufacturers		
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
No. 1 wire and heavy	8,077	63,921	5,860	6,244	3,854	22,459	110,415
No. 2 wire, mixed heavy, and light	2,253	87,777	12,771	1,648	1,791	10,077	116,317
Composition or red brass	54,826	81,076			18,677	27,819	182,398
Railroad-car boxes		1,598				30,725	32,323
Yellow brass	21,914	114,808	462,072	12,354	3,476	4,709	619,333
Auto radiators (unsweated)		34,563				423	34,986
Electrotype shells		2,637				287	2,924
Bronze	7,109	5,343	6,285	205	744	1,079	20,765
Nickel silver	107	1,032	1,978			37	3,154
Low brass	2,209	1,087	37,354	424	356	4,753	46,183
Aluminum bronze	2,459	4,079			2,056	1,169	9,763
High lead brass		464			14	1,997	2,475
Low-grade scrap and residues	87,133	40,593			20		127,746
	186,087	438,978	526,320	20,875	30,988	105,534	1,308,782

Many foundries that had formerly used scrap turned to specification ingot because war orders had to meet the rigid standards of the Army and Navy, and many of the alloys required were different from those used in commercial practice. Scrap requirements of the ingot makers differed from those of former years in that leaded brass scrap could not be used in production of many alloys such as manganese bronze and high-tin bronzes, which were so much in demand, and there was not enough low-lead brass scrap to fill all needs. Unusually large quantities of refined tin and zinc were consumed in production of brass and bronze casting alloy ingots during 1942, and refined copper consumed for this purpose totaled 13,421 tons, compared with 8,226 tons in 1941, although the total unalloyed copper scrap consumed by brass ingot makers and refiners in 1942 dropped only 1 percent from the quantity used in 1941. Fired cartridge cases constituted approximately 6 percent of the total yellow-brass scrap used by ingot makers.

Consumers' stocks of purchased copper-base scrap in the United States at end of year, 1941–42, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1941 [1]	Dec. 31, 1942
Unalloyed copper	15,981	10,019
Copper-base alloy	57,220	87,280
low-grade scrap and residues	34,402	32,647
	107,603	129,946

[1] Revised figures.

Consumers' stocks of purchased copper-base scrap rose 21 percent from 107,603 short tons on hand December 31, 1941, to 129,946 tons on hand December 31, 1942. Although stocks rose approximately one-third at both brass mills and smelters, the total copper-base scrap inventory reported by foundries and other manufacturers decreased by one-third.

Maximum prices for brass and bronze alloy ingots were established by written agreement of individual ingot makers with the Government effective February 1, 1942, but official ceiling prices varied in only a few minor details from those previously adhered to on a voluntary basis by ingot producers. Maximum prices were fixed for 85–5–5–5 at 13.50 cents a pound, 88–10–2 at 19.75 cents, and yellow brass at 11.00 cents a pound delivered in carload lots.

On May 18, 1942, the Federated Metals Division of the American Smelting & Refining Co. announced voluntary reductions ranging from one-half to three-quarters cent a pound on many grades of brass ingot, and all other principal manufacturers immediately followed suit.

Formal price ceilings for brass ingots were fixed by Government decree effective August 19, 1942, bringing the average weighted selling prices approximately 1.20 cents below March 1942 levels.

The maximum selling prices for unalloyed copper scrap in effect since October 1941 were continued for the first 4 months of 1942, with No. 1 copper scrap set at 10.00 cents a pound f. o. b. point of shipment. On February 27, 1942, copper alloy scrap was placed under formal ceilings, with prices regulated according to 24 definite grades. The top price for No. 1 red compostion was set at 9.50 cents a pound, and that for yellow-brass cast scrap was 7.25 cents.

Refining of copper from yellow-brass scrap was encouraged by amendments to the brass-scrap price schedule on April 17, 1942. The maximum prices of refinery brass were fixed at 9.25 cents a pound of copper content for material assaying 60.01 percent or more, and 9.00 cents a pound of copper content for material assaying 50.01 to 60.00 percent copper, and the need for sorting the yellow grades sold as refinery brass was eliminated.

Copper-base scrap prices were again revised downward on May 11, 1942, and a license was required for dealers selling to consumers. On August 17, 1942, maximum prices for 13 classifications of copper-alloy scrap were reduced to their proper relationship to the basic 12-cent price of electrolytic copper.

The August 17 scrap ceilings were unchanged during the remainder of 1942, but on December 31, 1942, price ceilings were removed from copper-base scrap imported for the Metals Reserve Co.

Dealers' monthly average buying prices [4] for No. 1 copper scrap at New York held at 9.37 cents a pound throughout 1942, but prices for No. 1 red composition scrap declined continuously from 9.64 cents in January to 8.12 cents averaged in August and September, then rose to 8.87 cents a pound in November and December.

According to new orders issued December 31, 1941, copper-base scrap could be purchased by consumers only under authority of the War Production Board, and controls were exercised to insure the most efficient use of materials available. Unalloyed copper scrap was allocated to replace refined copper wherever possible, and factory

[4] Quoted from the American Metal Market.

segregation of brass mill scrap was made mandatory so that the scrap could be remelted at brass mills for re-use in wrought products. Nevertheless, a substantial quantity of wrought-brass scrap became mixed or contaminated and was eventually consumed by brass ingot makers for casting brasses. Although the refining of copper from yellow-brass scrap was subsidized to some extent by the Government, beginning in April 1942, total production of secondary refined copper was less than in 1941.

Demand was strong for unalloyed copper scrap and high-tin bronze scrap throughout 1942, but the supply of leaded bronze and most grades of yellow brass exceeded demand until September, when consumption of refinery brass for the recovery of refined copper on Metals Reserve Co. accounts appeared to have caught up with the rate of supply in all except the very low grade materials.

A monthly canvass of nonferrous-scrap transactions of scrap-metal dealers was conducted by the Bureau of Mines throughout 1942. Approximately 4,500 dealers, exclusive of peddlers and auto wreckers, were engaged in the trade, and 488,436 short tons (gross weight) of copper and copper-alloy scrap were shipped to consumers during the year. Of the 554,283 tons of scrap received by brass mills from outside sources, only 15 percent, or 85,311 tons, was handled by scrap dealers; but 49 percent of the 812,773 tons of copper-base scrap purchased by all other consumers, including refiners, ingot makers, and foundries, was supplied by the scrap-metal dealers.

Stocks of copper-base scrap in dealers' yards fell from 50,492 short tons on January 1, 1942, to 39,499 tons on February 28, then increased steadily for 10 months to 57,587 tons on hand December 31, 1942.

Brass and copper scrap imported into and exported from the United States, 1941–42, in short tons

	1941	1942
Brass scrap imported	3,596	6,669
Scrap copper imported	2,113	912
Brass scrap exported	722	168
Scrap copper exported	3,259	2,233

SECONDARY NICKEL

Secondary nickel recovered from nonferrous scrap totaled 4,142 short tons valued at $2,899,400, compared with 5,315 tons valued at $3,720,500 in 1941. The value in both years was computed at 35.0 cents a pound, the spot-delivery price of electrolytic nickel, including duty.

Production of secondary Monel-metal pig and shot increased from 289 tons in 1941 to 2,564 tons in 1942, but secondary copper-nickel-shot production dropped from 1,873 tons averaging 48 percent nickel in 1941 to 1,154 tons averaging 40 percent nickel in 1942.

Restrictions on the use of nickel in nonferrous alloys showed their effect in the declines registered in secondary products as well as in decreased consumption of all types of nonferrous nickel-bearing scrap, with the single exception of Monel metal. Total consumption of scrap dropped to 7,908 short tons, of which 60 percent was new scrap and 40 percent was old scrap. Scrap-metal dealers complained

during 1942 that there was little outlet for the nickel-silver scrap they had collected, but dealers' shipments of pure nickel scrap and Monel to consumers totaled 3,297 tons.

Secondary nickel (nonferrous) recovered in the United States, 1941–42, in short tons

Secondary nickel recovered			Recoverable nickel content of scrap		
Form of recovery	1941	1942	Kind of scrap processed	1941	1942
As metal	248	90	New scrap:		
In nickel-base alloys	1,267	2,230	Nickel-base	1,904	1,698
In copper-base alloys	3,396	1,470	Copper-base	1,277	732
In cast iron [1]	(2)	114		3,181	2,430
In chemical compounds	404	238			
	5,315	4,142	Old scrap:		
			Nickel-base	1,670	1,373
			Copper-base	464	339
				2,134	1,712
				5,315	4,142

[1] Includes only nonferrous nickel scrap added to cast iron.
[2] Not available.

Consumption of purchased nickel scrap in the United States in 1942, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Pure nickel	137	48	64	83	332
Monel metal	2,118	1,243	27	296	3,684
Nickel silver	107	1,032	1,978	37	3,154
Miscellaneous nickel alloys	174	208	48	49	479
Nickel residues			64	195	259
	2,536	2,531	2,181	660	7,908

Priority control over nickel was tightened on April 1, 1942, by an order prohibiting the use of nickel in many items. In the same month, conservation of nickel in waste materials was attempted by means of regulations that ordered segregation of nickel-bearing scrap, both ferrous and nonferrous, as to grades and degrees of nickel content. On October 3, 1942, the use of nickel was restricted to implements of war except under special authorization.

The Government ceiling prices established in 1941 for nickel scrap continued in force throughout 1942. In April, imported nickel-bearing scrap and secondary nickel materials were placed under the maximum selling price regulations, but the Metals Reserve Co. was permitted to purchase manufacturers' unused stocks of metallic nickel without regard to established ceilings. In July, a maximum price of 46 cents a pound for new and 43 cents a pound for partly used nickel anodes was set for Metals Reserve Co. purchases from platers.

Dealers' buying prices for nickel clippings and sheet scrap in New York were quoted at 25 cents a pound until the first week in July, then dropped to 21 cents a pound for the remainder of 1942. Monel clippings were quoted in the New York market at 18 cents for the first 6 months and 16 cents a pound thereafter.

Consumers' stocks of purchased nonferrous nickel scrap[1] in the United States at end of year, 1941–42, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1941	Dec. 31, 1942
Unalloyed nickel	60	65
Nonferrous nickel alloys	3,965	2,282
Nickel residues	485	500
	4,510	2,847

[1] Includes nickel-silver scrap.

No imports of nickel scrap were reported, but exports totaled 4,498 short tons in 1942. Export figures for 1941 were available only for the period July 1 to December 31, and totaled 944 short tons.

SECONDARY LEAD

Secondary lead recovered in all forms in 1942 totaled 323,001 short tons valued at $40,698,126, a drop of 19 percent from recovery in 1941, which totaled 397,416 short tons valued at $45,305,424. Values were computed at 6.3 cents a pound in 1942 and at 5.7 cents a pound in 1941. Production of soft lead, including refined lead, remelt lead, and lead foil totaled 68,870 short tons in 1942, a decrease of 9 percent from the 75,292 short tons produced in 1941. Secondary antimonial lead production decreased 19 percent to 182,839 tons with a lead content of 170,559 tons.

Secondary lead recovered in the United States, 1941–42, in short tons

Secondary lead recovered			Recoverable lead content of scrap		
Form of recovery	1941	1942	Kind of scrap processed	1941	1942
As metal:			New scrap:		
At primary plants	13,454	12,856	Lead-base	9,469	8,569
At other plants	61,810	55,746	Copper-base	7,662	5,844
			Tin-base	5	
	75,264	68,602		17,136	14,413
In antimonial lead[1]	206,522	170,559			
In other lead alloys	88,200	88,834	Old scrap, lead-base:		
In copper-base alloys	26,406	24,518	Battery-lead plates	198,036	159,868
In tin-base alloys	1,024	488	All other lead-base	162,445	131,456
			Copper-base	19,769	16,900
	322,152	254,399	Tin-base	30	364
	397,416	323,001		380,280	308,583
				397,416	323,001

[1] Includes 13,862 tons of lead recovered in antimonial lead from secondary sources at primary plants in 1941 and 11,561 tons in 1942.

Production of secondary lead, tin, and lead- and tin-alloy products in the United States in 1942, gross weight, in short tons

	Gross weight of product	Secondary metal content			
		Lead	Tin	Antimony	Copper
Refined pig lead	58,935	58,922			
Remelt lead	9,894	9,680		9	
Lead foil	41	41			
	68,870	68,643		9	
Refined pig tin	155		152		
Remelt tin	386		379		
Tin foil	7		7		
	548		538		
Lead and tin alloys:					
Tinny lead (2 to 10 percent tin)	1,749	1,631	112		
Antimonial lead (to 2 percent antimony)	26,043	25,649	21	373	
Antimonial lead (2 to 4 percent antimony)	27,001	26,122	30	849	
Antimonial lead (4 to 8 percent antimony)	68,075	63,636	201	4,238	
Antimonial lead (over 8 percent antimony)	61,720	55,152	85	6,483	
Common babbitt	15,445	11,695	1,977	1,696	77
Genuine babbitt	2,265	453	1,546	197	69
Other tin babbitts	90	35	51	4	
Solder (to 15 percent tin)	4,117	3,569	524	23	1
Solder (15 to 30 percent tin)	13,188	9,549	3,598	39	2
Solder (over 30 percent tin)	6,967	4,497	2,457	12	1
Linotype metal	8,087	6,730	468	888	1
Other type metals	20,191	17,011	1,141	2,031	8
Miscellaneous lead-tin alloys	6,270	2,871	2,082	1,317	
	261,208	228,600	14,293	18,150	159
Composition foil	1,364	1,281	79	4	
Tin content of chemical products	303		303		

The decrease in lead and lead alloys recovered from purchased scrap in 1942 resulted not only from a diminished supply of some types of scrap, but also from Government restrictions on civilian consumption that were designed to conserve lead, tin, and antimony for possible war needs.

Orders that enabled the Government to direct the distribution of lead and tin scrap by allocation were issued on January 8, 1942, and as of January 10, 1942, a conservation order prohibited the use of lead in a definite list of civilian manufactures and curtailed the amount to be used in some of the more essential items. Priority control of secondary lead was incorporated in the regulations on May 18, 1942.

Secondary white-metal smelters were quite active during the first 6 months of 1942, apparently in the belief that lead would be used more widely in war production and as a substitute for scarcer metals. Increased consumer demand failed to materialize, with the result that working funds were tied up in large inventories of finished and semi-processed white-metal alloys, and during July and August many of the secondary lead plants were virtually shut down. When it was found that the lead supply was not as critical as had been anticipated, restrictions were relaxed somewhat beginning November 11, 1942, and were further eased on May 26, 1943.

Of the 276 plants engaged in remelting, smelting, and refining scrap lead and lead alloys during 1942, only 251 produced white-metal products, and the other 25 consumed lead and tin scrap in brass and bronze ingot alloys. A total of 361 manufacturers and foundries con-

sumed purchased lead or lead-alloy scrap in their operations but accounted for only a small portion of the secondary metal recovered.

Lead-base scrap consumed in 1942 totaled 396,531 short tons (gross weight), a decrease of 16 percent from the 474,278 short tons processed in 1941.

Consumption of purchased lead scrap in the United States in 1942, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Soft lead	80	39,125	219	1,087	40,511
Hard lead		18,323	6	116	18,445
Cable lead		15,074		121	15,195
Battery-lead plates		221,573		9	221,582
Mixed common babbitt		5,923		5,088	11,011
Solder and tinny lead		7,313	4,026	215	11,554
Type metals		20,646		43	20,689
Dross	7,479	42,495	81		50,055
Lead oxide	118	1,064		799	1,981
Residues		5,508			5,508
	7,677	377,044	4,332	7,478	396,531

Manufacturers and foundries treated 3 percent (11,810 short tons) of the total lead-base scrap, whereas remelters, smelters, and refiners handled 97 percent (384,721 short tons). The decrease in consumption of battery-lead plates and hard-lead scrap accounted for more than two-thirds of the total decline in consumption of all lead-base scrap in 1942.

Stocks of purchased lead and lead-alloy scrap held by remelters, smelters, and refiners increased 31 percent, and inventories of manufacturers and foundries gained 1 percent from the beginning to the end of 1942, bringing the over-all increase in total stocks at all plants to 30 percent, from 41,150 tons to 53,460 tons. A similar picture was noted in stocks of scrap lead and tin held by scrap-metal dealers, which gained 28 percent in 1942.

Consumers' stocks of purchased lead-base scrap in the United States at end of year, 1941–42, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1941	Dec. 31, 1942
Unalloyed lead	2,733	5,231
Lead-base alloy	25,642	35,357
Drosses and residues	12,775	12,872
	41,150	53,460

Flow of scrap lead and lead alloys in the scrap metal dealer trade was steady during the first 9 months of 1942 but rose sharply to a peak in October, only to drop back to normal levels in November and December.

On January 15, 1942, price ceilings were imposed on primary lead, secondary lead, and lead-base scrap. Maximum selling prices were set in relation to base prices fixed for each of 146 main shipping points

in 34 States. The base price was that of primary pig lead fixed at 6.50 cents a pound, f. o. b. New York, with the ceiling for heavy lead scrap in New York at 5.95 cents a pound. In general, the ceiling prices for scrap lead closely approximated the market prices prevailing at that time.

Dealers' buying prices for heavy lead scrap in New York averaged 5.51 cents a pound in January but rose to 5.62 cents in February and held this level through June. In July the price dropped to 5.39 cents owing to decline in demand. The price fell again in September to a low of 5.37 cents, which continued for the remainder of 1942.

Dealers' quotations for battery plates rose from 3.20 cents to 3.30 cents during January and held steady until May, when the price declined to 3.25 cents a pound. In July the price dropped to a low of 2.87, which was maintained to the end of the year.

Smelting charges for battery lead plates appeared to be nominal in the first half of 1942 but on July 16 were quoted at $24 a ton. In August the figure rose to $25, and this charge was carried through September and October.

Imports of lead scrap totaled 1,305 short tons in 1942, compared with 1,331 short tons in 1941; exports in both years were negligible.

SECONDARY TIN

Secondary tin recovered from scrap in 1942 totaled 37,918 short tons valued at $39,434,720, compared with 42,033 short tons valued at $43,722,726 in 1941. The value was calculated at 52.0 cents a pound in 1942 and at 52.01 cents in 1941.

Tin recovered as unalloyed metal dropped 2 percent, to 5,799 short tons, in 1942, compared with 5,900 tons recovered as metal in 1941; and the secondary-tin content of solder and tin babbitt produced in 1942 was almost halved in comparison with 1941 totals. Secondary tin in chemical compounds produced during 1942 was less than one-third the total reported in 1941, but tin recovered from scrap in lead-base alloy products and in bronze increased 38 and 16 percent, respectively, compared with 1941 figures.

Secondary tin recovered in the United States, 1941–42, in short tons

Secondary tin recovered			Recoverable tin content of scrap		
Form of recovery	1941	1942	Kind of scrap processed	1941	1942
As metal:			New scrap:		
At detinning plants	5,089	5,261	Tin plate	6,094	4,896
At other plants	811	538	Tin-base	3,277	2,980
			Lead-base	36	1,796
	5,900	5,799	Copper-base	3,020	4,385
In solder	12,361	6,579		12,427	14,057
In tin babbitt	3,145	1,597			
In chemical compounds	1,138	303	Old scrap:		
In lead-base alloys	4,499	6,196	Tin cans	121	597
In brass and bronze	14,990	17,444	Tin-base	6,463	3,490
			Lead-base	9,473	7,871
	36,133	32,119	Copper-base	13,549	11,903
	42,033	37,918		29,606	23,861
				42,033	37,918

Consumption of purchased tin scrap in the United States in 1942, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Block-tin pipe, scrap, and foil	33	929	25	103	1,090
Tin scruff and dross	4,238		9		4,247
No. 1 pewter		318		1	319
High-tin babbitt	44	2,507		15	2,566
Residues	771	23		161	955
Miscellaneous tin alloys		540			540
	5,086	4,317	34	280	9,717

Supplies of block-tin scrap and high-tin alloy scrap could not keep up with demand in 1942, particularly the need for additional tin in bronze ingots made to Army and Navy specifications. The use of scrap and secondary tin as a substitute for virgin tin was encouraged and was made mandatory in revised Government orders issued January 9, 1943, which stated that no product should be manufactured of pig tin if secondary tin could be substituted.

Secondary lead-tin and lead-tin-antimony alloys such as type metals and lead-base bearing metals were in poor demand throughout the year owing to restrictions on their use, and stocks of these alloys were built up by both scrap dealers and secondary smelters to such an extent that toward the end of 1942 a program was devised for separation of the tin content as refined tin, with the lead and antimony to be recovered as antimonial lead. Purchases of idle stocks of type metals and bearing metals for recovery of tin began in April 1943, with the National Lead Co. acting as agent for the Metals Reserve Co.

Consumers' stocks of purchased tin-base scrap in the United States at end of year, 1941–42, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1941 [1]	Dec. 31, 1942
Unalloyed tin	77	124
Tin-base alloys	431	604
Drosses and residues	1,160	1,199
	1,668	1,927

[1] Revised figures.

Manufacturers' stocks of jewelers' metal, after having been frozen on February 14, 1942, were collected for the account of Metals Reserve Co. and melted into bar tin and tin alloy for allocation as a substitute for primary pig tin. The metal thus recovered was not included in statistics covering scrap or secondary tin, inasmuch as this procedure represented merely a redistribution of metal already measured as part of the total supply.

Beginning April 7, 1942, consumers were required to turn in a used collapsible tube for each new tube of toilet preparations purchased, and the collections were shipped to the Tin Salvage Institute, Newark, N. J. Acting as agent of the Metals Reserve Co., this plant produced its first "tin alloy" pigs in July and by the end of 1942 had reclaimed

324 short tons of secondary pig metals containing 231 short tons of tin.

The dealers' buying price for block-tin pipe at New York held steady at 45.50 cents a pound throughout all of 1942, compared with an average of 46.35 cents in 1941. The ceiling prices of 52.00 cents a pound for Grade A pig tin and 51.625 cents for Grade B pig tin that had been fixed in 1941 were continued, and both grades sold at ceiling prices throughout 1942. Although there were no formal maximum prices for tin scrap, selling prices were held in line by virtue of the ceiling on pig tin.

According to orders issued January 8, 1942, the Government was enabled to direct the source, amount, or destination of deliveries of scrap tin and tin-bearing alloys, and scrap dealers' transactions were made dependent on the ratio between scrap shipments and stocks on the basis of a 60-day turnover.

Detinning plants.—The drop in recovery of tin from new tin-plate clippings at detinning plants in 1942 reflected a 16-percent decrease in the quantity of new clippings available; and although the processing of used tin cans brought the total weight of material treated by detinners almost as high as the 1941 figure, total recovery of tin by detinners dropped 9 percent, from 6,156 short tons in 1941 to 5,492 short tons in 1942.

On October 20, 1942, over 400 municipalities in 15 Northeastern States were ordered to collect prepared cans offered in trash collections. Housewives were urged to wash, cut open, and flatten the cans and to keep them in separate containers for collection. The campaign met with indifferent success in many areas owing to the difficulties of collection, lack of transportation facilities, and careless preparation of some of the cans.

Secondary tin recovered at detinning plants in the United States, 1941–42

	1941	1942
Scrap treated:		
Clean tin plate, long tons	341,075	287,660
Old tin-coated containers, do	5,963	51,721
	347,038	339,381
Tin recovered as metal:		
New tin-plate clippings, short tons	5,020	4,664
Old tin-coated containers, do	69	597
Tin content of tin compounds produced, do	1,067	231
	6,156	5,492
Weight of tin compounds produced, do	1,927	484
Average quantity of tin recovered per long ton of clean tin-plate scrap used, pounds	35.69	34.03
Average quantity of tin recovered per long ton of old tin-coated containers used, pounds	(1)	23.06
Average delivered cost of clean tin-plate scrap, per long ton	$18.51	$18.97
Average delivered cost of old tin-coated containers, do	(1)	$12.37

[1] Data not available.

In addition to the 7 detinning plants listed in the 1941 edition of this chapter, one other, the Fred L. Hazelquist Manufacturing Co., in Camden, N. J., engaged in detinning activities during the first half of 1942 and recovered tin oxide from old tin cans. Six additional detinning plants, to be located in New York, Buffalo, Birmingham, Chicago, Dallas, and Los Angeles, were planned for Federal construction, but building was halted, after little more than ground-clearing

operations had taken place, when it was found that collections of old cans in metropolitan areas could scarcely supply existing facilities. One new shredding plant at Carteret, N. J., was built to prepare "green" cans from the New York area for detinning and was not completed until early in 1943, and three others, at Houston, Kansas City, and Dallas, were constructed to shred cans for copper-precipitation plants.

Imports of tin-plate scrap totaled 24,082 long tons, compared with 22,600 long tons in 1941. Exports of tin-plate scrap, circles, waste-waste, and clippings were only 4,639 long tons in 1942; 14,204 long tons in 1941.

SECONDARY ANTIMONY

Secondary antimony recovered in 1942 totaled 18,200 short tons valued at $5,663,840, compared with 21,629 short tons valued at $6,056,120 in 1941. The value was computed at 15.56 cents a pound, the average selling price for ordinary brands of American-grade antimony in 1942, and at 14.00 cents in 1941.

The 16-percent decline in secondary-antimony recovery in 1942 was attributed to the decreased demand for many of the secondary antimony-bearing alloys usually produced and to reduction in the antimony content of many products (especially battery grids) in accordance with Government orders.

Of the total secondary antimony recovered in 1942, all but 3 tons was recovered from old scrap. Remelters, smelters, and refiners accounted for 96 percent of the total recovery, and manufacturers and foundries salvaged the other 4 percent.

Secondary antimony recovered in the United States, 1941–42, in short tons

Secondary antimony recovered			Recoverable antimony content of scrap		
Form of recovery	1941	1942	Kind of scrap processed	1941	1942
In antimonial lead	15,409	11,943	New scrap:		
In other lead alloys	5,842	6,019	Lead-base	54	(1)
In tin-base alloys	378	201	Tin-base	3	3
In copper-base alloys		37		57	3
	21,629	18,200	Old scrap:		
			Lead-base	21,283	18,017
			Tin-base	289	180
				21,572	18,197
				21,629	18,200

[1] Less than 1 ton.

Production of lead-base and tin-base alloy products containing secondary antimony may be found in a table in the section of this chapter relating to secondary lead. Secondary antimony incorporated in lead and tin products totaled 18,154 tons, of which 66 percent was in antimonial lead.

Battery lead plates, the principal source of secondary antimony, provided 56 percent (10,237 tons) of the antimony reclaimed from scrap in 1942, all of which was apparently recovered in antimonial lead products. Other types of lead-alloy scrap, such as lead babbitts, hard lead, cable lead, type metals, and drosses, supplied 43 percent

(7,780 tons) and tin-base scrap 1 percent (183 tons) of the total secondary antimony.

Effective January 15, 1942, the maximum price permitted to be charged for the antimony content of antimonial lead was 14.00 cents a pound, but a revision in the price schedule effective April 1 increased the ceiling price to 15.50 cents a pound, and this price remained unchanged for the remainder of 1942.

Government regulations put antimony under full priority control on May 1, 1942. The order prohibited use of antimony in paints, toys, or ornamental objects and limited the quantity of new antimony in automobile batteries to 7 percent of the total used for batteries in any month, with the balance to be obtained from antimony-bearing scrap or secondary alloys. When the supply of antimony became relatively more plentiful toward the middle of 1942, the regulations were liberalized, on July 11, to permit substitution of antimony for tin in bearing metals and other alloys. Effective August 8, 1942, the maximum antimony content of battery grids was raised from 7.5 to 12 percent by weight if only secondary antimonial lead was used in their production.

SECONDARY ZINC

Secondary zinc recovered from purchased scrap and residues totaled 330,526 short tons with a value of $57,511,524 calculated at 8.7 cents a pound, the average selling price for the year of all grades of refined zinc. This represents an increase of 16 percent over the 1941 recovery of 283,967 tons, worth $42,595,050 at an evaluation of 7.5 cents a pound. The figures for recovery include zinc recovered as unalloyed zinc, the zinc content of chemicals, and secondary zinc in aluminum alloys, in brass and bronze, and in zinc-base alloy products.

The over-all gain in secondary zinc was caused by a tremendous expansion in the brass industry, which saw the recovery of zinc in brass from brass scrap rise 61 percent, whereas zinc recovered from zinc-base scrap and residues was 20 percent less in 1942 than in 1941.

Secondary zinc recovered[1] *in the United States, 1941–42, in short tons*

Secondary zinc recovered			Recoverable zinc content of scrap		
Form of recovery	1941	1942	Kind of scrap processed	1941	1942
As metal:			New scrap:		
By distillation:			Zinc-base	122,577	95,296
Slab zinc	59,306	52,712	Copper-base	80,236	162,242
Zinc dust	18,950	17,685	Aluminum-base	----------	1
By remelting	11,400	11,048		202,813	257,539
	89,656	81,445	Old scrap:		
In zinc-base alloys	2,571	3,670	Zinc-base	33,267	29,200
In brass and bronze	143,220	212,038	Copper-base	47,877	43,787
In aluminum-base alloys	16	18	Aluminum-base	10	----------
In chemical products:				81,154	72,987
Zinc oxide	14,295	4,373			
Zinc sulfate	2,840	2,150			
Zinc chloride	13,613	10,815		283,967	330,526
Lithopone	17,408	15,750			
Miscellaneous	348	267			
	194,311	249,081			
	283,967	330,526			

[1] Zinc content.

Twenty-seven distillers produced 53,195 tons of redistilled slab having an average zinc content of 99.1 percent, a total exceeded only by the 1941 record high of 59,503 tons. The 18,101 tons of zinc dust manufactured from scrap by 10 distillers in 1942 contributed 80 percent of the total zinc-dust production from all sources but represented a decline of 4 percent from the 1941 figure for dust produced from scrap. The drop in production of both redistilled slab and dust was the result of a shortage in raw materials rather than a smaller demand for the products. Two producers of redistilled slab discontinued operations owing to the difficulty of obtaining enough residue for efficient operation.

Production of secondary zinc and zinc-alloy products in the United States, 1941–42, gross weight, in short tons

Product	1941	1942
Redistilled slab zinc	59,503	53,195
Zinc dust	18,950	18,101
Remelt spelter [1]	10,459	8,637
Remelt die-cast slab	2,735	2,488
Zinc die and die casting alloys		1,403
Galvanizing stock	527	683
Rolled zinc	497	1,958
Zinc powder	78	
Zinc in chemical products	48,504	33,355

[1] Includes small tonnages of zinc anodes.

Consumption of purchased zinc scrap in the United States in 1942, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Clippings	3,241		2,398		5,639
Sheet and strip	293	8,183	461	351	9,288
Engravers' plates		1,930		80	2,010
Skimmings and ashes	43,353		21,976		65,329
Dross	47,412		11		47,423
Die castings	670	14,203	135	311	15,319
Flue dust and residues	10,983	783	10,364	13,692	35,822
	105,952	25,099	35,345	14,434	180,830

The auto-wrecking campaign conducted throughout most of 1942 increased the supply of scrap die castings, and Federal regulations of zinc consumption in the printing trade were responsible for the movement of old engravers' plates. Old zinc scrap composed of die castings, engravers' plates, sheet, strip, and flue dust constituted 22 percent of the total zinc scrap consumed in 1942. Metallic scrap was used in making remelt spelter, zinc alloys, brass, and redistilled zinc.

By the end of 1942, galvanizing activity had decreased to 40 percent of what it had been in the comparable portion of 1941. The net result of this diminished activity was a 20-percent decrease in the supply of galvanizers' skimmings and dross and a lower yield of zinc dust and redistilled slab in 1942.

Consumers' stocks of purchased zinc-base scrap in the United States at end of year, 1941–42, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1941	Dec. 31, 1942
Metallic zinc scrap	1,378	2,960
Dross	5,634	4,232
Skimmings and residues	32,433	34,625
	39,445	41,817

The rate of shipment of zinc scrap from nonferrous scrap-metal dealers to consumers increased steadily from the beginning of 1942 until the year's high mark was reached in May, then declined for 4 months before another increase was evident. Zinc scrap handled by dealers consisted for the most part of old metallic scrap, as flue dust and most of the new scrap and residues were shipped directly from generator to consumer.

Virtually no control was exercised over scrap or remelt zinc during 1942, but early in 1943 a general zinc shortage forced the Government to amend refined-zinc regulations to include remelt zinc in the list of completely allocated materials. At the same time the disposition of all zinc scrap was put under control, and delivery of zinc scrap was not permitted to anyone other than a scrap dealer or a manufacturer for use in the production of redistilled zinc, remelt zinc, brass, zinc dust, zinc oxide, chemicals, or salts unless specific authority to do otherwise was first obtained.

Government control kept prices of zinc scrap in line throughout 1942. Scrap dealers' monthly average buying prices for new zinc clips at New York averaged 6.45 cents a pound during 1942 and ranged from a high of 7.00 cents in March and April to a low average of 5.79 cents in September. Corresponding prices for old zinc scrap in the same market averaged 4.65 cents a pound during 1942, with high and low monthly averages of 5.25 cents in March and April and 3.83 cents in September.

Imports of old zinc scrap totaled 143 short tons, compared with 103 tons in 1941. Imports of residues classed as "zinc dross and skimmings" totaled 353 short tons in 1941 but soared to 3,199 tons in 1942 owing to importation of large quantities of fume from a primary zinc smelter in Canada. Zinc recovered from this fume was not counted as secondary zinc.

IRON AND STEEL SCRAP[1]

By Harold E. Carmony and Herbert L. Cullen

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GENERAL SUMMARY

The continued stimulus of expanding war industries' needs was responsible for a record production of steel ingots in 1942, with consequent greatest demand for iron and steel scrap ever known. The production increased 4 percent over that in 1941. Reflecting this rise, use of purchased ferrous scrap at steel furnaces increased 6 percent over consumption in 1941—the previous record year—although pig-iron production rose 7 percent. During the entire year consumption of scrap remained fairly stable, since steel-ingot production was consistently greater than 95 percent of rated capacity, the use of scrap reaching a peak in October.

Total consumption of ferrous scrap and pig iron was 3 percent greater than that in 1941. Of the 119,308,034 short tons used, 97,598,709 were charged to steel-making furnaces and 20,443,522 to iron furnaces. In making the average ton of steel in 1942, more pig iron and less scrap were used than in 1941; the relative use of home scrap decreased considerably in 1942 from 1941, but that of purchased scrap increased slightly. The relative decline in the use of home scrap undoubtedly was caused by exportation of large quantities of steel ingots and semifinished steel under lend-lease agreements, which removed potential plant scrap from circulation. In iron furnaces, also, the use of pig iron increased relatively and that of scrap decreased.

During the first 3 months of 1942 stocks of iron and steel scrap declined consistently; however, with the advent of warmer weather the movement of scrap became easier, and there was a gradual uptrend in inventories throughout the remainder of the year. The continued high operating rates in steel production during the year occasioned considerable alarm over the position of domestic stocks of iron and steel scrap. However, the monthly surveys conducted by the

[1] Minerals Yearbook, 1939, p. 513, gives definitions of the various scrap terms used in this report.

Bureau of Mines revealed that available inventories of scrap were rising above the late 1941 lows. The survey of suppliers', producers', and consumers' stocks at the end of 1942 [2] indicated inventories of 7,803,151 short tons, equivalent to 7 weeks' supply at the December rate of consumption. Consumers' stocks of scrap increased from 3,726,030 tons at the beginning of 1942 to 6,316,138 tons at the close. In contrast with the fluctuation in scrap inventories, pig iron stocks were fairly stable.

Prices for scrap remained at the maximums established by the Office of Price Administration early in 1941. According to Iron Age, the quotation for No. 1 Heavy-Melting steel scrap at Pittsburgh was $20 per gross ton ($17.86 a short ton) throughout the year, compared

Salient statistics of ferrous scrap and pig iron in the United States, 1941–42

	1941	1942	Change in 1942 (percent)
Stocks, December 31:			
Ferrous scrap and pig iron at consumers' plants:	*Short tons*	*Short tons*	
Home scrap	1,166,551	1,605,756	+38
Purchased scrap	2,559,479	4,710,382	+84
Pig iron	1,585,199	1,454,665	−8
	5,311,229	7,770,803	−46
Ferrous scrap at suppliers' yards and producers' plants:			
Prepared scrap	675,952	653,518	−3
Unprepared scrap	515,417	833,495	+62
	1,191,369	1,487,013	+25
Consumption:			
Ferrous scrap and pig iron charged to—			
Steel furnaces: [1]			
Home scrap	26,433,206	26,731,787	+1
Purchased scrap	18,061,681	19,103,976	+6
Pig iron	48,547,426	51,762,946	+7
	93,042,313	97,598,709	+5
Iron furnaces: [2]			
Home scrap	7,471,474	6,335,906	−15
Purchased scrap	7,249,895	6,827,698	−6
Pig iron	7,638,046	7,279,918	−5
	22,359,415	20,443,522	−9
All furnaces: [3]			
Home scrap	33,904,680	33,067,693	−2
Purchased scrap	25,311,576	25,931,674	+2
Pig iron	56,185,472	59,042,864	+5
	115,401,728	118,042,231	+2
Ferrous scrap (total)	[3] 59,216,256	[3] 58,999,367	(4)
Exports:			
Iron and steel	888,340	136,540	−85
Tin plate, waste-waste, circles, strips, cobbles, etc	15,909	5,196	−67
Average prices per gross ton:			
Scrap:			
No. 1 Heavy-Melting, Pittsburgh [5]	$20.34	$20.00	−2
No. 1 Cast cupola [5]	22.25	20.00	−10
For export	18.74	23.39	+25
Pig iron, f. o. b. Valley furnaces: [5]			
Basic	23.50	23.50	----------
No. 2 Foundry	24.00	24.00	----------

[1] Includes open-hearth, bessemer, and electric furnaces.
[2] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.
[3] Does not include ferro-alloy and miscellaneous consumption.
[4] Less than 1 percent decrease.
[5] Iron Age.

[2] Bureau of Mines Iron and Steel Scrap Monthly Reports: No. 28, Feb. 23, 1943, 5 pp.

with $20.34 ($18.16) in 1941. The price of basic pig iron, established at $23.50 per gross ton ($20.98 a short ton) at Valley furnaces in December 1940, prevailed throughout 1942.

Exports of scrap from the United States in 1942 declined 85 percent from 1941 mainly because exports to countries other than the United Kingdom and the Western Hemisphere were placed under Federal control and because shipping facilities were required for finished war materials.

Figure 1 shows the consumption of purchased scrap and the output of pig iron and steel ingots and castings from 1905 to 1942, inclusive.

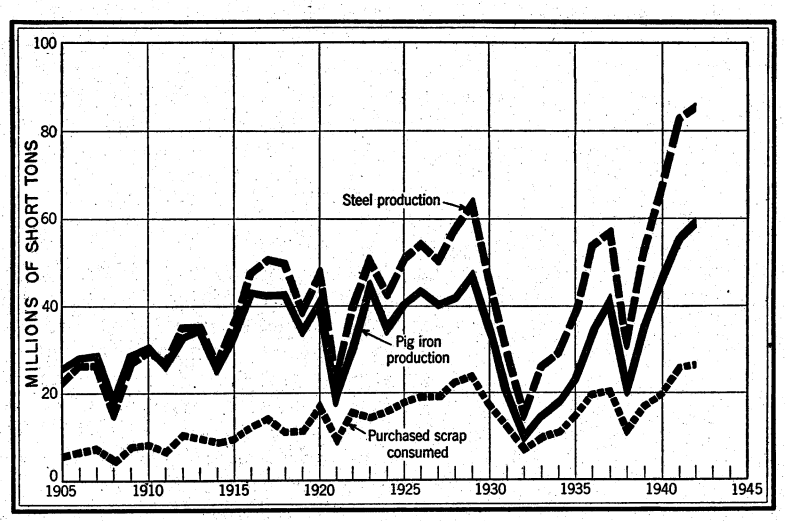

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–42. Figures on consumption of purchased scrap for 1905–32 are from *State of Minnesota* vs. *Oliver Iron Mining Co. et al.*, Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimates by authors; and those for 1935–42 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.

PRICES [3]

The ceiling prices for scrap fixed by Price Schedule 4 in 1941 remained effective throughout 1942. Market quotations for both No. 1 Heavy-Melting steel and No. 1 Cast cupola scrap were unchanged at $20 per gross ton ($17.86 per short ton) (Pittsburgh).

There were two minor revisions of the basic price schedule in the early part of 1942. These included adjustments in freight and other transportation charges together with the clarification of open-hearth and electric-furnace grades and unprepared scrap. On February 21, 1942, Price Schedule 4 was revised to incorporate all amendments issued after its promulgation on April 3, 1941, and thereafter was entitled Revised Price Schedule 4. Several minor revisions of Revised Price Schedule 4 that appeared during the year included price adjustments on special grades of scrap, addition of new "remote" scrap areas, modification of shipping-point prices, and definitions of No. 1 Heavy-Melting steel and No. 2 Heavy-Melting steel scrap. Gilding metal-clad steel scrap was exempted from price control effective November 16, 1942, by an amendment to the General Maximum Price Regulation.

[3] Pittsburgh price quotations from Iron Age.

On May 20, 1942, the Office of Price Administration introduced Supplementary Order 5 licensing every dealer selling to a consumer (and in the case of iron and steel scrap, to a consumer or his broker) any waste, scrap, or salvage materials for which maximum prices are established by price schedules.

The price of basic pig iron, established at $23.50 per gross ton ($20.98 per short ton) at Valley furnaces late in December 1940, remained unchanged throughout 1942.

As the price of scrap exported from the United States was regulated by Revised Price Schedule 4, the price structure remained firm during the entire year. Export-scrap prices in 1942, as indicated by the declared value of iron- and steel-scrap exports, averaged $23.39 per gross ton ($20.89 per short ton) for the year, or approximately 25 percent higher than the 1941 average of $18.74 ($16.73). The 1942 average price was the highest recorded since 1937, when the average was $18.91 ($16.88).

LEGISLATION

Representative Casey's bill (H. R. 5985, 76th Cong.) to suspend the effectiveness of tariff duties on scrap iron, scrap steel, and nonferrous-metal scrap was reintroduced without change as H. R. 6531, 77th Congress.[4] It provided for the suspension of tariff duties or import taxes on scrap metal imported for consumption during the period of unlimited national emergency. After debate in both the Senate and the House of Representatives, the bill was approved and became Public, No. 497, 77th Congress, on March 13, 1942. But on June 1, 1942, the Division of Industry Operations, War Production Board, acting under an Executive Order, issued an amendment to General Imports Order M–63 to restrict the private importation of scrap metals and to provide for purchase of these materials by Government agencies only.

During the year the Division of Industry Operations issued various amendments to General Preference Order M–24. It was made mandatory to segregate tinned and detinned scrap in certain localities, and the sale or shipment of this type of scrap was prohibited outside the areas of origin, except to a detinning plant or copper-precipitation plant; also, an amendment required the segregation of alloy scrap in the entire country. On May 23, 1942, an amendment was issued that removed the inventory restrictions of Priorities Regulation No. 1 and thereby permitted consumers to increase their inventories of iron and steel scrap without limit. The Division of Industry Operations also issued Limitation Order L–88 on May 18, 1943, that restricted the sale as scrap of usable, relaying, and rerolling rails in excess of 10 tons in any calendar month except by permission of the War Production Board.

STOCKS

Available stocks of iron and steel scrap and pig iron in the United States at the end of 1942 were determined by the regular annual canvass of consumers of these materials and the monthly canvass of

[4] H. R. 6531. A bill to suspend the effectiveness, during the existing national emergency, of tariff duties on scrap iron, scrap steel, and nonferrous metal scrap.

suppliers and producers. The monthly canvass was expanded to include as producers all manufacturers and railroads that produce 50 gross tons of iron or carbon steel scrap, 10 tons of alloy steel scrap, or 1 ton of high-speed steel scrap in a month. The final results of the annual survey indicate that consumers', suppliers', and producers' stocks of iron and steel scrap totaled 7,803,151 short tons on December 31, 1942, which represents a 59-percent increase over the 4,917,399 tons on hand December 31, 1941.

Consumers' stocks.—Consumers' stocks of home and purchased scrap were considerably larger at the end of 1942 than at the beginning. The supply of 1,605,756 short tons of home scrap on hand on December 31 represented a 38-percent increase over the 1,166,551 tons on hand at the beginning of the year, and the supply of 4,710,382 tons of purchased scrap on hand at the end of 1942 was 84 percent more than the 2,559,479 tons on hand December 31, 1941. Thus, consumers' stocks of scrap totaling 6,316,138 tons at the year end were 70 percent larger than the 3,726,030 tons on hand at the beginning of the year.

Consumers' stocks of pig iron totaled only 1,454,665 tons at the end of the year, a decrease of 8 percent from the 1,585,199 tons on hand at the beginning of the year.

Suppliers' and producers' stocks.—In appraising stocks insofar as suppliers and producers are concerned, it should be noted that the coverage of the canvass is not known precisely. However, the data assembled include virtually complete returns from the larger suppliers and producers, as well as a representative number of returns from others, and the figures shown undoubtedly represent a very substantial part of the total stock of iron and steel scrap in suppliers' and producers' hands.

Stocks held by dealers, automobile wreckers, railroads, and manufacturers increased 25 percent, from 1,191,369 tons on December 31, 1941, to 1,487,013 tons on December 31, 1942. Stocks in the hands of dealers were 37 percent greater at the end of 1942 than at the end of 1941, and manufacturers' inventories gained 20 percent during the same period.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on December 31, 1941, and December 31, 1942, by States and districts, in short tons

State and district	December 31, 1941				December 31, 1942			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Connecticut	9,304	27,616	36,920	26,444	5,392	34,199	39,591	14,535
Maine	81	2,256	2,337	3,928	143	4,701	4,844	1,444
Massachusetts	14,988	62,202	77,190	77,773	15,703	84,977	100,680	42,847
New Hampshire	215	2,790	3,005	1,765	355	2,788	3,143	643
Rhode Island	1,284	7,706	8,990	12,070	1,491	9,556	11,047	5,006
Vermont	395	4,965	5,360	3,722	708	9,650	10,358	1,908
Total New England	26,267	107,535	133,802	125,702	23,792	145,871	169,663	66,383
Delaware, New Jersey	22,229	98,754	120,983	44,536	16,772	203,408	220,180	39,049
New York	55,023	130,981	186,004	103,311	44,596	355,376	399,972	90,444
Pennsylvania	397,072	490,309	887,381	334,786	629,311	775,957	1,405,268	392,819
Total Middle Atlantic	474,324	720,044	1,194,368	482,633	690,679	1,334,741	2,025,420	522,312
Alabama	33,479	38,590	72,069	40,111	64,177	126,645	190,822	71,780
District of Columbia, Kentucky, Maryland	31,477	41,398	72,875	29,377	34,628	152,604	187,232	28,900
Florida, Georgia	833	29,743	30,576	5,508	3,300	37,280	40,580	7,400
Mississippi	100	275	375	135	26	406	432	97
North Carolina	159	5,177	5,336	1,212	269	8,927	9,196	1,147
South Carolina	844	2,143	2,987	667	191	8,161	8,352	888
Tennessee, Virginia	15,422	32,159	47,581	19,045	6,642	105,891	112,533	12,315
West Virginia	6,176	33,784	39,960	26,250	5,764	80,575	86,339	12,356
Total Southeastern	88,490	183,269	271,759	122,305	114,997	520,489	635,486	134,883
Arkansas, Louisiana, Oklahoma	434	18,573	19,007	790	787	24,581	25,368	409
Texas	6,806	27,602	34,408	1,385	4,139	64,339	68,478	1,690
Total Southwestern	7,240	46,175	53,415	2,175	4,926	88,920	93,846	2,099
Illinois	111,846	317,538	429,384	147,356	128,989	522,538	651,527	93,325
Indiana	103,529	240,384	343,913	99,170	183,301	309,529	492,830	79,448
Iowa	1,508	30,765	32,273	10,668	3,534	53,616	57,150	10,342
Kansas, Nebraska	863	13,739	14,602	780	585	14,054	14,639	923
Michigan, Wisconsin	89,521	210,891	300,412	237,570	111,566	304,760	416,326	233,074
Minnesota	4,401	51,767	56,168	5,713	10,047	126,302	136,349	7,384
Missouri	7,709	69,168	76,877	11,706	3,378	95,891	99,269	8,755
North Dakota, South Dakota	2,092	274	2,366	51	2,038	118	2,156	49
Ohio	215,993	273,206	489,199	250,580	281,693	634,767	916,460	252,305
Total North Central	537,462	1,207,732	1,745,194	763,594	725,131	2,061,575	2,786,706	685,605
Arizona, Nevada, New Mexico	2,350	7,571	9,921	95	2,351	16,600	18,951	116
Colorado, Utah	8,093	71,475	79,568	9,130	16,462	159,650	176,112	14,182
Idaho	130	3,534	3,664	52	2	3,026	3,028	55
Wyoming	5	1	6	2	4	1	5	1
Montana	1,279	15,235	16,514	252	2,735	18,752	21,487	137
Total Rocky Mountain	11,857	97,816	109,673	9,531	21,554	198,029	219,583	14,491
Alaska, Oregon, Washington	5,573	51,358	56,931	2,740	5,947	76,230	82,177	3,252
California	15,338	145,550	160,888	76,519	18,730	284,527	303,257	25,640
Total Pacific Coast	20,911	196,908	217,819	79,259	24,677	360,757	385,434	28,892
Total United States	1,166,551	2,559,479	3,726,030	1,585,199	1,605,756	4,710,382	6,316,138	1,454,665

Suppliers' stocks of iron and steel scrap on hand December 31, 1941, and December 31, 1942, by States and districts, in short tons

State and district	December 31, 1941			December 31, 1942		
	Prepared	Unprepared	Total	Prepared	Unprepared	Total
Connecticut	11,615	3,794	15,409	12,915	11,976	24,891
Maine	5,094	1,212	6,306	5,192	4,178	9,370
Massachusetts	13,940	17,959	31,899	18,449	27,962	46,411
New Hampshire	978	766	1,744	922	2,437	3,359
Rhode Island	1,437	707	2,144	2,286	5,097	7,383
Vermont	2,465	1,793	4,258	3,031	2,620	5,651
Total New England	35,529	26,231	61,760	42,795	54,270	97,065
Delaware	939	497	1,436	919	1,052	1,971
New Jersey	22,290	16,416	38,706	19,890	19,660	39,550
New York	54,783	37,179	91,962	47,453	71,830	119,283
Pennsylvania	42,355	57,876	100,231	54,831	87,387	142,218
Total Middle Atlantic	120,367	111,968	232,335	123,093	179,929	303,022
Alabama	5,932	7,226	13,158	9,709	14,171	23,880
District of Columbia	482	1,392	1,874	826	1,440	2,266
Florida	6,303	3,625	9,928	5,253	8,171	13,424
Georgia	9,681	4,253	13,934	8,146	12,374	20,520
Kentucky	8,533	6,255	14,788	10,443	11,336	21,779
Maryland	3,662	13,026	16,688	11,275	13,355	24,630
Mississippi	2,166	2,077	4,243	2,573	7,604	10,177
North Carolina	7,108	2,727	9,835	10,942	7,822	18,764
South Carolina	6,698	1,169	7,867	4,396	5,473	9,869
Tennessee	13,769	7,543	21,312	19,824	39,283	59,107
Virginia	15,970	8,505	24,475	10,918	13,236	24,154
West Virginia	6,748	6,459	13,207	6,303	10,013	16,316
Total Southeastern	87,052	64,257	151,309	100,608	144,278	244,886
Arkansas	2,381	2,223	4,604	2,652	7,837	10,489
Louisiana	10,139	7,954	18,093	6,685	12,086	18,771
Oklahoma	5,376	4,383	9,759	9,390	8,726	18,116
Texas	25,402	22,478	47,880	19,922	38,447	58,369
Total Southwestern	43,298	37,038	80,336	38,649	67,096	105,745
Illinois	77,894	48,768	126,662	42,373	52,624	94,997
Indiana	21,185	21,763	42,948	25,958	28,905	54,863
Iowa	8,644	15,095	23,739	11,684	15,978	27,662
Kansas	7,748	7,699	15,447	7,951	13,141	21,092
Michigan	29,783	24,335	54,118	34,070	45,810	79,880
Minnesota	67,650	23,502	91,152	71,750	44,765	116,515
Missouri	12,024	17,720	29,744	10,764	16,494	27,258
Nebraska	4,161	4,922	9,083	4,701	8,403	13,104
North Dakota	784	654	1,438	396	2,342	2,738
Ohio	64,219	47,804	112,023	47,496	57,890	105,386
South Dakota	505	1,216	1,721	692	3,776	4,468
Wisconsin	18,121	20,557	38,678	17,473	29,473	46,946
Total North Central	312,718	234,035	546,753	275,308	319,601	594,909
Arizona	140	515	655	787	5,927	6,714
Colorado	5,872	3,650	9,522	5,969	3,535	9,504
Idaho	2,258	644	2,902	616	985	1,601
Montana	390	2,979	3,369	5,808	2,872	8,680
Nevada	334	207	541	29	298	327
New Mexico	584	17	601	1,456	1,789	3,245
Utah	511	4,327	4,838	940	5,228	6,168
Wyoming	5,443	586	6,029	1,328	2,941	4,269
Total Rocky Mountain	15,532	12,925	28,457	16,933	23,575	40,508
California	43,130	19,602	62,732	37,768	32,427	70,195
Oregon	6,904	2,667	9,571	5,738	3,064	8,802
Washington	11,422	6,694	18,116	12,626	9,255	21,881
Total Pacific Coast	61,456	28,963	90,419	56,132	44,746	100,878
Total United States	675,952	515,417	1,191,369	653,518	833,495	1,487,013

CONSUMPTION

In the canvass of consumers of ferrous scrap and pig iron in 1942, data were assembled on the scrap used in miscellaneous operations, such as rerolling, reforging, and chemical uses, in addition to that used in remelting processes. To simplify the annual canvass, no details are sought regarding the ordinary trade classifications of scrap consumed, and no attempt is made to obtain data on its value or cost at consumers' plants. Statistics are compiled to show the consumption of scrap and pig iron by districts and States and by types of furnace. To avoid disclosing details concerning individual plants reporting, it is necessary in some instances to combine figures for some States. All such combinations are made with a view to revealing details of consumption by types of furnace rather than by geographic subdivisions.

The importance of scrap in the conservation of resources is illustrated by the relative quantities of scrap and ore used in the domestic iron and steel industry. The total scrap consumed in 1942 was equivalent to 114 percent of the iron content of all domestic and foreign iron and manganiferous ores used in blast furnaces, and purchased scrap alone equaled 51 percent of the iron content of the ores; in 1941 the comparable percentages were 123 and 53.

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 6 percent of the total scrap consumed in 1942. In the New England and Rocky Mountain districts (areas that are small producers of pig iron) and the Southwestern district proportionately more scrap was used in 1942 than in 1941; whereas in the remaining districts (Middle Atlantic, Southeastern, North Central, and Pacific Coast) proportionately less scrap was used.

Open-hearth steel furnaces use by far the largest quantities of ferrous scrap and pig iron. They consumed 66 percent of the total scrap in 1942 (67 percent in 1941), 71 percent of the home scrap (71 percent in 1941), 59 percent of the purchased scrap (63 percent in 1941), and 77 percent of the pig iron (76 percent in 1941).

In cupola furnaces, the second-largest consumers of scrap, the relative consumption of home and purchased scrap was changed considerably. They used 12 percent of the home scrap in 1942 (15 percent in 1941), 19 percent of the purchased scrap (22 percent in 1941), and 8 percent of the pig iron (9 percent in 1941).

Open-hearth and cupola furnaces together consumed 83 percent of the home scrap, 78 percent of the purchased scrap, and 85 percent of the pig iron in 1942.

Bessemer converters used 10 percent of the pig iron consumed in 1942 but only relatively small quantities of scrap (0.61 percent of the total). Although electric furnaces consumed only 10 percent of the total scrap in 1942, over 98 percent of the total charge to this type of equipment was home and purchased scrap.

Ferrous scrap and pig iron consumed in the United States and percent of total derived from home scrap, purchased scrap, and pig iron, 1941–42, by districts

District	1941					1942				
	Total used (short tons)	Percent of total used				Total used (short tons)	Percent of total used			
		Scrap			Pig iron		Scrap			Pig iron
		Home	Purchased	Total			Home	Purchased	Total	
New England	1,532,883	31.9	37.0	68.9	31.1	1,602,721	30.9	38.4	69.3	30.7
Middle Atlantic	40,056,774	28.6	19.5	48.1	51.9	42,029,787	26.6	20.1	46.7	53.3
Southeastern	14,286,365	26.3	19.8	46.1	53.9	15,006,739	24.4	19.9	44.3	55.7
Southwestern	295,465	25.1	73.0	98.1	1.9	461,624	22.0	76.4	98.4	1.6
North Central	55,915,636	30.8	22.1	52.9	47.1	56,464,226	29.7	22.7	52.4	47.6
Rocky Mountain	1,512,974	27.9	29.5	57.4	42.6	1,637,012	26.7	32.6	59.3	40.7
Pacific Coast	1,801,631	25.4	62.8	88.2	11.8	2,105,925	21.1	66.0	87.1	12.9
	115,401,728	29.4	21.9	51.3	48.7	119,308,034	27.8	22.7	50.5	49.5

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1941–42, in percent

Type of furnace	1941				1942			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open-hearth	29.1	19.3	48.4	51.6	27.6	18.9	46.5	53.5
Bessemer	5.0	1.2	6.2	93.8	4.0	1.7	5.7	94.3
Electric	49.6	48.7	98.3	1.7	50.5	48.0	98.5	1.5
Cupola	31.4	34.8	66.2	33.8	29.0	37.8	66.8	33.2
Air [1]	47.8	19.1	66.9	33.1	48.8	18.5	67.3	32.7
Crucible	53.3	41.0	94.3	5.7	73.1	20.7	93.8	6.2
Puddling	5.6	27.8	33.4	66.6	4.7	30.3	35.0	65.0
Blast	54.7	45.3	100.0	----	53.3	46.7	100.0	----

[1] Includes data for 3 Brackelsberg furnaces.

CONSUMPTION BY DISTRICTS AND STATES

All 48 States, the District of Columbia, and Alaska contain plants consuming ferrous scrap and pig iron. The greatest consumption, however, is concentrated in the steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas include the 8 largest consuming States, which used 82 percent of the total scrap, 91 percent of the pig iron, and 86 percent of the total scrap and pig iron charged into furnaces in 1942; the comparable percentages in 1941 were 83, 92, and 87, respectively. These States (the relative position of which varied slightly from 1941) and the percentage of the total ferrous scrap and pig iron each consumed in 1942 were as follows: Pennsylvania 28, Ohio 20, Indiana 11, Illinois 9, New York 5, Alabama 5, Michigan 4, and Maryland 4.

The second table following shows total consumption of ferrous scrap and pig iron by districts and percentage change in use of home scrap, purchased scrap, total scrap, and pig iron, 1938 to 1942.

Consumption of ferrous scrap and pig iron in the United States, 1941–42, by type of furnace, in short tons

Type of furnace or equipment	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
1941					
Open-hearth	139	24,002,629	15,920,857	39,923,486	42,481,404
Bessemer	33	320,738	72,506	393,244	5,993,264
Electric	306	2,109,839	2,068,318	4,178,157	72,758
Cupola	2,798	5,004,864	5,559,273	10,564,137	[1] 5,388,747
Air	128	872,227	349,425	1,221,652	604,835
Brackelsberg	3				
Crucible	14	1,949	1,499	3,448	207
Puddling	8	4,568	22,626	27,194	54,183
Blast	78	1,587,866	1,317,072	2,904,938	
Direct castings	24				1,590,074
	[2] 3,531	33,904,680	25,311,576	59,216,256	56,185,472
1942					
Open-hearth	145	23,445,884	16,114,069	39,559,953	45,538,846
Bessemer	33	260,025	109,887	369,912	6,131,222
Electric	346	3,025,878	2,880,020	5,905,898	92,878
Cupola	2,763	3,936,603	5,117,918	9,054,521	[1] 4,490,513
Air	129	828,178	313,266	1,141,444	555,436
Brackelsberg	3				
Crucible	13	2,610	741	3,351	221
Puddling	8	3,603	23,174	26,777	49,835
Blast	73	1,564,912	1,372,599	2,937,511	
Direct castings	30				2,183,913
Ferro-alloy [3]	21	10,853	307,316	318,169	19
Miscellaneous [3]	137	50,826	896,789	947,615	
	[2] 3,701	33,129,372	27,135,779	60,265,151	59,042,883

[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.
[3] Comparable data not obtained for 1941.

Consumption of ferrous scrap and pig iron in the United States, 1938–42, by districts

District and year	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)
New England:									
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
1941	267	489,163	+72.5	566,952	+36.9	1,056,115	+51.4	476,768	+57.9
1942	271	494,569	+1.1	616,166	+8.7	1,110,735	+5.2	491,986	+3.2
Middle Atlantic:									
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
1941	859	11,472,727	+39.9	7,796,243	+39.0	19,268,970	+39.6	20,787,804	+19.5
1942	914	11,190,820	−2.5	8,446,963	+8.3	19,637,783	+1.9	22,392,004	+7.7
Southeastern:									
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
1941	490	3,761,458	+19.9	2,825,903	+13.7	6,587,361	+17.1	7,699,004	+11.5
1942	525	3,669,073	−2.5	2,981,358	+5.5	6,650,431	+1.0	8,356,308	+8.5
Southwestern:									
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
1941	139	74,059	+86.7	215,699	+58.7	289,758	+65.0	5,707	+28.7
1942	138	101,683	+37.3	352,460	+63.4	454,143	+56.7	7,481	+31.1

Consumption of ferrous scrap and pig iron in the United States, 1938–42, by districts—Continued

District and year	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)
North Central:									
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
1941	1,424	17,227,439	+34.6	12,329,204	+28.1	29,556,643	+31.8	26,358,993	+26.0
1942	1,480	16,793,338	−2.5	12,814,917	+3.9	29,608,255	+.2	26,855,971	+1.9
Rocky Mountain:									
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
1941	75	421,191	+61.5	446,745	+30.9	867,936	+44.2	645,038	+40.8
1942	87	436,470	+3.6	533,604	+19.4	970,074	+11.8	666,938	+3.4
Pacific Coast:									
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
1941	277	458,643	+40.3	1,130,830	+29.2	1,589,473	+32.2	212,158	+12.0
1942	285	443,419	−3.3	1,390,311	+22.9	1,833,730	+15.4	272,195	+28.3
United States:									
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
1941	[1] 3,531	33,904,680	+35.4	25,311,576	+29.9	59,216,256	+33.0	56,185,472	+21.7
1942	[1] 3,701	33,129,372	−2.3	27,135,779	+7.2	60,265,151	+1.8	59,042,883	+5.1

[1] Where 2 or more separate departments, such as blast-furance, 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 1942, by States and districts

State and district	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Connecticut	72	161,654	0.5	192,666	0.7	354,320	0.6	138,938	0.3
Maine	22	10,907	(1)	8,557	(1)	19,464	(1)	8,763	(1)
Massachusetts	127	246,322	.7	323,603	1.2	569,925	1.0	244,993	.4
New Hampshire	21	5,727	(1)	18,008	.1	23,735	(1)	20,523	(1)
Rhode Island	14	50,465	.2	51,094	.2	101,559	.2	58,116	.1
Vermont	15	19,494	.1	22,238	.1	41,732	.1	20,653	(1)
Total New England	271	494,569	1.5	616,166	2.3	1,110,735	1.9	491,986	.8
Delaware	11	515,000	1.6	707,946	2.6	1,222,946	2.0	532,783	.9
New Jersey	117								
New York	248	1,643,531	5.0	1,435,330	5.3	3,078,861	5.1	3,015,417	5.1
Pennsylvania	538	9,032,289	27.2	6,303,687	23.2	15,335,976	25.5	18,843,804	31.9
Total Middle Atlantic	914	11,190,820	33.8	8,446,963	31.1	19,637,783	32.6	22,392,004	37.9
Alabama	103	1,412,731	4.3	722,511	2.7	2,135,242	3.5	3,408,958	5.8
District of Columbia	4								
Kentucky	28	1,596,118	4.8	1,148,549	4.2	2,744,667	4.6	3,055,553	5.2
Maryland	38								

See footnote at end of table.

Consumption of ferrous scrap and pig iron in the United States in 1942, by States and districts—Continued

State and district	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Florida	22	58,733	0.2	140,562	0.5	199,295	0.3	81,229	0.1
Georgia	63								
Mississippi	12	678	(1)	1,867	(1)	2,545	(1)	615	(1)
North Carolina	59	19,734	.1	27,273	.1	47,007	.1	16,076	(1)
South Carolina	20	4,353	(1)	12,872	.1	17,225	(1)	4,532	(1)
Tennessee	73	196,187	.6	358,112	1.3	554,299	.9	165,331	.3
Virginia	67								
West Virginia	37	380,539	1.1	569,612	2.1	950,151	1.6	1,624,014	2.8
Total Southeastern	526	3,669,073	11.1	2,981,358	11.0	6,650,431	11.0	8,356,308	14.2
Arkansas	14	27,924	.1	98,079	.4	126,003	.2	3,053	(1)
Louisiana	26								
Oklahoma	72								
Texas	26	73,759	.2	254,381	.9	328,140	.6	4,428	(1)
Total Southwestern	138	101,683	.3	352,460	1.3	454,143	.8	7,481	(1)
Illinois	264	3,104,643	9.4	2,374,597	8.7	5,479,240	9.0	5,369,942	9.1
Indiana	165	3,888,524	11.7	2,198,196	8.1	6,086,720	10.1	6,963,040	11.8
Iowa	69	113,355	.3	235,803	.9	349,158	.6	64,012	.1
Kansas	38	29,234	.1	75,131	.3	104,365	.2	5,882	(1)
Nebraska	17								
Michigan	224	2,185,868	6.6	1,822,251	6.7	4,008,119	6.6	2,104,082	3.6
Wisconsin	139								
Minnesota	82	216,532	.7	379,773	1.4	596,305	1.0	308,937	.5
Missouri	78	227,074	.7	727,075	2.7	954,149	1.6	81,677	.1
North Dakota	2	1,103	(1)	687	(1)	1,790	(1)	76	(1)
South Dakota	3								
Ohio	399	7,027,005	21.2	5,001,404	18.4	12,028,409	20.0	11,958,323	20.3
Total North Central	1,480	16,793,338	50.7	12,814,917	47.2	29,608,255	49.1	26,855,971	45.5
Arizona	9	17,974	.1	56,022	.2	73,996	.1	36	(1)
Nevada	4								
New Mexico	4								
Colorado	33	405,016	1.2	444,469	1.7	849,485	1.4	666,254	1.1
Utah	19								
Idaho	6	1,095	(1)	7,830	(1)	8,925	(1)	112	(1)
Wyoming	1	2	(1)	1	(1)	3	(1)	1	(1)
Montana	11	12,383	(1)	25,282	.1	37,665	.1	535	(1)
Total Rocky Mountain	87	436,470	1.3	533,604	2.0	970,074	1.6	666,938	1.1
Alaska	1	76,544	.2	314,537	1.2	391,081	.6	17,178	(1)
Oregon	43								
Washington	71								
California	170	366,875	1.1	1,075,774	3.9	1,442,649	2.4	255,017	.5
Total Pacific Coast	285	443,419	1.3	1,390,311	5.1	1,833,730	3.0	272,195	.5
Total United States:									
1942	[2] 3,701	33,129,372	100.0	27,135,779	100.0	60,265,151	100.0	59,042,883	100.0
1941	[2] 3,531	33,904,680	100.0	25,311,576	100.0	59,216,256	100.0	56,185,472	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 1942 totaled 85,098,799 tons—a 3-percent increase over 1941. Of the 1942 total, home scrap constituted 27 percent, purchased scrap 19 percent, and pig iron 54 percent. The use of home scrap decreased 2 percent, with the use of purchased scrap and pig iron increasing 1 and 7 percent, respectively.

Charges to open-hearth furnaces in 1942 consisted of 46 percent total scrap and 54 percent pig iron, compared with percentages of 48 and 52, respectively, in 1941. Of the total scrap consumed in open hearths in 1942, 41 percent was purchased scrap, compared with 40 percent in 1941 and 41 percent in 1940. Higher proportions of scrap are used in areas remote from pig-iron-producing centers, but the practice of using scrap exclusively is relatively rare. In 1942 only 3 plants out of a total of 145 operated on a 100-percent scrap basis; they consumed only 541,762 tons, less than 1 percent of the total consumption of raw materials in open hearths.

Pennsylvania, the leading steel-producing State, outranked all others in 1942 in the consumption of ferrous scrap and pig iron in open hearths, followed by Ohio, Indiana, and Illinois.

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1942, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	1				
Massachusetts	2	113,600	264,374	377,974	154,343
Rhode Island	1				
Total: 1942	4	113,600	264,374	377,974	154,343
1941	4	134,958	228,518	363,476	148,899
Middle Atlantic:					
Delaware	1				
New Jersey	3	1,420,892	997,469	2,418,361	2,849,286
New York	8				
Pennsylvania	52	7,160,202	4,495,210	11,655,412	14,788,260
Total: 1942	64	8,581,094	5,492,679	14,073,773	17,637,546
1941	61	9,056,244	5,369,913	14,426,157	16,631,043
Southeastern and Southwestern:					
Alabama	4				
Georgia	1				
Tennessee	1	943,265	551,063	1,494,328	2,624,876
Oklahoma	1				
Texas	1				
District of Columbia	1				
Kentucky	2	1,761,443	1,304,706	3,066,149	3,980,770
Maryland	1				
West Virginia	2				
Total: 1942	14	2,704,708	1,855,769	4,560,477	6,605,646
1941	12	2,686,917	1,834,492	4,521,409	5,787,602
North Central:					
Illinois	12	2,122,889	1,366,008	3,488,897	3,732,154
Indiana	8	3,479,930	1,809,941	5,289,871	6,406,822
Michigan	4	782,693	562,207	1,344,900	1,365,749
Iowa	1	149,658	496,243	645,901	21,468
Missouri	3				
Minnesota	1	182,984	243,376	426,360	285,129
Wisconsin	2				
Ohio	25	4,780,436	2,959,336	7,739,772	8,513,188
Total: 1942	56	11,498,590	7,437,111	18,935,701	20,324,510
1941	55	11,567,667	7,456,887	19,024,554	19,196,973
Rocky Mountain and Pacific Coast:					
Colorado	1				
California	5	547,892	1,064,136	1,612,028	816,801
Washington	1				
Total: 1942	7	547,892	1,064,136	1,612,028	816,801
1941	7	556,843	1,031,047	1,587,890	716,887
Total United States: 1942	145	23,445,884	16,114,069	39,559,953	45,538,846
1941	139	24,002,629	15,920,857	39,923,486	42,481,404

Bessemer converters.—The consumption of ferrous scrap and pig iron in bessemer converters in 1942 totaled 6,501,134 tons—a 2-percent increase over 1941. The proportion of scrap consumed in converter practice is low (amounting to only 5.7 percent in 1942), and the major portion was home scrap. Almost all of the small tonnage of purchased scrap consumed in converters was used in small steel-foundry plants.

Pennsylvania was the principal consumer of scrap in bessemer converters in 1942.

Consumption of ferrous scrap and pig iron in bessemer converters in the United States in 1942, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England and Middle Atlantic:					
Connecticut	1				
Delaware	2	4,128	3,769	7,897	2,511
Massachusetts	1				
Pennsylvania	9	98,118	55,924	154,042	2,314,482
Total: 1942	13	102,246	59,693	161,939	2,316,993
1941	13	107,508	52,257	159,765	2,201,311
Southeastern and Southwestern:					
Alabama	1				
Maryland	1				
West Virginia	1	32,015	17,362	49,377	514,930
Louisiana	1				
Texas	1				
Total: 1942	5	32,015	17,362	49,377	514,930
1941	5	63,088	5,090	68,178	488,351
North Central and Pacific Coast:					
Illinois	4	9,295	15,517	24,812	586,453
Indiana	1				
Iowa	1	11,514	12,437	23,951	319,654
Michigan	1				
Minnesota	1				
Missouri	1	5,837	4,878	10,715	3,446
Washington	1				
Ohio	5	99,118	----------	99,118	2,389,746
Total: 1942	15	125,764	32,832	158,596	3,299,299
1941	15	150,142	15,159	165,301	3,303,602
Total United States: 1942	33	260,025	109,887	369,912	6,131,222
1941	33	320,738	72,506	393,244	5,993,264

Electric steel furnaces.—Ferrous scrap and pig iron consumed in electric furnaces totaled 5,998,776 tons—a 41-percent increase over 1941. Pig iron constituted less than 2 percent of the total ferrous raw materials used in electric furnaces. Of the 346 active plants reporting, 104 operated exclusively on scrap and consumed 942,678 tons—about 16 percent of the total scrap and pig iron used.

Ohio led all States in 1942 in the consumption of scrap in electric furnaces, followed by Pennsylvania, Illinois, Michigan, and California.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1942, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	6	11,980	12,800	24,780	767
New Hampshire	1				
Rhode Island	1	1,551	1,594	3,145	78
Vermont	1				
Massachusetts	11	35,911	15,386	51,297	1,282
Total: 1942	20	49,442	29,780	79,222	2,127
1941	15	30,946	21,505	52,451	1,632
Middle Atlantic:					
Delaware	2				
New Jersey	9	86,574	77,693	164,267	2,346
New York	20	124,298	131,741	256,039	4,493
Pennsylvania	60	672,426	629,976	1,302,402	13,566
Total: 1942	91	883,298	839,410	1,722,708	20,405
1941	84	585,822	674,863	1,260,685	22,724
Southeastern:					
District of Columbia	1				
Kentucky	2	33,883	63,105	96,988	482
Maryland	4				
West Virginia	1				
Alabama	5				
Florida	1	17,958	41,065	59,023	142
Georgia	3				
Tennessee	4	23,995	42,441	66,436	1,152
Virginia	3				
Total: 1942	24	75,836	146,611	222,447	1,776
1941	17	53,207	122,688	175,895	877
Southwestern:					
Arkansas	1				
Oklahoma	1	34,550	47,456	82,006	653
Louisiana	4				
Texas	8				
Total: 1942	14	34,550	47,456	82,006	653
1941	13	25,167	35,625	60,792	561
North Central:					
Illinois	25	291,612	310,385	601,997	22,055
Indiana	13	41,703	34,283	75,986	793
Iowa	5				
Kansas	1	18,625	25,544	44,169	140
Nebraska	1				
Michigan	31	305,434	230,646	536,080	18,148
Minnesota	4	6,782	12,148	18,930	509
Missouri	10	15,574	18,554	34,128	1,564
Ohio	36	1,074,413	777,699	1,852,112	14,515
Wisconsin	14	101,719	135,168	236,887	8,435
Total: 1942	140	1,855,862	1,544,427	3,400,289	66,159
1941	126	1,339,762	1,064,756	2,404,518	45,936
Rocky Mountain:					
Arizona	2				
Colorado	2	11,291	18,113	29,404	314
Nevada	1				
Utah	1				
Total: 1942	6	11,291	18,113	29,404	314
1941	6	10,337	15,150	25,487	118
Pacific Coast:					
Alaska	1				
Oregon	6	7,379	15,120	22,499	11
California	29	90,811	185,177	275,988	1,368
Washington	15	17,409	53,926	71,335	65
Total: 1942	51	115,599	254,223	369,822	1,444
1941	45	64,598	133,731	198,329	910
Total United States: 1942	346	3,025,878	2,880,020	5,905,898	92,378
1941	306	2,109,839	2,068,318	4,178,157	72,788

Cupola furnaces.—Consumption of ferrous scrap and pig iron in cupola furnaces totaled 13,545,034 tons—a 15-percent decrease from 1941. Use of home scrap declined 21 percent, purchased scrap 8 percent, total scrap 14 percent, and pig iron 17 percent. Thus, the proportionate decrease in the use of purchased scrap was less than that of pig iron, undoubtedly owing to the establishment of scrap price lower than the price of pig iron.

Charges to cupola furnaces consisted of 29 percent home scrap, 38 percent purchased scrap, and 33 percent pig iron; in 1941 the percentages were 31, 35, and 34, respectively. Many cupola plants operate on a 100-percent scrap charge; 509 plants reported the use of 699,690 tons of ferrous scrap without pig iron in 1942, compared with 511 plants that reported the use of 922,685 tons in 1941.

The relative position of States that are large consumers of scrap in cupola furnaces was altered in 1942 as compared with 1941. Ohio was the principal consumer, followed in order by Michigan, Pennsylvania, Illinois, Alabama, and New York.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1942, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron[1]
		Home	Purchased	Total	
New England:					
Connecticut	56	91,399	62,066	153,465	93,152
Maine	22	10,907	8,557	19,464	8,763
Massachusetts	104	113,228	145,048	258,276	132,452
New Hampshire	17	3,250	16,049	19,299	18,623
Rhode Island	11	30,402	25,952	56,354	30,341
Vermont	14	19,494	22,238	41,732	20,653
Total: 1942	224	268,680	279,910	548,590	303,984
1941	229	266,473	282,850	549,323	294,792
Middle Atlantic:					
Delaware	5	4,671	6,684	11,355	4,216
New Jersey	82	160,446	286,251	446,697	247,819
New York	185	238,659	301,292	539,951	277,079
Pennsylvania	327	395,377	492,614	887,991	607,456
Total: 1942	599	799,153	1,086,841	1,885,994	1,136,570
1941	613	918,860	1,187,215	2,106,075	1,181,810
Southeastern:					
Alabama	78	318,762	279,237	597,999	795,096
District of Columbia	2	49,489	64,678	114,167	57,609
Maryland	29				
Florida	21	1,786	5,135	6,921	1,419
Georgia	57	26,538	38,038	64,576	28,893
Kentucky	22	26,904	26,097	53,001	67,343
Mississippi	12	678	1,867	2,545	615
North Carolina	59	19,734	27,273	47,007	16,076
South Carolina	19	4,353	4,501	8,854	4,532
Tennessee	63	111,287	119,208	230,495	111,278
Virginia	62	57,816	162,117	219,933	52,186
West Virginia	24	10,888	27,879	38,767	13,724
Total: 1942	448	628,235	756,030	1,384,265	1,148,771
1941	441	709,765	693,029	1,402,794	1,337,657

See footnote at end of table.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1942, by districts and States, in short tons—Continued

District and State	Active plants reporting	Scrap			Pig iron[1]
		Home	Purchased	Total	
Southwestern:					
Arkansas	13	419	1,857	2,276	75
Louisiana	21	2,794	6,311	9,105	1,077
Oklahoma	22	5,041	12,301	17,342	1,551
Texas	59	29,694	99,687	129,381	1,862
Total: 1942	115	37,948	120,156	158,104	4,565
1941	121	36,347	127,328	163,675	3,301
North Central:					
Illinois	190	417,961	410,235	828,196	332,325
Indiana	122	171,408	194,103	365,511	170,136
Iowa	60	82,246	97,479	179,725	52,124
Kansas	37	19,625	56,148	75,773	3,941
Michigan	170	530,608	514,320	1,044,928	410,411
Minnesota	68	37,503	104,429	141,932	28,101
Missouri	57	68,348	163,735	232,083	61,590
Nebraska	15	3,744	7,867	11,611	1,919
North Dakota	2	1,103	687	1,790	76
South Dakota	3				
Ohio	271	445,474	614,359	1,059,833	537,666
Wisconsin	109	239,984	241,125	481,109	182,594
Total: 1942	1,104	2,018,004	2,404,487	4,422,491	1,780,883
1941	1,108	2,837,408	2,873,312	5,710,720	2,436,964
Rocky Mountain:					
Arizona	6	9,133	24,065	33,198	----------
Colorado	25	15,221	62,960	78,181	33,165
Idaho	5	778	3,125	3,903	112
Montana	8	9,420	7,980	17,400	535
Nevada	2	4,049	4,236	8,285	19
New Mexico	2				
Wyoming	1	2	1	3	1
Utah	12	32,076	58,100	90,176	24,648
Total: 1942	61	70,679	160,467	231,146	58,480
1941	64	70,997	142,468	213,465	70,421
Pacific Coast:					
California	126	88,638	227,483	316,121	45,864
Oregon	36	9,360	28,307	37,667	6,453
Washington	50	15,906	54,237	70,143	4,943
Total: 1942	212	113,904	310,027	423,931	57,260
1941	222	165,014	253,071	418,085	63,802
Total United States: 1942	2,763	3,936,603	5,117,918	9,054,521	[1] 4,490,513
1941	2,798	5,004,864	5,559,273	10,564,137	[1] 5,388,747

[1] Includes some pig iron used in making direct castings.

Air furnaces.—Ferrous scrap and pig iron consumed in air furnaces in 1942 amounted to 1,696,880 tons—a 7-percent decline from 1941. The use of home scrap decreased 5 percent, of purchased scrap 10 percent, and pig iron 8 percent; the use of total scrap decreased 7 percent. Thus, equipment of this type used relatively more pig iron than purchased scrap in 1942. No air-furnace operators reported the exclusive use of scrap in 1942 or 1941.

Ohio led in the consumption of scrap in air furnaces in 1942, followed in order by Illinois, Pennsylvania, Indiana, Michigan, Wisconsin, and New York.

Consumption of ferrous scrap and pig iron in air furnaces [1] in the United States in 1942, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	7	27,238	6,136	33,374	15,018
Massachusetts	4				
New Hampshire	1	21,153	8,377	29,530	16,110
Rhode Island	1				
Total: 1942	13	48,391	14,513	62,904	31,128
1941	12	45,134	15,215	60,349	31,198
Middle Atlantic:					
Delaware	1				
New Jersey	2	15,820	2,417	18,237	11,044
New York	12	59,490	16,743	76,233	35,273
Pennsylvania	25	107,172	43,483	150,655	85,027
Total: 1942	40	182,482	62,643	245,125	131,344
1941	41	192,951	77,996	270,947	151,761
Southeastern and Southwestern:					
West Virginia	3				
Texas	1	10,857	5,298	16,155	6,022
Total: 1942	4	10,857	5,298	16,155	6,022
1941	4	11,571	6,656	18,227	6,984
North Central:					
Illinois	15				
Indiana	10	225,196	86,805	312,001	145,926
Michigan	8	85,766	34,547	120,313	50,200
Iowa	1				
Minnesota	1	12,870	4,048	16,918	10,965
Missouri	1				
Ohio	21	196,903	86,913	283,816	118,322
Wisconsin	11	60,822	17,481	78,303	56,761
Total: 1942	68	581,557	229,794	811,351	382,174
1941	70	617,965	248,234	866,199	409,912
Rocky Mountain and Pacific Coast:					
Colorado	2				
California	2	4,891	1,018	5,909	4,768
Total: 1942	4	4,891	1,018	5,909	4,768
1941	4	4,606	1,324	5,930	4,980
Total United States: 1942	129	828,178	313,266	1,141,444	555,436
1941	131	872,227	349,425	1,221,652	604,835

[1] Includes 3 Brackelsberg furnaces—1 each in Indiana, Ohio, and Michigan.

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.

Blast furnaces.—Ferrous scrap constitutes only a small proportion of the metal-bearing materials consumed in blast furnaces. Other materials used in 1942 were 104,055,422 tons of iron and manganiferous iron ores, 6,368,611 tons of cinder and scale, and 4,177,674 tons of flue dust. Total consumption of scrap in 1942, as reported by 73 plants operating blast furnaces, was 2,937,511 tons, a 1-percent increase over 1941. Of the 1942 total, 53 percent was home scrap and 47 percent purchased scrap.

The proportion of scrap used in blast furnaces decreased in 1942, amounting to 5.0 percent of the pig iron produced, compared with 5.3 percent in 1941 and 4.5 percent in 1940. Purchased scrap was equivalent to 2.3 percent of the pig iron produced in 1942, compared with 2.4 percent in 1941 and 1.7 percent in 1940.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1942, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	1				
Massachusetts	2	293	265	558	2
New Hampshire	1				
Total: 1942	4	293	265	558	2
1941	4	861	854	1,715	6
Middle Atlantic and Southeastern:					
New Jersey	2				
Kentucky	1	121	4,166	4,287	15,872
Pennsylvania	11	5,730	19,475	25,205	34,084
Total: 1942	14	5,851	23,641	29,492	49,956
1941	13	5,518	22,964	28,482	54,225
North Central and Southwestern:					
Ohio	1				
Oklahoma	1	69	9	78	98
Wisconsin	1				
Total: 1942	3	69	9	78	98
1941	5	138	307	445	159
Total United States: 1942	21	6,213	23,915	30,128	50,056
1941	22	6,517	24,125	30,642	54,390

Consumption of ferrous scrap in blast furnaces in the United States in 1942, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England and Middle Atlantic:				
Massachusetts	1	12,671	13,701	26,372
New York	6	39,199	59,427	98,626
Pennsylvania	17	584,796	448,690	1,033,486
Total: 1942	24	636,666	521,818	1,158,484
1941	28	617,486	433,525	1,051,011
Southeastern:				
Alabama	8	184,614	57,136	241,750
Kentucky	1			
Maryland	1			
Tennessee	2	58,312	128,503	186,815
West Virginia	2			
Total: 1942	14	242,926	185,639	428,565
1941	12	248,499	212,214	460,713
North Central:				
Illinois	5	135,934	52,773	188,707
Indiana	3	67,159	96,897	164,056
Michigan	5			
Minnesota	2	54,812	55,580	110,392
Ohio	18	420,563	459,537	880,100
Total: 1942	33	678,468	664,787	1,343,255
1941	36	714,552	670,874	1,385,426
Rocky Mountain:				
Colorado	1			
Utah	1	6,852	355	7,207
Total: 1942	2	6,852	355	7,207
1941	2	7,329	459	7,788
Total United States: 1942	73	1,564,912	1,372,599	2,937,511
1941	78	1,587,866	1,317,072	2,904,938

The relative position of the two States that are large consumers of scrap in blast furnaces was reversed in 1942. Pennsylvania became the principal consumer, using 17 percent more than Ohio, the second ranking State; in 1941, Ohio furnaces consumed 8 percent more than Pennsylvania furnaces.

CONSUMPTION IN FERRO-ALLOY PRODUCTION

Data covering the consumption of iron and steel scrap and pig iron in the production of ferro-alloys were assembled for the first time for 1942. The canvass showed that 318,188 tons of ferrous scrap and pig iron were used for this purpose during the year. Various types of furnaces were operated for the manufacture of ferro-alloys, such as blast, electric, and thermic-reduction.

Consumption of ferrous scrap and pig iron by ferro-alloy producers in the United States in 1942,[1] by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
Middle Atlantic:					
New York	5	30	74,291	74,321	----------
Pennsylvania	3	225	1,442	1,667	----------
	8	255	75,733	75,988	----------
Southeastern:					
Alabama	1				
South Carolina	1				
Tennessee	2	40	92,811	92,851	19
West Virginia	1				
	5	40	92,811	92,851	19
North Central and Pacific Coast:					
Iowa	1				
Minnesota	1				
California	1	1,235	120,226	121,461	----------
Oregon	1				
Ohio	4	9,323	18,546	27,869	----------
	8	10,558	138,772	149,330	----------
Total United States	21	10,853	307,316	318,169	19

[1] Comparable data not obtained for 1941.

CONSUMPTION IN MISCELLANEOUS USES

As in ferro-alloy uses, data were gathered for the first time for 1942 showing the consumption of iron and steel scrap in such miscellaneous uses as rerolling, copper precipitation, flux in lead blast furnaces, and as a reducing agent in chemical processes. A total of 947,615 tons of ferrous scrap was reported used in these operations during 1942; no pig iron was reported consumed. Illinois was the largest consumer of scrap for miscellaneous purposes, followed by Pennsylvania and New Jersey.

Consumption of ferrous scrap in miscellaneous uses in the United States in 1942,[1] by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England:				
Massachusetts	2	112	12,243	12,355
New Hampshire	1			
	3	112	12,243	12,355
Middle Atlantic:				
New Jersey	19	4,460	109,816	114,276
New York	10	1,123	76,591	77,714
Pennsylvania	21	8,243	116,873	125,116
	50	13,826	303,280	317,106
Southeastern:				
Alabama	5	2,249	26,531	28,780
Maryland	1	684	55,398	56,082
Virginia	2			
West Virginia	2			
Georgia	2	367	13,064	13,431
Tennessee	1			
	13	3,300	94,993	98,293
Southwestern:				
Oklahoma	1	307	7,999	8,306
Texas	2			
	3	307	7,999	8,306
North Central:				
Illinois	10	2,313	169,853	172,166
Indiana	6	19,169	20,334	39,503
Nebraska	1	57	29,199	29,256
Wisconsin	2			
Michigan	4	1,952	3,920	5,872
Minnesota	3	309	411	720
Missouri	6	44	59,413	59,457
Ohio	10	765	85,005	85,770
	42	24,609	368,135	392,744
Rocky Mountain:				
Arizona	1	65	22,390	22,455
Nevada	1			
New Mexico	2			
Colorado	2	3,479	24,901	28,380
Montana	3			
Idaho	1			
Utah	5	1,940	30,912	32,852
	15	5,484	78,203	83,687
Pacific Coast:				
California	7	601	31,672	32,273
Washington	4	2,587	264	2,851
	11	3,188	31,936	35,124
Total United States	137	50,826	896,789	947,615

[1] Comparable data not obtained for 1941.

FOREIGN TRADE [5]

Imports.—Imports of iron and steel scrap into the United States, which have never been very significant, totaled 101,337 short tons valued at $1,352,055 in 1942, compared with 71,775 tons valued at $730,844 in 1941. Of the 1942 total, 60,024 tons came from Canada, 19,658 from Cuba, 9,058 from the Panama Canal Zone, 3,959 from Curaçao (N. W. I.), 3,532 from Jamaica, 2,242 from British Guiana, and 2,864 from other countries. In addition, 26,972 short tons of tin-plate scrap were imported during 1942, largely from Canada, compared with 25,312 tons in 1941 and 18,609 tons in 1940.

Exports.—Ferrous scrap exports (all types) from the United States in 1942 totaled only 141,736 short tons valued at $3,321,523. In 1941, 904,249 tons valued at $15,973,863 was exported. The low exportation in 1942 was due to two principal factors. Export licensing established in 1940 restricting exports of all grades of scrap, except to Great Britain and countries of the Western Hemisphere, remained in effect through 1942; also, available shipping facilities were more needed for the transportation of finished war materials. The shipments in 1942 included 5,196 tons of tin-plate circles, waste-waste tin plate, and terne plate clippings valued at $469,458. In 1941, exports of this type of scrap totaled 15,909 tons valued at $1,109,217. The following table shows the principal countries to which scrap was exported during the 5-year period 1938–42.

Ferrous scrap exported from the United States, 1938–42, by countries, in short tons

Country	1938	1939	1940	1941	1942
Canada	103,283	196,556	411,571	314,555	(1)
Germany	258,611	18,574			
Italy	486,883	477,004	356,859		
Japan	1,547,617	2,279,315	1,079,141	324	
Netherlands	231,341	60,665	389		
Poland and Danzig	169,625	173,161			
United Kingdom	433,829	569,288	1,100,774	539,650	
Other countries	127,233	240,009	210,549	49,720	
Total value	3,358,422	4,014,572	3,159,283	904,249	141,736
	$45,829,533	$55,911,516	$48,314,146	$15,973,863	$3,321,523

[1] Figures not yet compiled on annual basis for individual countries.

WORLD ASPECTS

Statistics on the production of steel and pig iron in the world during 1942 are not available, as publication of information has been suspended in many of the countries involved. However, as this is a mechanized war, iron and steel are highly essential to the military and naval forces; therefore, world steel and pig-iron production undoubtedly increased considerably, and the demand for and use of iron and steel scrap was greater than in any previous year.

REVIEW BY COUNTRIES

Canada.—Steel production in Canada reached unprecedented levels in 1942, when the output of steel ingots and castings increased approximately 16 percent over the production in 1941, the previous record

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

year. Steel ingots and castings produced during 1942 totaled 3,121,000 short tons, whereas production in 1941 amounted to 2,701,000 tons. The increase in Canadian blast-furnace capacity in 1942 was reflected in the record production of pig iron, which showed a larger percentage increment than did steel manufacture. Production of pig iron in 1942 totaled 1,975,000 tons, compared with the previous record of 1,528,000 tons established in 1941, an increase of more than 29 percent.[6] In the record production of steel approximately 1,619,000 tons of pig iron and 1,833,000 tons of scrap were used, resulting in a ratio of 47 percent pig iron to 53 percent scrap, with the scrap charge containing 49 percent home scrap and 51 percent purchased scrap. Slightly more than 130,000 tons of scrap was used in the manufacture of pig iron during 1942. The increased production of steel occasioned alarm as to the scrap supply, but with the large increase in pig-iron production augmented by the scrap obtained from ingots and semifinished steel imported into Canada, these fears were unfounded. Although the production of steel increased, no shortage of scrap occurred, and dealers as well as consumers were able to create stock piles large enough to satisfy requirements for several months in 1943.[7]

At the beginning of 1942, to provide a larger quantity of steel and metals for war industries, the Minister of Munitions and Supply issued orders curtailing the manufacture of civilian materials in which steel or metal was the principal component.[8] At various times throughout the year these restrictions were extended to embrace additional items, including civilian automobiles, refrigerators, other electrical products, and cast-iron and steel pipe.

The maximum price regulations covering scrap established in 1941 were extended to include British Columbia and the Maritime Provinces, placing prices for scrap throughout the entire Dominion of Canada under strict control.[9] In addition, the Steel Controller undertook supervision of distribution of scrap produced by war plants and placed this material under allocation to consuming mills most urgently in need of scrap.[10] Early in the year the government agreed to permit consumers to absorb freight cost in excess of the established maximum prices when the origin of the scrap was remote from the consuming plant; however, they were required to adhere to the ceiling price at the point of purchase.[11] This action tended to stimulate collection of scrap in the western provinces, thereby augmenting supplies near the consuming areas. Former programs to collect scrap were intensified and in the last 6 months of the year were placed under direct control of the government, which provided for a more aggressive salvage campaign on a nationwide basis.[12] The Steel Controller also placed operators of automobile-wrecking yards under strict control, which required them to dispose of all wrecked cars within 90 days from the date the order was issued in March.[13] During August the Department of Munitions and Supply issued an order stating that it would be illegal to retain possession of any scrap metal weighing 500

[6] Department of Trade and Commerce, Monthly Report, Production of Iron and Steel in Canada, December 1942.
[7] American Metal Market, vol. 49, No. 246, Dec. 23, 1942, p. 7.
[8] Steel, vol. 110, No. 1, Jan. 5, 1942, p. 383.
[9] American Metal Market, vol. 49, No. 74, Apr. 18, 1942, p. 9.
[10] The Iron Age, vol. 149, No. 13, Mar. 16, 1942, p. 129.
[11] American Metal Market, vol. 49, No. 10, Jan. 15, 1942, p. 9.
[12] Daily Metal Trade, vol. 32, No. 210, Oct. 27, 1942, p. 14.
[13] Daily Metal Reporter, vol. 42, No. 55, Mar. 21, 1942, p. 11.

pounds or more after September 15.[14] The order included as scrap any machinery, structural steel, or other article containing iron and steel; it also provided for disposal within 20 days of any scrap metal obtained after the effective date. All these acts increased the flow of scrap material during the year, thereby creating supplies in excess of demands and providing ample inventories at the close of the year. Since exportation of iron and steel scrap from Canada ceased in 1939, except to the United Kingdom and nations of the Western Hemisphere, exports have decreased considerably.

Germany.—Statistics on the production of steel and pig iron and on the consumption of scrap in Germany are not now available. However, as a result of annexation and military occupancy of European countries, steel-ingot capacity is estimated to have been 53,800,000 short tons at the beginning of 1942, or 6 percent greater than it was on January 1, 1941.[15] Nevertheless, steel production has been curtailed considerably by shortages of raw materials and transportation difficulties. The shortage of alloy materials is greatest, which has caused the German steel industry to reduce previously accumulated stock piles of alloying elements.[16] Drives for scrap were intensified, and orders were issued for the confiscation of all unused iron and steel, including finished castings and spare parts.[17] In addition, authorities in charge of war economy established an immense drive in all occupied areas to obtain scrap from sources other than war material.[18]

The German iron and steel industry was organized into one association under the supervision of the Ministry of Economics, with control over the foundries, blast furnaces, and steel works as well as the ore trade and the large iron and steel merchants. This organization was given complete control over the entire industry, including raw materials, production, imports and exports, and prices.[19]

Japan.—Reserve accumulations of scrap held by Japan at the beginning of the year 1942 were estimated at approximately 10,000,000 short tons.[20] The request, made in 1941 by the Ministry of Commerce, that steel-manufacturing companies use a ratio of 70 percent pig iron and 30 percent scrap, had the effect of extending the supply of scrap so that it would last several years should ingot production be maintained at the full capacity of 7,200,000 tons each year.[21] To augment the scrap supply, the Government extended salvage operations previously inaugurated by recovering sunken ships from Japanese waters and by investigation and exploitation of all possible sources.[22] All raw materials were placed under better control, with pig-iron sales being centralized through a separate organization that would purchase the entire output of the principal producers and then sell it to steel mills and foundries at a uniform price.[23]

United Kingdom.—Scrap became a more significant factor in the manufacture of steel in the United Kingdom in 1942, especially since production facilities were expanded and operations increased to a degree never before attained. Imports of scrap from the United

[14] Daily Metal Trade, vol. 32, No. 163, Aug. 20, 1942, p. 16.
[15] Steel, vol. 111, No. 1, July 6, 1942, p. 74.
[16] American Metal Market, vol. 49, No. 233, Dec. 5, 1942, p. 1.
[17] Daily Metal Trade, vol. 32, No. 165, Aug. 22, 1942, p. 14.
[18] Daily Metal Reporter, vol. 42, No. 251, Dec. 31, 1942, p. 11.
[19] The Iron Age, vol. 150, No. 5, July 30, 1942, p. 96.
[20] The Iron Age, vol. 149, No. 4, Jan. 22, 1942, p. 73.
[21] Foreign Commerce Weekly, vol. 4, No. 2, July 12, 1941, p. 14.
[22] Daily Metal Trade, vol. 32, No. 133, July 9, 1942, p. 14.
[23] Iron and Coal Trades Review (London), vol. 144, No. 3860, Feb. 20, 1942, p. 174.

States had been discontinued in September 1941, thereby disturbing normal operations; however, this was partly counteracted by the varying amounts of scrap obtainable from ingots and semifinished material imported under lend-lease agreements. As nearly all the scrap contained in buildings damaged by bombs had been salvaged in 1941, the Ministry of Works and Buildings undertook intensive nationwide drives for iron and steel scrap from other sources, including homes, farms, commercial premises, derelict properties, disused machinery, and pithead equipment.[24] The control of Iron and Steel (Scrap) Order 14, which was issued in 1941 by the British Ministry of Supply to completely control all buying and selling of scrap, was amended to provide higher prices for high-speed steel scrap and magnet scrap.[25] The Ministry of Works and Buildings issued an order designed to compel any person having more than 3 tons of scrap in his possession to sell it if required, thus making it possible to enforce compulsory liquidation of all substantial quantities of this essential raw material.[26] Since transportation difficulties were anticipated and also to compensate for the lack of imports, a series of dumps throughout the country was established to provide a reserve supply of scrap.[27] Also, issued by the Ministry of Works and Buildings was an order making the disclosure of scrap metal compulsory in Great Britain. Under this order, any metal that forms part of any unused, obsolete, or redundant building, structure, plant, or article is considered to be scrap.[28] In the meantime, the voluntary salvage drives underway yielded approximately 1,400,000 tons in 14 months.

[24] American Metal Market, vol. 49, No. 25, Feb. 5, 1942, p. 8.
[25] The Metal Bulletin (London), No. 2685, Apr. 17, 1942, p. 10.
[26] Iron and Coal Trades Review, vol. 145, No. 3872, May 15, 1942, p. 127.
[27] Iron and Coal Trades Review, vol. 145, No. 3876, June 12, 1942, p. 291.
[28] American Metal Market, vol. 49, No. 202, Oct. 17, 1942, p. 7.

IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL

By Norwood B. Melcher and Edward J. Langey [1]

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GENERAL FEATURES IN 1942

Steel-industry production figures continued upward in 1942. Steel-making capacity increased 2 percent, while production of steel ingots and castings increased 4 percent and totaled 86,031,931 short tons—an all-time high. Pig-iron production totaled 59,077,593 tons, and usable iron-ore output (exclusive of ore containing 5 percent or more manganese) was 118,189,336 tons—both all-time records.

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

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Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States, 1941–42

	1941		1942	
	Short tons	Value	Short tons	Value
Crude iron ore:				
Production by districts:				
Lake Superior	[1] 99,921,135	(2)	115,773,591	(2)
Southeastern	12,810,546		17,132,415	
Northeastern	6,284,913		6,940,702	
Western	1,629,335		1,863,708	
	120,645,929	(2)	141,710,416	(2)
Production by mining methods:				
Open pit	[3] 88,971,076	(2)	103,269,505	(2)
Underground	[3] 31,674,853		38,440,911	
	120,645,929	(2)	141,710,416	(2)
Production by types of ore:				
Hematite	(2)	(2)	125,650,342	(2)
Brown			8,646,791	
Magnetite			7,412,137	
Carbonate	987		1,146	
	120,645,929	(2)	141,710,416	(2)
Shipments	(2)	(2)	142,010,365	(2)
Usable iron ore:				
Production by districts:				
Lake Superior	[1] 88,321,332	(2)	101,925,624	(2)
Southeastern	9,123,408		10,258,335	
Northeastern	4,437,521		3,493,847	
Western	1,616,468		1,791,358	
Undistributed (byproduct ore)	(2)		720,172	
	103,498,729	(2)	118,189,336	(2)
Production by variety:				
Direct	(2)	(2)	91,551,205	(2)
Sinter			3,429,898	
Concentrates			22,488,061	
Byproduct ore (pyrite cinder and sinter)	(4)	(4)	720,172	
	103,498,729	(2)	118,189,336	(2)
Shipments	[5] 104,220,473	[5] $249,705,903	118,707,133	$279,178,751
Average value per ton at mine		2.40		2.35
Stocks at mines December 31	4,023,197	(2)	3,770,869	(2)
Imports	2,625,261	5,347,277	819,084	2,142,569
Exports	2,136,525	6,212,308	2,817,235	8,114,586
Pig iron:				
Production	55,085,446	(2)	59,077,593	(2)
Shipments	55,223,641	1,111,811,316	59,100,601	1,227,389,689
Average value per ton at furnace		20.13		20.77
Imports	3,675	61,130		
Exports	578,533	15,606,692	110,647	3,144,701
Ferro-alloys:				
Production	1,636,073	(2)	1,889,409	(2)
Shipments:				
Ferromanganese	619,395	69,378,004	659,219	82,726,298
Spiegeleisen	181,177	5,793,481	186,163	5,931,728
Ferrosilicon	661,913	34,084,428	707,522	39,691,636
Other ferro-alloys	257,300	95,600,706	307,383	129,399,523
	1,719,785	204,856,619	1,860,287	257,749,185
Imports:				
Ferromanganese	7,032	557,150	14,772	1,274,749
Spiegeleisen	4,741	215,108	1,990	95,853
Ferrosilicon	18,261	750,975	15,211	569,134
Steel:				
Production:				
Open-hearth:				
Basic	73,312,851	(2)	75,183,065	(2)
Acid	1,076,768		1,318,892	
Bessemer	5,578,071		5,553,424	
Crucible	2,313		2,010	
Electric	2,869,256		3,974,540	
	82,839,259	(2)	86,031,931	(2)
Shipments to consuming industry	62,484,162	(2)	60,440,000	(2)

[1] Includes a small quantity of ore from southern Wisconsin. [2] Data not available.
[3] Some underground included with open pit in 1941. [4] Undetermined—not included in total.
[5] Exclusive of ore for paint in 1941.

Most of the normal steel-consuming industries received less steel in 1942 than in 1941, owing to the very heavy demands for steel by industries engaged in direct war production. The automobile industry, normally the largest single consumer, ceased producing passenger cars in March, and output totaled only 206,274 units, compared with nearly 5 million in 1941; it was the largest industry to convert to war production. Shipbuilding activity increased phenomenally in 1942; deliveries of steel for shipbuilding soared from less than 3 million tons in 1941 to 9,425,000 tons in 1942. Miscellaneous industries and exports (which include arms production and Lend-Lease consignments) received the largest share (24.6 percent)

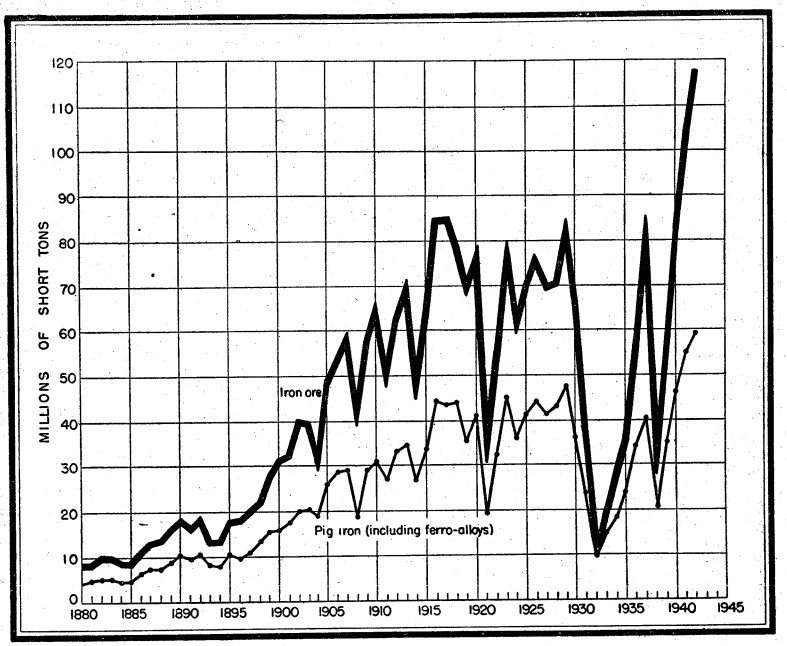

FIGURE 1.—Trends in production of iron ore and pig iron in the United States, 1880–1942.

of steel shipments in 1942, and a slight increase in shipments to the construction industry was apparent during the year.

The annual steel-making capacity of the United States increased to a total of 90,293,000 tons of steel ingots and castings as of January 1, 1943, or 1,723,000 tons above the previous high level of 88,570,000 tons on January 1, 1942. Blast-furnace capacity increased from 60,394,000 tons on January 1, 1942, to 63,302,000 tons at the opening of 1943. The present expansion program for pig-iron- and steel-making capacity will be completed about January 1, 1944. At the completion of the program the United States will have the capacity to produce 97,340,000 tons of steel ingots and castings and 70,881,000 tons of pig iron.

During 1942 the most important development in Government regulation of the flow of steel for war production was the establishment of the Controlled Materials Plan, known as CMP. This plan, effective in the first quarter of 1943, is designed to maintain maximum

production of war products and essential civilian products within the limits of available materials and facilities. Its sponsors claimed that it established quantitative controls for a direct balancing of the demand for products with the supply of materials and facilities available for their production.

A drop in employment was felt in the steel industry during 1942. The average number of men engaged in the industry (blast furnaces, steel works, and rolling mills) declined from 543,000 in December 1941 to 520,000 in December 1942. However, employment reached a maximum in June 1942, with a total of 549,000 employees. The average earnings per week in 1942 increased from $39.26 in January to $45.15 in December. Early in 1943, the War Manpower Com-

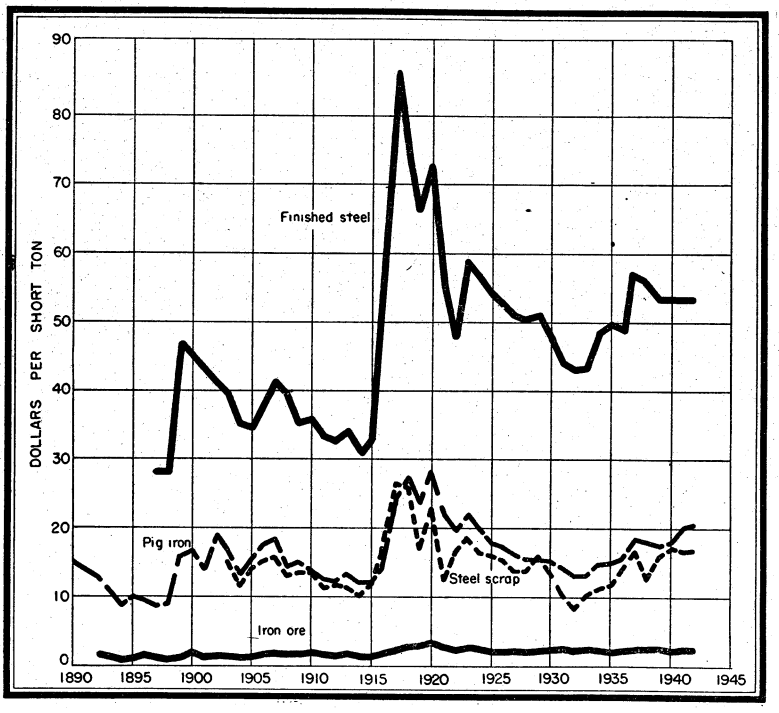

FIGURE 2.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap, 1890–1942. The prices of iron ore and pig iron are the averages, f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No. 1 Heavy Melting, computed by Iron Age.

mission gave notice to the steel industry that unless mills are operating on a 48-hour week after July 1, 1943, no additional workers shall be hired for work therein without the approval of the War Manpower Commission. This order in effect will make a 48-hour work week mandatory. It is estimated that because of time-and-a-half pay for work over 40 hours, total wages will increase about 100 million dollars a year. However, about 50,000 fewer employees will be required under this program.

In July 1942 the National War Labor Board granted 157,000 employees of four steel companies (Bethlehem Steel Corporation, Inland Steel Co., Republic Steel Corporation, and Youngstown Sheet

& Tube Co.) an increase in wages of 5½ cents per hour. This action brought about adoption of the Little Steel Formula, designed to guide the settlement of wage disputes in other industries. The program provides for a 15-percent increase from the wage level of January 1, 1941. Dr. George W. Taylor, representing the public on the Board, in reviewing the program gave the following principle as a guide in evaluating claims for wage increases [2]:

> For the period from January 1, 1941, to May 1942, which followed a long period of relative stability, the cost of living increased by about 15 percent. If any group of workers averaged less than a 15-percent increase, the hourly wage rate during, or immediately preceding, or following this period, their established peacetime standard has been broken. If any group of workers averaged a 15-percent wage increase or more, their established peacetime standard has been preserved.

This formula eventually affected almost every wage earner in the steel industry and most salaried workers as well, with increases retroactive to February 1942. Application of the formula led to wage advances in the automobile industry, whose case was then pending, and to increases in other industries.

IRON ORE

PRODUCTION AND SHIPMENTS

The enormous demand for iron ore by a wartime steel industry resulted in a record year in domestic iron mining. United States iron mines produced 141,710,416 short tons of crude ore during 1942, and shipments totaled 142,010,365 tons. Of this latter quantity, 49,936,613 tons were shipped to beneficiation plants and 92,073,752 tons direct to consumers. A total of 25,917,959 tons of beneficiated ore were produced at milling plants, in addition to 720,172 short tons of byproduct cinder and sinter from the pyrite industry. In all, 118,189,336 short tons of usable ore were produced in 1942. Output in 1942 came from 252 mines, of which 35 mined over 1,000,000 tons of crude ore each. Minnesota, with 82,809,939 tons, supplied 70 percent of the usable ore, and Michigan, with 17,499,060 tons or 15 percent, was the second-largest producer. These two States and Wisconsin (1,682,897 tons or 1 percent) constitute the Lake Superior region, which supplied 86 percent of the domestic output. About three-fourths of the iron ore mined in 1942 came from open-pit mines.

Shipments of usable ore from mines totaled 118,707,133 short tons in 1942. Of this quantity, 91,972,925 tons or 77 percent was direct shipping ore for iron and steel furnaces. Total shipments also include 74,036 tons for cement manufacture, 29,424 tons for paint, and 34,842 tons for miscellaneous uses. Shipments and values of byproduct ore for iron- and steel-furnace use are included for the first time in 1942. These shipments totaled 755,844 tons in 1942 valued at $3,237,511.

[2] Taylor, George W., "Terminal" for Present Ratio of Wages, Prices Sought by Board: Steel, vol. 11, No. 3, July 20, 1942, pp. 43–44.

Crude iron ore mined in the United States in 1942, by States and varieties, in short tons

[Exclusive of ore containing 5 percent or more manganese]

State	Number of mines	Hematite	Brown ore	Magnetite	Carbonate	Total
Alabama	[1] 47	8,678,345	6,930,768			15,609,113
Arizona	1	386				386
California	5	[2] 91,525		[2] 14,995		106,520
Georgia	[1] 20	5,128	1,501,137			1,506,265
Michigan	44	17,499,060				17,499,060
Minnesota	101	96,591,634	101,956			96,693,590
Missouri	[1] 4	6,935	61,173			68,108
New Jersey	4			1,494,853		1,494,853
New Mexico	[1] 8	18,631		88,675		107,306
New York	5	2,183		5,442,520	1,146	5,445,849
Pennsylvania	2					
Texas	1		51,757			51,757
Virginia	2					
Utah	2			359,558		359,558
Washington	3	1,748		11,536		13,284
Wisconsin	2	1,682,897				1,682,897
Wyoming	1	1,071,870				1,071,870
Total: 1942	[1] 252	[2] 125,650,342	8,646,791	[2] 7,412,137	1,146	141,710,416
1941	[1] 276	[3]	[3]	[3]	987	120,645,929

[1] Excludes an undetermined number of small pits. Output of these pits included in tonnage given.
[2] Small quantity of magnetite included with hematite.
[3] Break-down by varieties not available for 1941.

The output of manganese-bearing ore containing 5 percent or more manganese is not considered in this chapter.

Crude iron ore mined in the United States, 1941–42, by States and mining methods, in short tons

State	1941			1942		
	Open pit	Underground	Total	Open pit	Underground	Total
Alabama	3,775,851	7,767,665	11,543,516	7,044,822	8,564,291	15,609,113
Arizona				386		386
California	60,293		60,293	105,473	1,047	106,520
Connecticut	99		99			
Georgia	1,264,978	1,624	1,266,602	1,506,265		1,506,265
Michigan	1,911,140	14,520,595	16,431,735	1,101,359	16,397,701	17,499,060
Minnesota	76,632,384	5,248,435	81,880,819	91,214,064	5,479,526	96,693,590
Mississippi	57		57			
Missouri	19,453	1,438	20,891	63,568	4,540	68,108
Nevada	241		241			
New Jersey		1,429,556	1,429,556		1,494,853	1,494,853
New Mexico				104,882	2,424	107,306
New York	[1] 4,855,258	(1)	4,855,258	1,705,835	3,740,014	5,445,849
Pennsylvania						
South Dakota						
Virginia	34,846		34,846	51,757		51,757
Texas						
Oklahoma						
Utah	397,607		397,607	359,558		359,558
Washington	11,200	474	11,674	11,536	1,748	13,284
Wisconsin	4,480	1,604,101	1,608,581		1,682,897	1,682,897
Wyoming	3,189	1,100,965	1,104,154		1,071,870	1,071,870
	88,971,076	31,674,853	120,645,929	103,269,505	38,440,911	141,710,416

[1] Underground included with open pit.

Usable iron ore produced in the United States in 1942, by States and types of product, in short tons

[Exclusive of ore containing 5 percent or more manganese]

State	Direct shipping ore	Sinter [1]	Concentrates	Pyrite cinder and sinter	Total	Iron content, natural (percent)
Alabama	7,112,171	1,203,792	1,596,635		9,912,598	36.77
Arizona	386				386	58.00
California	106,520				106,520	56.30
Georgia	5,128		329,214		334,342	47.28
Michigan	17,499,060				17,499,060	51.68
Minnesota	63,271,187	301,434	19,237,318		82,809,939	52.11
Missouri	53,091		6,089		59,180	49.74
New Jersey	107,323		569,214		676,537	62.89
New Mexico	107,306				107,306	54.85
New York	161,171	1,924,672	731,467		2,817,310	65.95
Pennsylvania						55.19
Texas	253		18,124		18,377	52.51
Virginia						37.41
Utah	359,558				359,558	53.49
Washington	13,284				13,284	61.33
Wisconsin	1,682,897				1,682,897	52.65
Wyoming	1,071,870				1,071,870	49.89
	91,551,205	3,429,898	22,488,061		117,469,164	51.00
Byproduct ore: [2]						
Delaware						61.89
Michigan						65.91
Pennsylvania				720,172	720,172	62.66
Tennessee						67.20
Virginia						54.10
				720,172	720,172	63.74
Grand total	91,551,205	3,429,898	22,488,061	720,172	118,189,336	51.08

[1] Exclusive of sinter produced at consuming plants.
[2] Obtained from pyrite treated in, but not necessarily mined in, States indicated.

Crude iron ore mined in the United States in 1942, by mining districts and varieties, in short tons

[Exclusive of ore containing 5 percent or more manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
Lake Superior [1]	115,773,591				115,773,591
Birmingham	8,678,263	2,665,924			11,344,187
Chattanooga	5,210	2,576,970			2,582,180
Adirondack and Cornwall			5,442,520		5,442,520
Northern New Jersey			1,494,853		1,494,853
Other districts	[2] 1,193,278	3,403,897	[2] 474,764	1,146	5,073,085
	[2] 125,650,342	8,646,791	[2] 7,412,137	1,146	141,710,416

[1] Includes only those mines in Minnesota that are in the true Lake Superior district.
[2] Small quantity of magnetite included with hematite.

Shipments of usable iron ore in the United States in 1942, by States and uses, in short tons

[Exclusive of ore containing 5 percent or more manganese]

State	Iron and steel				Cement	Paint	Miscellaneous	Total	
	Direct shipping ore	Sinter [1]	Concentrates	Pyrite cinder and sinter				Short tons	Value
Alabama	7,109,814	1,203,792	1,592,957					9,906,563	$19,034,753
Arizona	386							386	(2)
California	20,265				69,449		14,306	104,020	239,429
Georgia	4,960		329,214					334,174	722,013
Michigan	18,065,011							18,065,011	45,599,536
Minnesota	63,187,629	301,434	19,239,922					82,728,985	179,752,236
Missouri	53,636		7,226			397	988	62,247	177,587
New Jersey	107,156		550,828		2,850	14,825	104	675,763	3,672,750
New Mexico	107,306							107,306	299,097
New York, Pennsylvania, Texas	152,567	1,928,640	686,049			2,687		2,769,943	16,750,627
Virginia	22					11,515	7,908	19,445	(2)
Utah	358,214							358,214	(2)
Washington					1,737		11,536	13,273	(2)
Wisconsin	1,734,089							1,734,089	3,936,590
Wyoming	1,071,870							1,071,870	(2)
Undistributed									[3] 5,756,622
	91,972,925	3,433,866	22,406,196		74,036	29,424	34,842	117,951,289	275,941,240
Byproduct ore: [4] Delaware, Michigan, Pennsylvania, Tennessee, Virginia				755,844				755,844	3,237,511
Grand total	91,972,925	3,433,866	22,406,196	755,844	74,036	29,424	34,842	118,707,133	279,178,751

[1] Exclusive of sinter produced at consuming plants.
[2] Value included with "Undistributed."
[3] Includes values for States entered as "2".
[4] Obtained from pyrite treated in, but not necessarily mined in, States indicated.

Crude iron ore shipped from mines in the United States in 1942, by States and disposition, in short tons

State	Direct to consumers	To beneficiation plants	Total
Alabama	7,109,814	8,505,422	15,615,236
Arizona	386		386
California	104,020		104,020
Georgia	4,960	1,501,137	1,506,097
Michigan	18,065,011		18,065,011
Minnesota	63,187,629	33,142,184	96,329,813
Missouri	55,021	14,029	69,050
New Jersey	107,156	1,397,425	1,504,581
New Mexico	107,306		107,306
New York, Pennsylvania, Texas	154,750	5,324,912	5,479,662
Virginia	253	51,504	51,757
Utah	358,214		358,214
Washington	13,273		13,273
Wisconsin	1,734,089		1,734,089
Wyoming	1,071,870		1,071,870
	92,073,752	49,936,613	142,010,365

PRINCIPAL MINES

The size of a mine is determined by the quantity of crude ore excavated. Hence, mines producing low-grade ores, which require concentration, will be comparable in size to mines producing direct shipping ores. A total of 35 mines, yielding more than 1,000,000

short tons of crude ore each, produced 62 percent of the entire output in 1942. Of these producers, 25 were in Minnesota, 4 were in Alabama, 2 in New York, and 1 each in Michigan, Pennsylvania, Wisconsin, and Wyoming; 22 were open-pit operations, 9 were underground operations, and 4 were combination mines. Except for 3 mines that produced magnetite, all the million-ton mines produced hematite.

Iron-ore mines in the United States in 1942, by size of crude output

Name of mine	State	Nearest town	Range or district	Mining method	Short tons
Hull-Rust-Burt-Sellers	Minnesota	Hibbing	Mesabi	Open pit	24,121,665
Penobscot	do	Calumet	do	do	5,727,103
Hill Annex	do	Hibbing	do	do	4,531,691
Mahoning	do	Eveleth	do	Combined	4,172,410
Adams Spruce	do	Nashwauk	do	Open pit	2,627,703
Kevin	do	Marble	do	do	2,598,771
Hill Trumbull	do	Chisholm	do	do	2,184,218
Frazer D'Autremont	do	Virginia	do	do	2,056,700
Alpena (stockpile)	Alabama	Bessemer	Birmingham	Underground	1,972,851
Muscoda	do	do	do	do	1,908,448
Wenonah	Minnesota	Hibbing	Mesabi	Open pit	1,840,337
Scranton	do	Coleraine	do	do	1,836,122
Morrison	do	Taconite	do	do	1,820,090
Holman-Brown	do	Chisholm	do	do	1,820,039
Leonard-Burt-Glen	do	Eveleth	do	do	1,727,621
Hull-Nelson	do	Hibbing	do	Combined	1,676,040
Morris	do	Marble	do	Open pit	1,645,399
Arcturus	do	Cooley	do	do	1,587,118
Harrison	do	Coleraine	do	do	1,550,127
Canisteo	Alabama	Bessemer	Birmingham	Underground	1,480,482
Ishkooda	Minnesota	Keewatin	Mesabi	Combined	1,409,763
Bennett	do	Coleraine	do	Open pit	1,329,095
Danube	Alabama	Bessemer	Birmingham	Underground	1,279,211
Woodward No. 3	Wisconsin	Montreal	Gogebic	do	1,252,489
Montreal	Michigan	Negaunee	Marquette	do	1,239,497
Negaunee	Minnesota	Virginia	Mesabi	Open pit	1,175,953
Rouchleau (stockpile)	do	Nashwauk	do	do	1,165,438
Hawkins	do	do	do	do	1,146,003
Argonne	do	Calumet	do	do	1,135,485
Majorca	do	Hibbing	do	do	1,132,984
Susquehanna	Wyoming	Sunrise	Hartville	Underground	1,071,870
Sunrise	Minnesota	Gilbert	Mesabi	Open pit	1,015,250
Schley	Michigan	Negaunee	Marquette	Underground	988,287
Maas	Alabama	Russellville	Russellville	Open pit	976,724
Russellville Nos. 5 and 12	Minnesota	Nashwauk	Mesabi	do	949,554
Galbraith	do	Elcor	do	do	948,510
Corsica	do	Hibbing	do	Combined	929,341
Webb	New Jersey	Dover	New Jersey	Underground	921,060
Scrub Oaks	Michigan	Vulcan	Menominee	do	879,825
Penn Group	Alabama	Woodstock	Birmingham	Open pit	874,720
Giles	Minnesota	Ely	Vermilion	Underground	847,967
Zenith	Alabama	Bessemer	Birmingham	do	809,310
Raimund Nos. 1 and 2	Minnesota	Hibbing	Mesabi	Open pit	801,250
Warren	Michigan	Ishpeming	Marquette	Underground	799,154
Cliffs Shaft	Minnesota	Buhl	Mesabi	Open pit	791,246
Wabigon	Michigan	Wakefield	Gogebic	do	771,960
Plymouth	do	Negaunee	Marquette	Underground	763,558
Athens	Minnesota	Greenway	Mesabi	Open pit	762,393
Barbara	Michigan	Ironwood	Gogebic	Underground	751,140
Geneva-West Davis	Minnesota	Buhl	Mesabi	Open pit	745,552
Grant	Michigan	Stambaugh	Menominee	Underground	727,229
Hiawatha Nos. 1 and 2	Minnesota	Chisholm	Mesabi	do	725,985
Godfrey	Pennsylvania	Cornwall	Cornwall	Combined	5,011,676
Cornwall	New York	Lyon Mountain	Adirondack	Underground	
Chateaugay	do	Mineville	do	do	
Harmony-Old Bed					
Output of 55 mines producing more than 700,000 tons each					105,014,354
Output of 9 mines producing 600,000 to 700,000 tons each					5,851,973
Output of 10 mines producing 500,000 to 600,000 tons each					5,530,976
Output of 14 mines producing 400,000 to 500,000 tons each					6,412,988
Output of 16 mines producing 300,000 to 400,000 tons each					5,502,063
Output of 21 mines producing 200,000 to 300,000 tons each					4,974,749
Output of 33 mines producing 100,000 to 200,000 tons each					4,659,660
Output of 24 mines producing 50,000 to 100,000 tons each					1,691,892
Output of 70 mines producing less than 50,000 tons each					891,860
Output from reprocessed tailings (3 plants)					1,179,901
Grand total of United States (252 [1] mines and 3 reprocessing plants)					141,710,416

[1] Excludes an undetermined number of small pits. The output of these pits is included in the total given.

BENEFICIATION

Iron ore is concentrated by washing, jigging, and magnetic and high-density separation to remove objectionable impurities, thereby improving the grade of the ore. Fine ores are agglomerated or sintered into lumps, which are desirable in blast and steel furnaces because of their porous character and their improved grade and structure. Sintering likewise has the beneficial effect of reducing the sulfur and moisture content. At many mines the ore is crushed and screened to improve its physical characteristics, but ore known to be so improved is not included in the statistics on beneficiated ore.

In 1942 a total of 25,917,959 short tons of beneficiated ore was produced from 49,936,613 tons of crude ore. Beneficiation of iron ore was reported at 120 miles in 9 States in 1942, compared with 112 mines in 8 States in 1941. Beneficiated ore shipped from domestic mines in 1942 increased 21 percent over 1941; concentrates comprised 19 percent and sinter 3 percent of total usable ore shipments.

Beneficiation of crude iron ore in the Lake Superior district (all in Minnesota) began in 1907, when 10,994 short tons of concentrates were shipped from the experimental washing plant of the Oliver Iron Mining Co. on the Mesabi range.[3] From that date, the construction of additional washing, drying, jigging, magnetic concentrating, sintering, and high-density plants in Minnesota increased the proportion of beneficiated-ore shipments to total shipments from 0.03 percent in 1907 to 24 percent in 1942. The quantity of crude ore beneficiated in 1942 totaled 33,142,184 short tons and the beneficiated ore recovered 19,538,752 tons—a ratio of 1.696:1. In 1941 the crude ore treated totaled 28,774,481 short tons and the beneficiated ore recovered therefrom 16,940,412 tons—a ratio of 1.699:1. During 1942, E. W. Davis,[4] Mines Experimental Station, University of Minnesota, and G. W. Hewitt,[5] Wheeling Steel Corporation, urged the construction of additional concentrating plants to beneficiate the magnetic taconite ore at the eastern end of the Mesabi range, to conserve the reserves of Mesabi open-pit direct shipping ores. Davis states that the magnetic taconite may be treated by a process similar to that now in use by the Republic Steel Corporation in New York State. The process consists of crushing the crude ore to a fine size, extracting the iron oxide from it magnetically, and then agglomerating the concentrate. The sintered taconite concentrate would average 62 to 65 percent iron.

The Universal-Atlas Portland Cement Co., Universal, Pa., and the Buffalo Sintering Corporation, Buffalo, N. Y., beneficiated Lake ores. The nodulized ore produced at Universal was used for charge ore in the open hearth, and the sinter produced at Buffalo was consumed in both blast and open-hearth furnaces. Production from these plants is not included in usable ore statistics, as the tonnage has been accounted for in mine shipments.

[3] Craig, John J., Shipments of Concentrated Iron Ore from Minnesota at New Peak in 1941: Skillings Mining Review, vol. 30, No. 47, March 14, 1942, Duluth, Minn., pp. 1, 2, and 6.
[4] Davis, E. W., Lake Superior Iron Ore and the War Emergency: Blast Furnace and Steel Plant, vol. 30, No. 12, December 1942, pp. 1364–1368; vol. 31, No. 2, February 1943, pp. 211–216.
[5] Hewitt, G. W., Future Possibilities of Mesabi Magnetic Sinter: Blast Furnace and Steel Plant, vol. 30, No. 7, July 1942, pp. 753–754.

Iron ore shipped from mines in the United States, 1925–29 (average) and 1938–42, in short tons, and percentage of beneficiated ore compared to total shipped

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint [1]]

Year	Beneficiated	Total	Proportion of beneficiated to total (percent)	Year	Beneficiated	Total	Proportion of beneficiated to total (percent)
1925–29 (ave.)	9,692,021	74,700,781	13.0	1940	14,476,830	84,221,854	17.2
1938	5,416,807	29,602,619	18.3	1941	21,701,254	104,220,473	20.8
1939	10,556,906	61,406,352	17.2	1942	[1] 25,877,538	[1] 117,951,289	21.9

[1] Includes ore for paint in 1942.

AVERAGE VALUE

The average value per short ton of usable iron ore at the mine was $2.35 in 1942, compared with $2.40 in 1941.

The accompanying table gives the average value at the mines of the different classes of iron ore in 1942 for each of the producing States or groups of States, except when there are fewer than three shippers of a certain class 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 short ton of usable iron ore at mines in the United States in 1942

[Exclusive of ore containing 5 percent or more manganese]

State	Direct			Concentrates			Sinter	Pyrite cinder and sinter
	Hematite	Brown ore	Magnetite	Hematite	Brown ore	Magnetite		
Alabama	$1.83			(1)	$2.23		(1)	
California	2.09		(1)					
Georgia	(1)				2.14			
Michigan	2.52							
Minnesota	2.14			$2.15	(1)		$2.23	
Missouri	4.19	(1)			(1)			
New Jersey			(1)			$5.26		
New Mexico	3.86		$2.56					
New York	(1)		(1)			4.08	6.57	
Pennsylvania			(1)					
Wisconsin	2.27							
Other [2]	4.02	(1)	2.99		(1)			
Average, all States	2.24	$2.66	4.52	2.17	2.36	4.62	4.10	
Byproduct ore: [3]								
Delaware								
Michigan								
Pennsylvania								$4.28
Tennessee								
Virginia								

[1] Less than 3 producers; permission to publish not given, therefore value may not be shown.
[2] Includes Arizona, Texas, Utah, Virginia, Washington, and Wyoming.
[3] Obtained from pyrite treated in, but not necessarily mined in, States indicated.

CONSUMPTION

The production of 59,077,593 short tons of pig iron in 1942 required 104,055,422 tons of iron ore and manganiferous iron ore, 6,368,611 tons of mill cinder and roll scale, and 1,372,599 tons of purchased scrap, an average of 1.892 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of pig iron made.

Most of the iron ore used in Alabama furnaces in 1942 was hematite from mines in Jefferson County, but small quantities of hematite from Cherokee and Etowah Counties and Walker County, Ga., were also employed. In addition, brown ore, iron sinter, pyrite ash, imported ore, and manganese-bearing ores were consumed. The brown ore originated chiefly in mines of the Birmingham and Russellville districts, Ala., and the Chattanooga district, Ga. The manganese-bearing ores came from Arkansas, Georgia, Tennessee, Virginia, and Cuba. Because of the low-grade ore used in Alabama, the furnaces in this State use more ore per ton of pig iron than any other district in the United States. During 1942 Alabama furnaces consumed an average of 2.537 tons of metalliferous materials per ton of pig produced.

Iron ore and other metallic materials consumed and pig iron produced in 1942, by States, in short tons

	Metalliferous materials consumed				Pig iron produced	Materials consumed per ton of pig iron made		
	Iron and manganiferous iron ores		Cinder, scale, and purchased scrap	Total		Ores	Cinder, scale, and purchased scrap	Total
	Domestic	Foreign						
Alabama	10,206,796	6,133	141,424	10,354,353	4,081,710	2.502	0.035	2.537
Illinois	10,398,886		462,668	10,861,554	5,850,070	1.778	.079	1.857
Indiana	11,383,956		821,562	12,205,518	6,430,820	1.770	.128	1.898
Kentucky	778,100		45,587	823,687	457,124	1.702	.100	1.802
Maryland	3,410,606	726,501	551,074	4,688,181	2,490,571	1.661	.221	1.882
Michigan	2,918,514	23,861	124,309	3,066,684	1,683,414	1.748	.074	1.822
Minnesota	644,566		64,727	709,293	373,492	1.726	.173	1.899
New York	7,255,202	94,599	362,582	7,712,383	4,040,756	1.819	.090	1.909
Ohio	22,135,165		1,689,900	23,825,065	13,140,362	1.684	.129	1.813
Pennsylvania	29,623,693	25,650	3,327,035	32,976,378	18,064,888	1.641	.184	1.825
West Virginia	2,465,576		101,492	2,567,068	1,408,993	1.750	.072	1.822
Undistributed [1]	1,933,438	24,180	48,850	2,006,468	1,055,393	1.855	.046	1.901
	103,154,498	900,924	7,741,210	111,796,632	59,077,593	1.761	.131	1.892

[1] Includes California, Colorado, Massachusetts, Tennessee, and Utah.

Maryland furnaces consumed chiefly domestic ore in 1942, in addition to ores from Africa, Brazil, Chile, Cuba, and India. These furnaces used an average of 1.661 tons of ore per ton of pig iron; however, they consumed proportionately more cinder, scale, and scrap than those in any other State.

Blast furnaces in Illinois, Indiana, Kentucky, Michigan, Minnesota, and West Virginia 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, magnetite from New York, and some manganese ore from Cuba, and the furnace at Troy consumed magnetite from the Chateaugay mine at Lyon Mountain, N. Y.

Blast furnaces in Ohio consumed magnetite from New York in addition to ore from the Lake Superior district.

Virtually all the ore consumed in western Pennsylvania furnaces came from the Lake Superior district. Those in the eastern part of the State used some Lake ore; magnetite ores from Pennsylvania, New Jersey, and New York; and some ore from Africa, Australia, Chile, Cuba, and Sweden.

The Pueblo (Colo.) blast furnaces consumed hematite from the Sunrise mine in Wyoming, hematite and magnetite from New Mexico, and manganese-bearing ores, chiefly from Colorado, New Mexico, and California.

The Provo (Utah) furnace treated semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, manganese tailings from Montana, and manganese-bearing ores from Nevada, Texas, and Utah.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1941–42, by sources of ore, in short tons

Source	1941	1942	Source	1941	1942
Africa	14,775	4,871	Newfoundland	----------	24,180
Australia	2,265	790	Palestine	554	----------
Brazil	17,883	9,173	Spain	9,496	2,721
Canada	202,809	114,906	Sweden	----------	990
Chile	1,907,980	662,420	Source not stated	----------	1,932
Cuba	232,848	77,368			
India	----------	1,573		2,388,610	900,924

STOCKS AT MINES

Stocks of usable iron ore at mines totaled 3,770,869 tons at the end of 1942. In addition, 594,751 tons of pyrite cinder and sinter were in stock at plants that produce these byproducts for consumption in iron and steel furnaces. About 90 percent of United States mine stocks were in Michigan and Minnesota.

Stocks of usable iron ore at mines, December 31, 1941–42, by States, in short tons

State	1941	1942	State	1941	1942
Alabama	32,136	33,048	New York	30,947	61,977
Connecticut	67	----------	Pennsylvania	90,733	14,354
California	----------	2,500	Texas	7,683	6,615
Georgia	----------	168	Utah	560	1,344
Michigan	2,172,192	1,909,968	Virginia	3,456	4,379
Minnesota	1,467,745	1,493,331	Wisconsin	213,127	184,144
Missouri	2,790	1,620			
New Jersey	1,761	57,421		4,023,197	3,770,869

STOCKS AT CONSUMING PLANTS

Stocks of iron ore at consuming plants totaled 45,658,562 short tons on December 31, 1942, compared with 40,509,863 tons on December 31, 1941. This large increase was made possible by a favorable shipping season, which enabled shipments to exceed demand. Despite the late opening of the 1943 shipping season, it is believed that stocks at consuming plants at the end of the year will suffice to meet demands until the opening of the 1944 shipping season.

FOREIGN TRADE

Imports of iron ore in 1942 decreased tremendously from 1941 owing to the crucial shipping problem. Because of enemy submarine activity, shipments from Chile, which had long been the largest supplier of foreign ore, were suspended in 1942.

Iron ore imported for consumption in the United States, 1940–42, by countries, in short tons

Country	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Brazil	111,065	$460,669	133,134	$479,122	53,312	$188,908
British West Africa	8,053	32,775				
Canada [1]	[1] 248,468	[1] 1,056,381	[1] 313,864	[1] 1,182,566	[1] 287,017	[1] 1,145,431
Chile	1,884,512	3,028,699	1,888,074	3,064,838	429,330	689,998
Cuba	246,011	436,515	201,699	359,863	46,105	83,504
Iran	4,088	85,733				
Mexico	4,021	7,206	4,978	9,669	2,708	6,974
Newfoundland and Labrador	26,118	63,698	63,869	159,017		
Philippine Islands			10,864	22,254	10	75
Spain	12,331	55,793	8,167	50,755		
Sweden	236,101	968,925				
United Kingdom	440	14,290	612	19,193	602	27,679
Other countries	14	287				
	2,781,222	6,210,971	2,625,261	5,347,277	819,084	2,142,569

[1] Includes pyrite cinder.

Exports of iron ore from the United States totaled 2,817,235 short tons valued at $8,114,586 ($2.88 a ton) in 1942 compared with 2,136,525 tons valued at $6,212,308 ($2.91 a ton) in 1941.

MINING IN CUBA

Because of war-shipping limitations, shipments from Cuban mines in 1942 were only 9 percent of those made in 1941. The 1942 total of 20,208 short tons included 4,575 tons from the Daiquiri-Juragua mines, averaging (dried) 56.12 percent iron; 2,371 tons from the Estancia mine, averaging (dried) 27.35 percent iron; and 13,262 tons of nodulized brown ore from the Mayari mine, averaging (dried) 56.83 percent iron. The Mayari mine was idle during October, and the Estancia was active only the first 4 months of the year.

Stocks of usable ore totaled 228,071 short tons at the end of the year compared with 101,842 tons at the end of 1941.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1942, in short tons

Year	Juragua, Daiquiri, and Estancia (hematite and magnetite)	Sigua (hematite)	Mayari (brown ore)	Guamá (hematite)	El Cuero (hematite)	Total
1884–1940	25,019,868	22,891	4,406,312	46,190	1,011,475	30,506,736
1941	176,628		47,764			224,392
1942	6,946		13,262			20,208
	25,203,442	22,891	4,467,338	46,190	1,011,475	30,751,336

REVIEW OF LAKE SUPERIOR DISTRICT

Production and shipments.—The largest movement of iron ore in the history of Great Lakes shipping signalized 1942. A total of 102,596,379 tons of iron and manganese-bearing ores was moved from United States ports during the year compared with the previous record shipments of 89,213,359 tons in 1941 and 72,502,302 tons in 1916. For the first time in the history of Lake Superior commerce, iron ore was shipped in March. On March 25, 1942, the first uplake boat arrived at Marquette, Mich., and on March 26 another boat reached Duluth. A total of 887,665 tons of ore was shipped in March and 8,723,884 tons in April. Lake shipments reached a monthly record in July, when they totaled 14,933,801 tons. The lakes remained open long enough to permit the movement of 712,128 tons in December. All-rail shipments from the Lake Superior district in 1942 totaled 1,563,490 tons.

A new all-time output of ore from the iron ranges in the Lake Superior district was made in 1942. Production of crude iron ore in the Lake Superior district amounted to 115,773,591 tons, a 16-percent increase over the 99,921,135 tons mined in 1941. Usable iron ore produced in the Lake Superior district, comprising direct shipping ore, concentrates, and sinter, totaled 101,925,624 tons, an increase of 15 percent over 1941. The Lake Superior district supplied 82 percent of the United States crude ore and 86 percent of the usable ore in 1942.

Of the six ranges contributing to the district total, the Mesabi was the largest producer, supplying 77 percent of the Lake Superior total and 67 percent of the United States total of usable ore in 1942.

Usable iron ore produced in the Lake Superior district, 1854–1942, by ranges, in short tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1880	15,977,658	961,866					16,939,524
1881–1890	20,829,773	13,347,506	9,696,747	3,651,676			47,525,702
1891–1900	30,541,890	24,236,657	26,164,368	13,548,694	36,156,817		130,648,426
1901–1910	42,255,520	47,011,764	38,656,687	17,192,651	218,013,490		363,130,112
1911–1915	20,613,174	24,485,948	23,930,840	8,102,513	159,847,759	3,574,622	240,554,856
1916	5,368,145	7,447,527	8,631,953	1,908,973	46,284,382	1,742,318	71,383,298
1917	5,194,979	7,130,461	8,826,980	1,659,057	46,062,602	2,225,001	71,099,080
1918	4,420,140	6,766,633	8,778,150	1,335,798	43,742,694	1,909,953	66,953,368
1919	4,657,801	5,447,644	8,253,273	1,178,010	37,254,508	1,888,182	58,679,418
1920	4,992,522	6,329,727	9,293,991	1,179,940	41,038,906	1,968,708	64,803,794
1921	2,468,608	2,405,277	3,511,734	1,099,365	18,345,813	503,506	28,334,303
1922	3,075,101	3,685,518	5,500,084	1,241,816	29,909,153	1,070,266	44,481,938
1923	4,380,218	5,503,166	6,846,181	1,253,407	46,826,100	1,590,585	66,399,657
1924	4,008,577	4,234,344	6,249,469	1,278,693	33,397,241	1,054,402	50,222,726
1925	4,271,329	5,610,105	7,143,035	1,491,563	39,033,242	754,188	58,303,462
1926	4,531,734	6,099,165	7,783,910	1,757,227	42,557,533	1,271,047	64,000,616
1927	4,497,618	6,113,164	7,397,409	1,767,155	36,809,958	1,139,361	57,724,665
1928	4,205,984	5,438,423	7,103,143	1,823,684	39,039,093	1,208,909	58,819,236
1929	5,091,340	6,079,885	7,940,354	2,109,573	47,455,735	1,686,853	70,363,740
1930	4,950,194	4,962,806	6,735,692	2,236,098	35,055,888	1,367,892	55,308,570
1931	2,969,116	2,333,136	4,142,016	1,322,971	17,470,619	744,813	28,982,671
1932	840,775	906,529	1,596,048	405,593	4,766,154	601,058	9,116,157
1933	1,110,596	628,889	1,242,443	338,000	12,730,831	313,597	16,364,356
1934	2,610,469	961,023	2,746,300	876,503	16,145,077	215,075	23,554,447
1935	3,209,127	818,111	2,685,753	948,211	20,522,538	228,828	28,412,568
1936	4,954,230	1,839,654	4,570,560	1,175,689	33,830,023	424,440	46,794,596
1937	6,307,206	2,568,204	5,953,558	1,696,007	51,823,370	707,646	69,055,991
1938	3,009,119	1,437,591	3,235,490	1,044,406	14,847,398	291,417	23,865,421
1939	4,374,938	2,152,308	4,820,489	1,568,382	33,064,894	700,149	46,681,160
1940	5,918,297	3,000,888	6,462,800	1,715,799	50,941,464	807,965	68,847,213
1941	6,978,285	4,281,145	6,780,885	2,075,394	66,850,613	1,354,957	88,321,279
1942	7,083,224	5,385,930	6,712,804	2,167,340	78,722,184	1,854,142	101,925,624
Total	245,697,687	219,610,994	259,393,146	81,150,188	1,398,546,079	33,199,880	2,237,597,974

Shipments from the Michipicoten range in Ontario, Canada, were made to the lower Lake ports for consumption by the Canadian iron and steel industry. This output is not included in Bureau of Mines statistics. Shipments of sinter from the Helen mine of the Algoma Steel Corporation totaled 545,066 short tons in 1942 compared with 518,277 tons in 1941. There was much interest during the year concerning the iron-ore deposits at Steep Rock Lake, in the Lake Superior region, Ontario, Canada. Diamond and churn drilling during 1942 developed indicated reserves of 14,377,000 tons, in addition to 1,525,000 tons of measured Bessemer-grade hematite having an analysis of 62.55 percent iron and 0.17 phosphorus. To exploit the deposit, it will be necessary to divert waters flowing into the lake and build dams so that water covering the deposit can be pumped out. The upper part of the deposit will be mined by an open-cut; however, most of the ore will be mined by underground methods.

Analyses.—The accompanying table was compiled by the Lake Superior Iron Ore Association.

Average analyses of total tonnages (bill-of-lading weights) of all grades of iron ore from all ranges of Lake Superior district, 1938–42

Year	Short tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1938	21,675,917	51.90	0.089	8.25	0.81	10.13
1939	50,381,804	51.75	.085	8.27	.76	10.73
1940	70,905,423	52.09	.085	8.00	.77	10.93
1941	89,534,189	51.83	.085	8.18	.78	11.01
1942	103,118,290	51.65	.089	8.21	.79	10.98

Stocks at Lake Erie ports.—On December 1, 1942, just before navigation stopped, the Lake Superior Iron Ore Association reported 8,009,612 short tons of iron ore at Lake Erie ports, compared with 5,924,931 tons on the same date in 1941. At the opening of the 1943 shipping season in May 1943, 3,152,789 short tons of ore were in stock at these ports, compared with 2,832,676 tons on May 1, 1942. Withdrawals from stocks during this 5-month period in 1942–43 were 57 percent greater than in 1941–42.

Prices of Lake Superior ore.—The prices established April 17, 1940, for the four standard grades of Lake Superior ore remained unchanged. Since that date the price of the various grades quoted at Lake Erie ports for a short-ton unit were as follows: Old-Range Bessemer, 8.235 cents; Mesabi Bessemer, 7.975 cents; Old-Range Nonbessemer, 7.975 cents; and Mesabi Nonbessemer, 7.715 cents; respectively, $4.24, $4.11, $4.11, and $3.97 a short ton. The base of the four standard grades for 1925–42 is an iron content of 51.5 percent natural. For the bessemer grades, the allowable phosphorus content is 0.045 percent (dry), and for the nonbessemer grades the phosphorus content ranges from 0.045 to 0.18 percent. Ores containing more than 0.18 percent phosphorus are classed as high-phosphorus ores, whereas those containing 18 percent or more silica are classed as siliceous ores.

Reserves.—During 1942 there was considerable discussion concerning the possible depletion of high-grade iron-ore reserves on the Mesabi range. War requirements will amount to 100,000,000 tons of iron ore to be provided annually by the Lake Superior district. As produc-

tion from underground mines and concentrating plants is limited, most of the output must be supplied by open-pit direct shipping ore.

Davis [6] has pointed out that where a deposit of iron ore is flat-lying and is not covered by too much overburden, it is ordinarily mined by open-pit methods; and simply by putting additional shovels into operation and providing the necessary additional transportation, production from open-pit mines can often be doubled or tripled, whereas increasing the production from underground mines is not nearly so simple. The rate of production from an underground mine depends largely on the number of mining faces that can be worked simultaneously, and the maximum rate at which the ore is to be mined is established before an underground mine is opened. Consequently, it is not ordinarily possible to increase the rate of production radically.

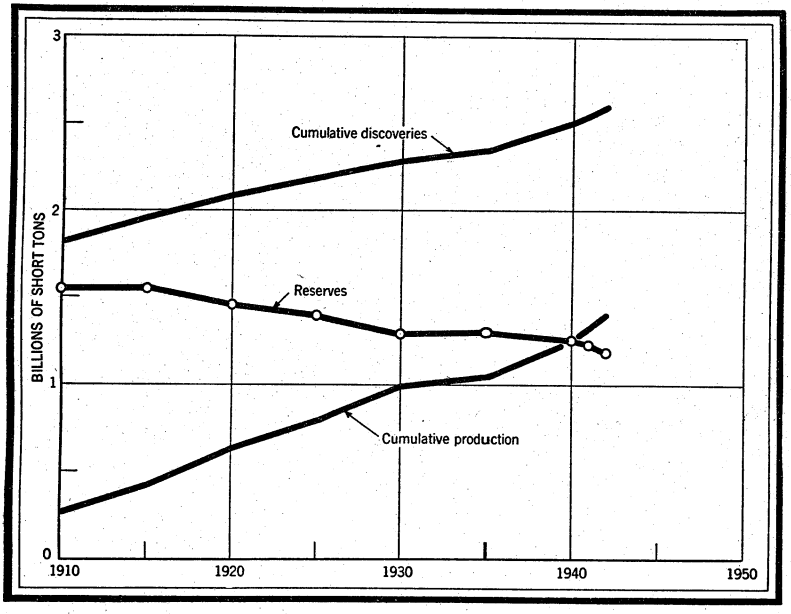

FIGURE 3.—Rates of production, discoveries, and depletion of reserves, Mesabi range, 1910–42.

Actual reserves of the Lake Superior district are not given in the reports of the tax commissions of the various States. Although these commissions have access to all records of the mining companies and compile figures on reserves for the different ranges from them, the figures represent taxable reserves, and the actual tonnages that will eventually be produced from the Lake Superior district will exceed the tax commission estimates. Past records indicate that this excess may be considerable. Figure 3 compares cumulative production and discoveries with reserves on the Mesabi range from 1910 to 1942. During this period, 1.15 billion tons of iron ore were mined. However, this depletion was offset in large part by additions to reserves totaling 0.80 billion tons, so that known reserves decreased only 0.35 billion tons. At current rates of production, it is evident that the known reserves will be exhausted in a relatively short period. Although addi-

[6] Work cited in footnote 3.

tions to reserves during the past 3 decades have offset depletion to a large extent, continuation of this trend into the future will depend on the ability of producers to find additional ore and the extent to which present low- and off-grade deposits become commercial in the future.

Unmined iron-ore reserves in Minnesota, May 1, 1938–42, in short tons

Range	1938	1939	1940	1941	1942
Mesabi	1,288,915,900	1,268,414,950	1,257,304,301	1,228,640,029	1,198,122,968
Vermilion	15,986,908	15,267,262	14,793,743	15,701,206	16,691,755
Cuyuna	67,973,468	69,331,231	72,829,434	72,813,737	72,141,173
	1,372,876,276	1,353,013,443	1,344,927,478	1,317,154,972	1,286,955,896

Iron-ore reserves in Michigan, January 1, 1939–43, in short tons

Range	1939	1940	1941	1942	1943
Gogebic	45,310,722	41,620,208	35,396,179	33,682,351	36,850,185
Marquette	58,386,031	55,522,649	54,174,528	54,102,855	57,110,705
Menominee	64,028,731	63,753,461	62,554,000	62,865,694	62,231,371
	167,725,484	160,896,318	152,124,707	150,650,900	156,192,261

MINING BY STATES

Alabama.—Production of crude iron ore in Alabama in 1942 was 35 percent greater than in 1941. Mining activity in this State trended away from small operations; this is indicated by statistics which show that despite the increase in output there were only 47 active mines in 1942, compared with 76 in 1941. The small operators were unable to obtain much necessary equipment and labor. In addition, some of the operators entered the armed forces, and others went to work in war plants. Hematite represented 56 percent of the total crude-ore production in Alabama in 1942, and about 82 percent of the hematite produced was shipped direct to furnaces, 14 percent was sintered, and 4 percent was concentrated. In 1942, 55 percent of the total crude-ore production came from underground mines, most of which are in Jefferson County. The most important producing mines in this county were the Muscoda, Wenonah, and Ishkooda, which comprise the Red Mountain group, operated by the Tennessee Coal, Iron & Railroad Co. Other important underground mines in Jefferson County were the Spaulding and Raimund mines of the Republic Steel Corporation, the Woodward No. 3 mine operated by the Woodward Iron Co., and the Ruffner and Sloss Nos. 1 and 2 mines of the Sloss-Sheffield Steel & Iron Co. The usable hematite produced in Alabama in 1942 averaged (natural) 35.03 percent iron, 0.16 percent manganese, 0.32 percent phosphorus, 15.21 percent silica, and 14.97 percent lime.

Crude brown-ore (limonite) production in Alabama in 1942 amounted to 6,930,768 tons. This ore is mined by open-cut methods from a number of widely scattered deposits. All of this ore is concentrated before being consumed in blast furnaces. Log washers are commonly used for this purpose. Brown-ore concentrates produced in 1942 totaled 1,367,246 short tons, an increase of 12 percent over 1941. In 1942 the principal brown-ore mines were the Russellville Nos. 5,

11, and 12, operated by the Sloss-Sheffield Steel & Iron Co., the Giles mine of the Central Iron Ore Co., and the Martaban and Greeley mines of the Tennessee Coal, Iron & Railroad Co. Other important producers were the La Grange, Ironaton, Parish, Doc Ray, Waco, and Reno mines. Most of the brown-ore production came from Franklin, Tuscaloosa, Blount, Colbert, Butler, Talladega, and Cherokee Counties. Usable brown-ore production in 1942 averaged 46.0 percent iron, 0.63 percent manganese, 0.53 percent phosphorus, and 10.4 percent silica.

Arizona.—A small quantity of hematite was produced in Yuma County during the year. An open-cut mine is operated by E. E. Carlisle and produces ore for acid electric furnaces at Alhambra, Calif.

California.—The demands of the shipbuilding industry on the West coast caused 1942 usable iron-ore production in California to increase 78 percent over 1941. The Vulcan mine, an open-cut in San Bernardino County operated by the Kaiser Steel Co., made initial shipments of hematite to Fontana in December. Hematite from the Cave Canyon mine, the largest producer in the State, was shipped for consumption in cement manufacture. Magnetite from the Heroult mine in Shasta County was used largely for making concrete ballast blocks for shipping vessels. Shipments of usable ore in 1942 averaged 56.3 percent iron.

Georgia.—Virtually all of the output from Georgia is brown ore produced from open pits. Production of crude ore in 1942 totaled 1,506,265 tons, resulting in 334,342 tons of usable ore. The concentrating ratio of crude ore to usable ore was about 4.5:1. The outstanding producers in 1942 were the Porter, Woodward, Clemmons Hill, and Blanchard Reed mines and properties operated by the Mitchell & Hodge Co. and the Chulafinee Ore Co. Most of the ore came from Polk and Bartow Counties and relatively small amounts from Cherokee, Floyd, and Walker Counties. Shipments of usable ore from Georgia during the year averaged 47.3 percent iron and 0.59 percent manganese.

Michigan.—Output in Michigan comes from three ranges—Marquette, Menominee, and Gogebic. During the year the output from the Marquette range increased slightly, and the Menominee range showed a substantial gain, but production from the Gogebic range decreased slightly from 1941. Production in Michigan during 1942 totaled 17,499,060 short tons of usable iron ore, an increase of 6 percent over 1941. Underground mines supplied 94 percent of the total output in 1942. The iron content of ore produced in Michigan during the year averaged 51.68 percent, the same as in 1941.

The Negaunee and Maas mines, situated on the Marquette range and operated by the Cleveland-Cliffs Iron Co., were the leading producers in 1942, with 1,238,497 and 988,287 short tons, respectively. The Penn Group, Cliffs Shaft, Athens, Geneva-West Davis and Hiawatha Nos. 1 and 2 were also important producers. All of these underground mines produced hematite. The Plymouth mine on the Gogebic range was the largest open-pit producer in Michigan during the year.

Considerable expansion of the Michigan iron-ore industry was accomplished during 1942. The Sherwood mine of the Inland Steel Co., near Iron River, Mich., on the Menominee range, came into production in 1942. The Wauseca mine of the M. A. Hanna Co.,

also on the Menominee range, became an active producer in 1942, as did the Princeton mine of the Cleveland-Cliffs Iron Co. The Mather mine, at Ishpeming, Mich., owned jointly by the Cleveland-Cliffs Iron Co. and the Bethlehem Steel Co., was developed by the Negaunee Mine Co., although no output was reported in 1942.

A report of the iron-ore mines of Michigan for 1942, published by the Geological Survey Division of the Michigan Department of Conservation,[7] shows that the average number of men employed was 8,242 (7,553 in 1941), the average number of days worked 273 (248 in 1941), the average daily wage $7.60 (same as 1941), the average yearly earnings $2,073.53 ($1,885.79 in 1941), and the average tons of ore mined per man per day 6.75 (7.15 in 1941).

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 short ton, of mining iron ore at underground mines and at siliceous open pits in Michigan in 1942

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Menominee	Total	
Cost of mining:					
Labor	$1.0227	$1.1325	$0.9675	$1.0503	$0.2254
Supplies	.4950	.4875	.5192	.4999	.2154
Deferred costs	.2183	.0518	.1151	.1175	.0487
Taxes	.1954	.1470	.0899	.1409	.0417
General overhead	.1687	.1820	.1413	.1653	.0908
Transportation	1.6387	1.3604	1.4502	1.4773	1.3639
Marketing	.0600	.0860	.0696	.0742	.0714
Total ore cost	3.7988	3.4472	3.3528	3.5254	2.0573
Lake Erie value per ton	4.2196	4.1989	3.9442	4.1214	2.0771
Gross ore profit [1]	.4208	.7517	.5914	.5960	.0198
Other costs:					
Royalty	.3113	.2023	.2166	.2369	.0755
Interest on borrowed money	.0002	.0293	.0033	.0132	.0056
Federal income and excess profits	.1071	.1975	.0843	.1356	.0246

[1] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

Minnesota.—A record total of 96,693,590 tons of crude iron ore was produced in Minnesota in 1942, an increase of about 18 percent over 1941; open-pit mines supplied about 94 percent of the total. Sixty-six percent of the crude ore shipped was for direct use in blast and steel furnaces, and the remainder was shipped to concentrating plants. Concentrates represented about 23 percent of usable ore shipped from mines in Minnesota, sinter accounted for less than 1 percent, and the remainder was direct shipping ore.

Three ranges (Cuyuna, Mesabi, and Vermilion) contribute to Minnesota's production. Production in 1942 from the Mesabi comprised about 96 percent of Minnesota's crude ore and 95 percent of usable ore output. In Minnesota 34 of the 101 active mines produced more than 700,000 tons of crude ore each during the year. The iron content (natural) of the usable ore produced in 1942 averaged 52.11 percent iron compared with 52.43 percent in 1941.

[7] Pardee, F. G., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., Lansing, 1943, 9 pp.

During the year, the Evergreen Mines Co. completed a concentrating plant at the Maroco mine, which will serve the Maroco and several other mines on the Cuyuna range.

Missouri.—Output of usable iron ore in 1942 totaled 59,180 tons, over three times the amount produced in 1941. The various properties of the Missouri-Cliffs Mining Co. supplied 83 percent of the State output. However, the Christy and Pioneer mines operated by the Missouri Mining Co. were important producers. Both hematite and brown ore were produced in Missouri; 93 percent came from open-pit mines. Usable ore shipped from mines in Missouri averaged 49.74 percent iron in 1942.

New Jersey.—Crude iron-ore production in 1942 totaled 1,494,853 tons, an increase of about 5 percent over 1941. The usable ore produced totaled 676,537 tons, a 7-percent decrease from the 1941 figure. To produce 1 ton of concentrates, 2.1 tons of crude ore were used in 1941 compared with 2.4 tons in 1942. This change in ratio may be caused by the variation of iron content in the ore; the proportion of ore to country rock mined; and the efficiency of the concentrator.

The Scrub Oaks mine, operated by the Alan Wood Steel Co., continued to be the outstanding producer in New Jersey. Other mines active in 1942 were the Mount Hope, Richard, and Washington. The magnetite ore is produced from underground mines in Morris and Warren Counties. The magnetite concentrates produced average (natural) 62.89 percent iron.

New Mexico.—Most of the iron ore produced in New Mexico in 1942 came from the El Paso iron claim in Grant County, operated by the St. Louis Smelting & Refining Co. Seven new mines in Lincoln and Socorro Counties supplied the remainder of the State output. The hematite and the magnetite that came from both underground mines and open pits were shipped direct to furnaces in Colorado. A total of 107,306 tons of ore was mined, averaging 54.85 percent iron. No production was reported in 1941.

New York.—The mining industry in the Adirondack district was greatly expanded during 1942. This expansion was not shown by production figures, because the activity was confined mostly to mine development and the construction of surface plants, although two new mines came into production on a small scale during the year. Late in the summer of 1942, the National Lead Co. made the initial shipments of magnetite and ilmenite concentrates from the MacIntyre mine [8] on Lake Sanford near Tahawus, Essex County. The Clifton mine near De Grasse, St. Lawrence County, was brought into production by the Clifton Ore Co. during the year. At the Clifton mine, most of the magnetite ore will be mined by underground methods, although open-pit methods of mining were used in 1942.

Surface structures, including magnetic separators and sintering plants, were under construction at the Benson mine in St. Lawrence County and the Fisher Hill mine near Mineville, Essex County. The magnetite deposit at the Benson mine will be exploited by the Jones & Laughlin Ore Co., using open-pit methods. At the Fisher Hill mine considerable underground development was done by the Republic Steel Corporation, although no production was reported during the year. A new inclined shaft, constructed at Mineville to serv-

[8] Matthews, Allan F., Minor Metals: Minerals Yearbook, 1941.

ice the Harmony-Old Bed-New Bed group should increase the output and efficiency of the mines by eliminating much rehandling of the crude ore. The Chateaugay mine at Lyon Mountain and the Mineville properties continue to be the outstanding iron-ore producers in the State. Shipments from New York State averaged (natural) 65.95 percent iron, 0.07 percent manganese, and 0.09 percent phosphorus.

Pennsylvania.—In 1942 the Cornwall mine, operated by the Bethlehem Steel Co., continued to supply virtually all of the ore produced in Pennsylvania. The magnetite ore body at Cornwall is mined by both underground and open-pit methods. The crude ore is hauled about 6 miles by rail to Lebanon, where all of the ore is concentrated and part of the concentrates sintered. In previous years the crude ore shipped from Cornwall was included with usable ore statistics. However, in 1942 a break-down is made between crude ore and usable ore, the concentrates and sinter shipped from Lebanon being included, for the first time, in usable ore statistics. It is believed that this new method of handling Cornwall figures will make the statistics more comparable with those of other magnetite mines, although the figures for this mine in 1942 will not be comparable with those for previous years.

The Hazard and Little Gap mines operated by the Prince Manufacturing Co. produced a small quantity of carbonate ore during the year.

Tennessee.—The treatment of copper-iron ores by the Tennessee Copper Co. at Ducktown results in the production of a considerable amount of pyrite ash. This residue is sintered and shipped for consumption in blast and open-hearth furnaces. The tonnage of this by-product material produced is included in usable ore statistics in 1942. Shipments of sinter during the year averaged 67.2 percent iron, 0.15 percent manganese, 0.007 percent phosphorus, and 2.2 percent silica.

Texas.—The Linden mine in Cass County was the only producer in the State in 1942; the brown ore shipped after concentrating averaged 52.5 percent iron.

Utah.—In 1942 the Iron Mountain mine operated by the Columbia Steel Co. continued to supply most of the iron ore output from Utah. The ore, principally semialtered magnetite, was mined by open-cut methods. Most of the ore was shipped to the blast furnace at Provo and contained (natural) 53.49 percent iron. The Great Western mine operated by Helene Beatty was the only other producer in the State.

Virginia.—The American Pigment Corporation mine in Pulaski County supplied virtually all of the output in 1942. The brown ore is mined from an open-cut and is consumed by the paint industry.

Washington.—Most of the ore produced in Washington during the year was from the Neutral mine in Okanogan County. This magnetite ore was used for ballast in war vessels. Some hematite was produced from the Napoleon mine in Stevens County and the Keystone mine in Pend Oreille County.

Wisconsin.—Production of crude hematite from underground mines in 1942 increased 5 percent over 1941. Ore from the Montreal Mining Co., averaged (natural) 52.48 percent iron, 1.26 percent manganese, 0.51 percent phosphorus, and 6.63 percent silica. The Cary mine, operated by the Odanah Iron Co., produced ore containing

(natural) 53.13 percent iron, 0.82 percent manganese, 0.05 percent phosphorus, and 6.07 percent silica. During the year a small quantity of ore was shipped from the Matilda-mine stock pile.

Wyoming.—The Sunrise mine in Platte County supplied all of the Wyoming output in 1942. Production came from both open-pit and underground operations by the Colorado Fuel & Iron Corporation. Shipments of hematite averaged (natural) 49.89 percent iron, 0.09 percent manganese, 0.06 percent phosphorus, and 12.95 percent silica.

Crude iron ore mined in the United States in 1942, by States and counties

[Exclusive of ore containing 5 percent or more manganese]

State and county	Active mines	Short tons
Alabama:		
Bibb	[1] 1	148
Etowah	1	
Blount	1	168,000
Butler	[1] 2	415,150
Crenshaw	1	
Calhoun	[1] 2	293,328
Cherokee	[1] 5	309,939
Chilton	2	8,064
Clay	[1] 1	33,600
Colbert	1	534,012
Franklin	[1] 8	2,226,185
Jefferson	12	8,678,263
Marshall	[1] 1	12,320
Pike	[1] 1	13,664
Talladega	[1] 4	426,681
Tuscaloosa	4	2,489,759
	[1] 47	15,609,113
Arizona:		
Yuma	1	386
California:		
Inyo	1	319
San Bernardino	2	90,159
Santa Cruz	1	196
Shasta	1	15,846
	5	106,520
Georgia:		
Bartow	[1] 7	501,101
Cherokee	[1] 1	8,064
Floyd	1	112
Polk	[1] 10	991,860
Walker	1	5,128
	[1] 20	1,506,265
Michigan:		
Dickinson	3	996,846
Gogebic	8	5,029,907
Iron	18	4,389,084
Marquette	15	7,083,223
	44	17,499,060
Minnesota:		
Crow Wing	10	2,146,514
Fillmore	1	101,956
Itasca	33	33,681,280
St. Louis	57	60,763,840
	101	96,693,590
Missouri:		
St. Francois	2	458
Washington		
Crawford, Miller, Franklin, Phelps, Howell, Oregon, and various	[1] 2	67,650
	[1] 4	68,108
New Jersey:		
Morris	3	1,494,853
Warren	1	
	4	1,494,853
New Mexico:		
Grant	1	107,306
Lincoln	[1] 6	
Socorro	1	
	[1] 8	107,306
New York:		
Clinton	1	5,444,703
Essex	2	
Oneida	1	
St. Lawrence	1	
Pennsylvania:		
Lebanon	1	
Carbon	1	1,146
	7	5,445,849
Texas:		
Cass	1	51,757
Virginia:		
Botetourt	1	
Pulaski	1	
	3	51,757
Utah:		
Iron	2	359,558
Washington:		
Okanogan	1	11,536
Pend Oreille	1	302
Stevens	1	1,446
	3	13,284
Wisconsin:		
Iron	2	1,682,897
Wyoming:		
Platte	1	1,071,870
	[1] 252	141,710,416

[1] In addition, there is an undetermined number of small pits. The output of these pits is included in the tonnage given.

EMPLOYMENT AT IRON MINES

Although complete information on employment at iron-ore mines in 1942 is not yet available, incomplete figures indicate that about 31,000 men worked 64,000,000 man-hours to produce 117,469,164 short tons of usable ore from domestic mines—an average of about 1.8 tons per man-hour and an all-time record. The man-hours worked in 1942 increased 6 percent over 1941, whereas the output of usable ore from domestic mines increased 13 percent; consequently, the output per man-hour increased 7 percent. The gain in output per man-hour was due mainly to open-pit mines, which represented 68 percent of the increase in production in 1942 over 1941.

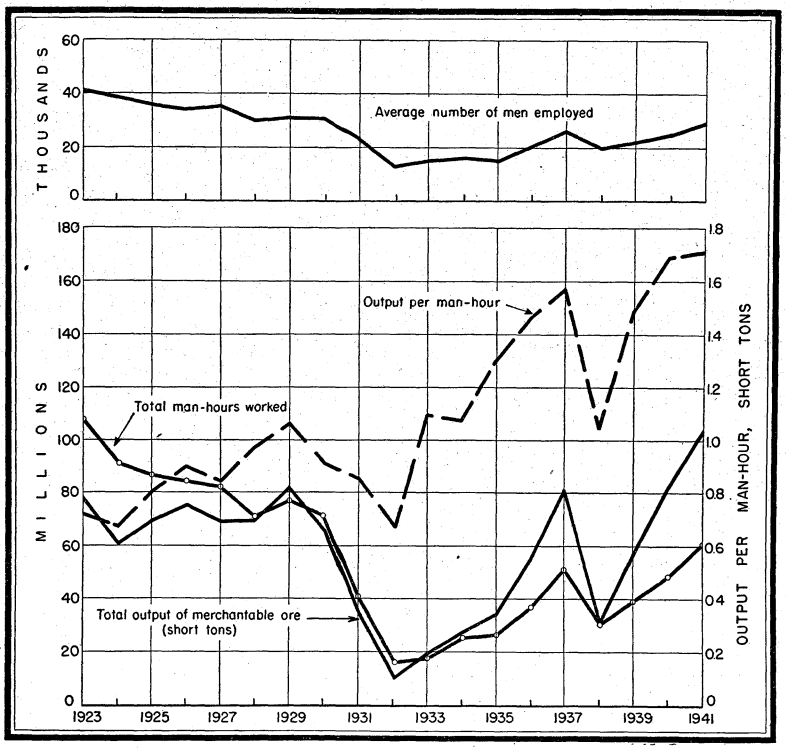

FIGURE 4.—Trends in number of men employed at iron-ore mines, output of merchantable (usable) ore, man-hours worked, and output per man-hour in the United States, 1923–41.

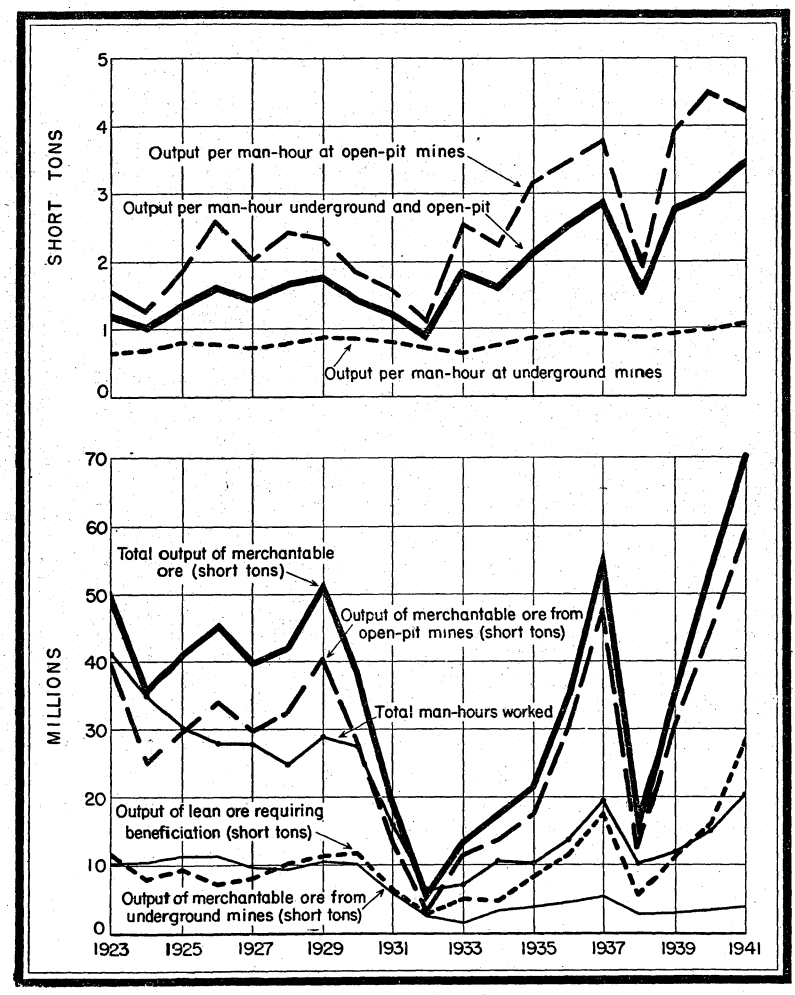

FIGURE 5.—Trends in output of merchantable (usable) iron ore per man-hour at open-pit mines in Minnesota compared with production of merchantable (usable) and lean ore and total man-hours worked, 1923–41.

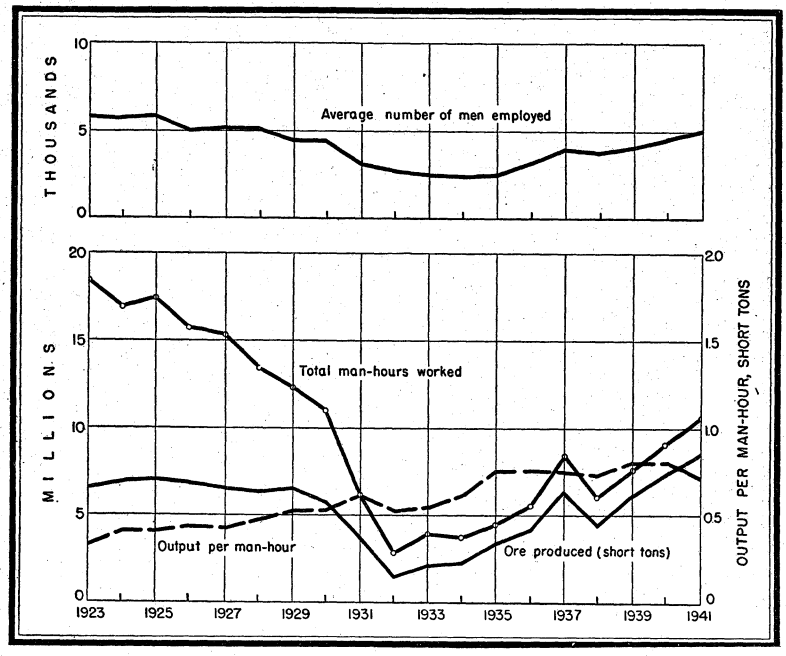

FIGURE 6.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923–41.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1941, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment					Production									
		Time employed					Usable ore			Average per man (short tons)					
				Man-hours				Iron contained		Crude ore (partly estimated)		Usable ore			
	Average number of men employed	Average number of days	Total man-shifts	Average per shift	Total	Crude ore (partly estimated), short tons	Short tons	Short tons	Percent natural	Per shift	Per hour	Per shift	Per hour	Iron contained Per shift	Iron contained Per hour
Lake Superior:															
Michigan	7,477	276	2,061,853	8.0	16,494,306	16,431,735	16,431,735	8,491,851	51.68	7.969	0.996	7.967	0.996	4.119	0.515
Minnesota	10,303	247	2,546,851	8.0	20,339,871	81,880,819	70,281,016	36,848,463	52.43	32.150	4.026	27.595	3.455	14.468	1.812
Wisconsin	785	261	205,129	8.0	1,641,032	1,608,581	1,608,581	857,690	53.32	7.842	.980	7.842	.980	4.181	.523
	18,565	259	4,813,833	8.0	38,475,209	99,921,135	88,321,332	46,198,004	52.31	20.757	2.597	18.347	2.296	9.597	1.201
Southeastern States:															
Alabama	6,159	262	1,615,508	8.2	13,208,120	11,543,516	8,831,033	3,280,489	37.15	7.145	.874	5.466	.669	2.031	.248
Georgia, Mississippi, Virginia	264	157	41,558	9.0	373,678	1,266,602	291,947	136,944	46.91	30.488	3.391	7.035	.782	3.301	.367
						428	428	224	45.80–53.60						
	6,423	258	1,657,066	8.2	13,581,798	12,810,546	9,123,408	3,417,657	37.46	7.732	.943	5.506	.672	2.062	.252
Northeastern States:															
Connecticut, New Jersey, New York	923	266	245,085	8.0	1,956,610	99	99	45	45.00	5,833	.731	2.968	.372	1.850	.232
						1,429,556	727,299	453,452	62.35						
Pennsylvania	2,106	339	713,385	7.4	5,304,048	4,855,258	3,710,123	1,790,812	66.92–39.64	6.806	.915	5.201	.699	2.510	.338
	3,029	316	958,470	7.6	7,260,658	6,284,913	4,437,521	2,244,309	50.58	6.557	.866	4.630	.611	2.342	.309
Western States:															
California						60,293	59,955	33,124	55.25						
Missouri						20,891	20,891	10,842	51.90						
Nevada						241	241	109	45.00						
Oklahoma						233	233	110	47.10						
Utah	190	173	32,841	8.0	262,823	397,607	397,607	216,579	54.47	15.992	1.998	15.600	1.949	8.518	1.064
Washington						11,674	11,674	7,744	66.30						
South Dakota, Texas						34,242	21,713	11,244	46.00–52.50						
Wyoming	380	259	98,606	8.0	788,848	1,104,154	1,104,154	567,093	51.36	11.198	1.400	11.198	1.400	5.751	.719
	570	235	131,447	8.0	1,051,671	1,629,335	1,616,468	846,845	52.39	12.395	1.549	12.297	1.537	6.442	.805
	28,587	264	7,560,816	8.0	60,369,336	120,645,929	103,498,729	52,706,815	50.93	15.957	1.998	13.689	1.714	6.971	.873

WORLD PRODUCTION

The following table shows the production of iron ore by countries from 1938 to 1942, insofar as statistics are available. Although complete returns are not available, it is probable that world production established a new record in 1942 because of the large increase in United States production.

World production of iron ore, 1938–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1938	1939	1940	1941	1942
North America:					
Canada	5,281	117,583	376,120	468,138	494,521
Cuba	234,061	166,739	160,339	192,851	132,847
Mexico	118,251	143,873	110,783	110,134	102,526
Newfoundland	1,707,180	1,679,625	1,532,990	981,735	[3] 1,200,000
United States	28,903,861	52,562,024	74,878,718	93,892,753	107,219,002
South America:					
Brazil	359,115	396,938	255,548	420,756	308,921
Chile [4]	1,608,399	1,626,490	1,749,840	1,702,692	408,587
Europe:					
Belgium	180,920	177,370	(2)	(2)	(2)
Bulgaria	16,771	20,115	30,000	(2)	(2)
Czechoslovakia [5]	693,000	766,000	862,000	978,000	1,040,000
France	33,137,000	(6)	(2)	(2)	(2)
Germany [7]	10,938,650	(6)	(2)	(2)	(2)
Austria	2,600,063	(6)	(2)	(2)	(2)
Greece	348,613	307,284	(2)	(2)	(2)
Hungary	369,935	370,000	(2)	(2)	(2)
Italy	990,043	(6)	(2)	(2)	(2)
Luxemburg	5,140,632	(6)	(2)	(2)	(2)
Norway	1,425,297	1,340,408	(2)	(2)	[3] 300,000
Poland	872,591	(6)	(2)	(2)	(2)
Portugal	2,519	418	301	287	(2)
Rumania	139,185	131,992	(2)	(2)	(2)
Spain	2,544,945	3,594,294	2,629,609	1,640,687	1,670,370
Sweden	13,928,023	13,787,202	(2)	(2)	(2)
Switzerland	[8] 133,998	[8] 171,279	200,000	(2)	(2)
U. S. S. R. [9]	26,529,700	(6)	27,500,000	(2)	(2)
United Kingdom: Great Britain [10]	12,049,531	(6)	18,000,000	(2)	(2)
Yugoslavia	606,884	666,816	(2)	[3 11] 523,000	(2)
Asia:					
Burma	18,340	26,680	(2)	(2)	(2)
Chosen	(6)	(6)	(2)	(2)	(2)
India, British	2,787,711	3,166,087	(2)	(2)	(2)
Indochina	130,298	136,000	32,861	(2)	(2)
Japan	(6)	(6)	(2)	(2)	(2)
Malay States:					
Federated	938	780	972	(2)	(2)
Unfederated	1,606,289	1,991,173	1,872,903	(2)	(2)
Philippine Islands [8]	910,952	1,154,738	1,191,641	[12] 852,080	(2)
Turkey	71,375	143,277	130,338	(2)	(2)
U. S. S. R.	(9)	(9)	(9)	(2)	(2)
Africa:					
Algeria	3,105,037	[3] 2,750,000	(2)	(2)	(2)
Belgian Congo	2,650	(6)	6,100	(2)	(2)
Morocco:					
French	266,100	(6)	(2)	(2)	(2)
Spanish	1,341,658	[8] 1,038,006	[8] 389,337	(2)	[8] 555,000
Northern Rhodesia	208	138	(2)	(2)	(2)
Sierra Leone	875,789	(6)	(2)	(2)	(2)
South-West Africa	23,861	19,500	(2)	(2)	(2)
Tunisia	822,053	764,731	(2)	(2)	(2)
Union of South Africa	505,314	490,136	638,757	[13] 680,041	[13] 607,767
Oceania:					
Australia:					
Queensland	5,207	4,003	(2)	(2)	(2)
South Australia	2,281,404	2,613,036	2,350,484	2,276,345	(2)
Tasmania		(6)	(2)	(2)	(2)
New Caledonia	36,279	83,567	176,600	(2)	(2)
New Zealand	1,238	1,611	1,208	1,569	(2)
	162,000,000	200,000,000	[3] 212,000,000	[3] 233,000,000	[3] 245,000,000

[1] In addition to the countries listed, China, Egypt, Eritrea, Finland, French West Africa, Madagascar, and New South Wales report production of iron ore, but complete data are not available.
[2] Data not available. [3] Estimated. [4] Production of Tofo Mines. [5] Slovakia only.
[6] Estimate included in total. [7] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[8] Exports. [9] U. S. S. R. in Asia included with U. S. S. R. in Europe.
[10] Exclusive of bog ore, which is used mainly for purification of gas.
[11] Croatia only. [12] January to July, inclusive. [13] January to October, inclusive.

SPONGE IRON

Considerable publicity was given to sponge iron during 1942 in view of an impending shortage of iron and steel scrap. Sponge iron of a usable grade for steel making can be produced by several techniques, including rotary and stationary kilns and multiple-hearth roasters. The economics of the operation depends on the scrap situation. When scrap is flowing to steel furnaces at a desired rate, sponge iron, if in powdered form, with more than a few percent of silica, and if special means of preventing entrance of sulfur during its production have not been used, would not be an economical melting stock in basic steel furnaces. However, during an emergency, the supply of scrap might not be adequate for maximum steel production and, with costs of secondary importance, there is little doubt that sponge iron could be used as a substitute for scrap. Early in our present steel-expansion program it seemed that such a shortage of scrap would develop; consequently, much publicity and speculation were given to the possibility of producing sponge in large quantities. Extensive use of sponge iron in steel furnaces would decrease steel-making capacity somewhat but would offset to some extent losses that might result from scrap shortages.

Except for metal powders, virtually no commercial sponge iron was produced in 1942. However, considerable progress was made in the development and construction of plants during the year. In October the War Production Board approved construction of a $450,000 sponge-iron plant at Youngstown, Ohio, as an experimental project to test the use of the material in electric furnaces. Likewise, funds totaling $600,000 were made available to the Bureau of Mines for construction and operation of sponge-iron pilot plants. Results of this work have not yet been made public.

PIG IRON

PRODUCTION AND SHIPMENTS

Domestic production of pig iron, exclusive of ferro-alloys, increased 7 percent in 1942 over 1941 and established a new record. The output in 1942 comprised 58,973,389 short tons using coke and 104,204 using charcoal as fuel. Pennsylvania was the largest producer of pig iron in 1942, with 31 percent of the total; Ohio ranked second, with 22 percent. Of the pig iron manufactured in 1942, it is calculated that 513,699 tons valued at $11,326,032 were made from 900,924 tons of foreign ores, including ore from Africa, Australia, Brazil, Canada, Chile, Cuba, India, Newfoundland, Spain, and Sweden, indicating an average yield of 57.02 percent from imported ore. Domestic ore (103,154,498 tons) and cinder, scale, and purchased scrap (7,741,210 tons) totaling 110,895,708 tons were reported as used in the manufacture of 58,563,894 tons of pig iron, indicating an average pig-iron yield of 52.81 percent from domestic materials. In addition, 1,564,912 tons of home scrap and 4,177,674 tons of flue dust were consumed in making pig iron in 1942.

Pig iron produced and shipped in the United States, 1941–42, by States

State	Produced		Shipped from furnaces			
			1941		1942	
	1941 (short tons)	1942 (short tons)	Short tons	Value	Short tons	Value
Alabama	3,696,566	4,081,710	3,712,018	$64,037,109	4,083,330	$70,638,989
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	5,354,767	5,850,070	5,461,459	113,558,606	5,871,858	125,662,134
Indiana	6,374,331	6,430,820	6,393,223	135,655,190	6,446,750	142,920,764
Iowa	(1)		(1)	(1)	(1)	(1)
Kentucky	328,912	457,124	329,125	(1)	457,124	(1)
Maryland	2,353,203	2,490,571	2,372,932	(1)	2,493,946	(1)
Massachusetts	(1)	(1)	(1)	(1)	(1)	(1)
Michigan	1,350,450	1,683,414	1,360,139	21,384,383	1,675,143	25,718,214
Minnesota	359,263	373,492	369,549	(1)	373,595	(1)
New York	3,574,901	4,040,756	3,724,989	66,718,244	4,011,238	78,734,591
Ohio	12,787,243	13,140,362	12,995,298	268,660,861	13,153,014	284,600,670
Pennsylvania	16,856,917	18,064,888	16,340,965	344,298,435	18,038,237	388,006,953
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Virginia			(1)	(1)	(1)	(1)
West Virginia	1,019,150	1,408,993	1,032,148	(1)	1,417,225	(1)
Undistributed [2]	1,029,743	1,055,393	1,131,796	97,498,488	1,079,141	111,107,374
	55,085,446	59,077,593	55,223,641	1,111,811,316	59,100,601	1,227,389,689

[1] Included under "Undistributed."
[2] Includes statistics for States entered as "(1)."

Shipments of pig iron, exclusive of ferro-alloys, increased 7 percent in quantity and 10 percent in value in 1942 over 1941. 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 figured in some of the market prices for pig iron published by trade journals.

Pig iron shipped from blast furnaces in the United States, 1941–42, by grades

Grade	1941			1942		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Charcoal	144,076	$3,618,686	$25.12	104,813	$2,860,086	$27.29
Foundry	3,125,413	61,309,626	19.62	2,656,089	53,221,988	20.04
Basic	40,642,051	801,328,939	19.72	44,317,871	900,681,890	20.32
Bessemer	7,900,369	170,051,203	21.52	8,892,477	197,565,272	22.22
Low-Phosphorus	508,727	13,881,518	27.29	520,642	13,998,587	26.89
Malleable	2,643,497	56,677,298	21.44	2,455,295	55,642,522	22.66
Forge	1,212	30,094	24.83			
All other (not ferro-alloys)	258,296	4,913,952	19.02	153,414	3,419,344	22.29
	55,223,641	1,111,811,316	20.13	59,100,601	1,227,389,689	20.77

The number of furnaces in blast June 30 and December 31 and the total number of blast furnaces recorded for 1941 and 1942 were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1941–42 [1]

State	In blast June 30, 1941	December 31, 1941			In blast June 30, 1942	December 31, 1942		
		In	Out	Total		In	Out	Total
Alabama	17	19	1	20	20	21		21
California						1		1
Colorado	3	3	1	4	3	3	1	4
Illinois	18	20	3	23	20	19	2	21
Indiana	19	19		19	19	19	1	20
Kentucky	2	2		2	2	3		3
Maryland	6	7		7	7	7		7
Massachusetts	1	1		1	1	1		1
Michigan	7	8		8	8	7	1	8
Minnesota	2	2		2	2	2	1	3
New York	15	15	1	16	16	16	1	17
Ohio	47	46	2	48	46	48	1	49
Pennsylvania	70	70	7	77	71	73	3	76
Tennessee	2	5		5	5	4	1	5
Utah	1	1		1	1	1		1
Virginia	1	1		1	1	1		1
West Virginia	3	4		4	4	4		4
	214	223	15	238	226	230	12	242

[1] American Iron and Steel Institute.

VALUE AT BLAST FURNACES

The average value of all grades of pig iron given in the accompanying table is based upon reports of producers 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 $20.77 a short ton in 1942, $0.64 more than in 1941.

Average value per short ton of pig iron at blast furnaces in the United States, 1938–42, by States

State	1938	1939	1940	1941	1942
Alabama	$13.10	$14.42	$14.30	$17.25	$17.30
Illinois	18.15	18.02	18.05	20.79	21.40
Indiana	18.29	18.03	18.26	21.22	22.17
Michigan	15.67	14.79	13.78	15.72	15.35
New York	18.58	18.29	16.89	17.91	19.63
Ohio	18.17	18.12	18.81	20.67	21.64
Pennsylvania	19.30	18.52	19.40	21.07	21.51
Other States [1]	15.21	14.91	15.20	18.62	19.09
Average for United States	17.51	17.44	17.90	20.13	20.77

[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 table following.

Average monthly prices per short ton of chief grades of pig iron, 1941–42 [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	
	1941	1942	1941	1942	1941	1942	1941	1942
January	$21.43	$21.43	$17.30	$18.20	$21.88	$21.88	$20.98	$20.98
February	21.43	21.43	17.30	18.20	21.88	21.88	20.98	20.98
March	21.43	21.43	17.51	18.20	21.88	21.88	20.98	20.98
April	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
May	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
June	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
July	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
August	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
September	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
October	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
November	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
December	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
Average	21.43	21.43	17.99	18.20	21.88	21.88	20.98	20.98

[1] Metal Statistics, 1943.

FOREIGN TRADE

There were no imports for consumption of pig iron during 1942.

Pig iron imported for consumption in the United States, 1938–42, by countries, in short tons [1]

Country	1938	1939	1940	1941
North America: Canada	2,975	7,685	3,826	308
South America: Brazil		174		
Europe:				
Denmark		1		
Netherlands	15,944	7,250		
Norway	952			
Sweden	230	292		
United Kingdom	47			
Asia: India, British	13,900	27,821	7,645	
Oceania: Australia				3,367
	34,048	43,223	11,471	3,675
Value	$598,461	$663,091	$189,379	$61,130

[1] None imported in 1942.

Pig iron exported from the United States, 1941–42, by countries, in short tons

Country	1941	1942	Country	1941	1942
North America:			Europe—Continued.		
Canada	5,118	1,691	Other Europe	841	
Cuba	21	84	Asia:		
Panama	458	127	British Malaya	171	
Other North America	274	63	China	280	
South America:			Netherlands Indies	2,897	168
Argentina	291	336	Philippine Islands	807	
Bolivia	6	235	Other Asia	70	
Chile	2,119	578	Africa:		
Colombia	441		Belgian Congo	121	263
Peru	1,064		Gold Coast	39	
Uruguay	195		Union of South Africa	7,075	
Other South America	131		Other Africa	2	59
Europe:			Oceania: New Zealand	203	1,118
Portugal	570				
U. S. S. R.		430		578,533	110,647
United Kingdom	555,339	105,495	Value	$15,606,692	$3,144,701

CONSUMPTION

Consumption of pig iron rose 5 percent in 1942 over 1941. 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 1942, 88 percent of the pig iron was consumed in steel making. Direct castings took 4 percent of the 1942 total, and the remaining 8 percent was consumed in iron-making furnaces, of which the cupola is the most important. The consumption of pig iron, by types of furnace, for 1939 to 1942 is shown in the following table. 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 1942 over 1941.

Consumption of pig iron in the United States, 1939–42, by type of furnace

Type of furnace or equipment	1939		1940		1941		1942	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Open-hearth	26,826,172	76.2	36,297,250	78.6	42,481,404	75.6	45,538,846	77.1
Bessemer	3,603,199	10.2	3,828,978	8.3	5,993,264	10.7	6,131,222	10.4
Electric	30,542	.1	46,506	.1	72,758	.1	92,878	.2
Cupola [1]	3,349,198	9.5	4,106,119	8.9	5,388,747	9.6	[2] 4,490,532	7.6
Air Brackelsberg	329,317	.9	374,187	.8	604,835	1.1	555,436	.9
Crucible	92	[3]	184	[3]	207	[3]	221	[3]
Puddling	27,959	.1	28,293	.1	54,183	.1	49,835	.1
Direct castings [1]	1,066,220	3.0	1,504,311	3.2	1,590,074	2.8	2,183,913	3.7
	35,232,699	100.0	46,185,828	100.0	56,185,472	100.0	[2] 59,042,883	100.0

[1] Some pig iron used in making direct castings included in cupola.
[2] Includes 19 tons used in making ferro-alloys.
[3] 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 uses of pig iron, consumption is concentrated largely in the iron- and steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas in 1942 used about 98 percent of the pig iron, Pennsylvania (the leading consumer) taking about 32 percent of the total and Ohio (the second-largest consumer) 20 percent.

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Consumption of pig iron in the United States, 1939–42, by States and districts

State and district	1939		1940		1941		1942	
	Consumers	Short tons	Consumers	Short tons	Consumers	Short tons	Consumers	Short tons
Connecticut	59	82,886	60	96,574	62	143,862	61	138,938
Maine	15	6,720	15	8,392	14	11,467	13	8,763
New Hampshire	15	1,826	14	2,479	15	5,816	16	20,523
Massachusetts	97	115,534	104	146,886	107	242,265	101	244,993
Rhode Island	12	26,257	11	37,308	12	57,082	12	58,116
Vermont	12	6,530	12	10,358	14	16,276	12	20,653
Total New England	210	239,753	216	301,997	224	476,768	215	491,986
Delaware	7	281,000	7	362,758	7	449,486	7	532,783
New Jersey	79		81		80		84	
New York	193	1,817,251	190	2,403,248	199	2,765,216	200	3,015,417
Pennsylvania	365	10,152,661	348	14,634,036	391	17,573,102	392	18,843,804
Total Middle Atlantic	644	12,250,912	626	17,400,042	677	20,787,804	683	22,392,004
Alabama	57	2,378,774	59	2,809,064	74	3,142,958	71	3,408,958
District of Columbia	2	2,365,534	1	2,825,324	1	2,974,834	1	3,055,553
Kentucky	24		24		23		23	
Maryland	26		25		26		28	
West Virginia	23	880,062	23	1,016,445	28	1,218,175	27	1,624,014
Florida	12	61,655	13	73,045	12	83,895	15	81,229
Georgia	40		40		43		44	
Mississippi	7	362	9	365	7	621	6	615
North Carolina	32	13,853	33	15,901	40	18,591	42	16,076
South Carolina	13	2,251	14	2,355	12	5,090	14	4,532
Tennessee	52	150,564	50	162,936	52	254,840	51	165,331
Virginia	46		44		45		47	
Total Southeastern	334	5,853,055	335	6,905,435	363	7,699,004	369	8,356,308
Arkansas	6	2,003	6	2,107	6	2,600	3	3,053
Oklahoma	6		8		7		7	
Louisiana	8		8		7		6	
Texas	24	2,572	23	2,327	27	3,107	28	4,428
Total Southwestern	44	4,575	45	4,434	47	5,707	44	7,481
Illinois	179	2,770,693	183	3,764,275	208	4,915,372	212	5,369,942
Indiana	124	3,830,053	126	5,522,177	131	6,833,091	127	6,963,040
Iowa	49	54,834	52	63,834	52	104,368	54	64,012
Minnesota	53	185,976	51	214,340	53	266,768	57	308,937
Missouri	53	37,760	53	45,486	51	80,065	53	81,677
Kansas	14	3,513	13	3,742	15	4,251	11	5,882
Nebraska	7		8		10		10	
Michigan	168	1,849,622	173	2,232,069	174	2,478,219	175	2,104,082
Wisconsin	118		115		111		114	
South Dakota	2	148	2	106	2	86	2	76
Ohio	290	7,558,466	285	9,080,242	319	11,676,773	325	11,958,323
Total North Central	1,057	16,291,065	1,061	20,926,271	1,126	26,358,993	1,140	26,855,971
Arizona	1	36	1	35	2	67	2	36
Nevada			1					
New Mexico			1					
Colorado	19	412,220	10	457,487	18	644,393	18	666,254
Utah			7					
Idaho			1					
Wyoming	5	308	1	687	4	578	5	648
Montana			3					
Total Rocky Mountain	25	412,564	25	458,209	24	645,038	25	666,938
Oregon	19	6,312	19	7,519	18	9,830	17	17,178
Washington	37		36		33		30	
California	95	174,463	93	181,921	98	202,328	93	255,017
Total Pacific Coast	151	180,775	148	189,440	149	212,158	140	272,195
Total United States	2,465	35,232,699	2,456	46,185,828	2,610	56,185,472	2,616	59,042,883

WORLD PRODUCTION

The accompanying table shows the production of pig iron, by countries, from 1938 to 1942, insofar as statistics are available.

World production of pig iron (including ferro-alloys), 1938–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1938	1939	1940	1941	1942
Australia [2]	944,597	1,122,334	[3]	[4]	[4]
Belgian Congo	[5] 600	[5] 600	[5] 600	[4]	[4]
Belgium	2,426,130	3,058,730	[6] 2,200,000	[4]	[4]
Brazil	122,352	160,016	185,570	208,795	[5] 208,000
Canada	773,573	845,461	1,323,128	1,579,648	1,985,500
China (Manchuria)	[5] 700,000	[5] 700,000	[5] 700,000	[4]	[4]
Chosen	[5] 200,000	[5] 200,000	[5] 200,000	[4]	[4]
Czechoslovakia	1,233,987	[7] 1,000,000	[8]	[4]	[4]
Finland	27,000	[5] 30,000	[3]	[4]	[4]
France	6,061,322	[7] 7,900,000	[6] 4,600,000	[4]	[4]
Germany [9]	18,596,000	20,300,000	[6] 21,000,000	[4]	[4]
Austria					
Hungary	350,537	[7] 460,000	[3]	[4]	[4]
India, British	1,583,284	1,785,242	2,015,116	[4]	[4]
Italy	928,847	[7] 1,000,000	[6] 890,000	[4]	[4]
Japan	[5] 2,800,000	[5] 3,000,000	[6] 3,000,000	[4]	[4]
Luxemburg	1,500,000	[7] 1,800,000	[6] 1,000,000	[4]	[4]
Mexico	98,376	141,335	93,179	108,524	[4]
Netherlands	266,956	284,004	[3]	[4]	[4]
Norway	173,748	190,785	[3]	[4]	[4]
Poland	967,668	1,000,000	[8]	[4]	[4]
Rumania	132,681	[5] 140,000	[3]	[4]	[4]
Spain	442,574	473,360	588,076	536,863	[10] 438,072
Sweden	713,579	691,402	787,211	[4]	[4]
Union of South Africa	294,406	300,227	303,923	[4]	[11] 196,300
U. S. S. R.	15,179,856	[7] 15,200,000	[6] 15,500,000	[4]	[4]
United Kingdom	6,871,546	[7] 8,300,000	[6] 8,437,000	[4]	[4]
United States	19,474,677	32,321,653	43,026,030	51,456,627	55,308,045
Yugoslavia	58,458	61,106	[3]	[12] 75,000	[4]
	82,923,000	102,466,000	107,882,000	[4]	[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] Estimate included in total.
[4] Data not available.
[5] Estimated production.
[6] Approximate production as published by The Iron Age, vol. 147, No. 1, January 2, 1941, p. 61.
[7] Approximate production as published by Steel, vol. 196, No. 1, January 1940, p. 269.
[8] Included in the German figure in 1940.
[9] Beginning with March 1935, production of the Saar is included with that of Germany.
[10] January to October, inclusive.
[11] January to July, inclusive.
[12] Croatia only.

FERRO-ALLOYS

PRODUCTION AND SHIPMENTS

The production of ferro-alloys in 1942 totaled 1,889,409 short tons, compared with 1,636,073 tons in 1941—an increase of 15 percent. In 1942, ferro-alloys were made at 18 blast-furnace plants, 20 electric-furnace plants, and 3 aluminothermic plants. In addition, 3 plants made ferrophosphorus, and 2 plants made ferrosilicon as a byproduct. Of the 1942 total, 1,076,328 tons were made in blast furnaces, 778,112 tons in electric furnaces, and 33,427 tons by the aluminothermic process, and 1,542 tons of alloys were produced as byproducts. Shipments of all classes of ferro-alloys in 1942 increased 8 percent in quantity and 26 percent in value over 1941.

Ferro-alloys produced and shipped from furnaces in the United States, 1941–42

Alloy	1941			1942		
	Production (short tons)	Shipments		Production (short tons)	Shipments	
		Short tons	Value		Short tons	Value
Ferromanganese	580,704	619,395	$69,378,004	661,338	659,219	$82,726,298
Spiegeleisen	177,915	181,177	5,793,481	186,026	186,163	5,931,728
Ferrosilicon	618,227	661,913	34,084,428	712,710	707,522	39,691,636
Ferrophosphorus	21,824	11,821	749,916	28,161	7,761	513,886
Ferrotungsten	6,549	6,415	19,056,118	7,108	7,148	21,547,454
Ferroboron	(1)	(1)	(2)	190	113	(2)
Ferrotitanium	14,238	15,194	(2)	17,048	16,823	(2)
Ferrovanadium						
Ferromolybdenum						
Molybdic oxide	22,331	23,314	(2)	41,718	41,680	(2)
Calcium molybdate and compounds						
Other varieties [3]	194,285	200,556	(2)	235,110	233,858	(2)
	1,636,073	1,719,785	204,856,619	1,889,409	1,860,287	257,749,185

[1] Included with "Other varieties."
[2] Value included in total.
[3] Silicomanganese, manganese briquets, ferrochromium, chrome-manganese, ferrocolumbium, and zirconium-ferrosilicon.

Ferromanganese.—The output of ferromanganese in 1942 came from 11 blast-furnace plants and 3 electric-furnace plants compared with 10 blast-furnace plants and 3 electric plants in 1941. Of the manganese ore used in 1942, 98.6 percent was foreign ore. The ferromanganese produced in 1942 averaged 79.01 percent manganese. During 1942, steel producers used 12.4 pounds of metallic manganese as ferroalloys per ton of steel produced. Of this quantity, 11.2 pounds was in the form of ferromanganese. A total of 665,299 tons of ferromanganese was consumed in 1942—all by the iron and steel industry.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1938–42

Year	Ferromanganese produced			Materials consumed (short tons)				Manganese ore used per ton of ferromanganese made (short tons)
	Short tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Short tons	Foreign	Domestic			
1938	272,153	78.65	214,036	466,746	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	[1] 8,868	1.923
1941	580,704	79.48	461,539	1,122,187	9,414	5,166	6,031	1.949
1942	661,338	79.01	522,553	1,273,596	17,572	19,545	4,634	1.952

[1] Corrected figure.

Manganese ore used in manufacture of ferromanganese in the United States, 1938–42, by sources of ore

Source of ore	1938		1939		1940		1941		1942	
	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)
Domestic	25,254	53.20	------	------	13,419	55.89	9,414	41.61	17,572	39.69
Foreign:										
Africa	171,022	48.99	144,734	48.14	233,370	45.89	221,940	47.11	274,450	46.61
Brazil	71,747	41.44	65,278	43.75	189,389	42.39	328,769	42.29	342,538	41.55
Chile	------	------	959	48.16	6,076	46.13	4,715	45.81	5,677	46.64
Cuba	40,650	48.07	66,079	48.16	112,859	48.59	135,581	48.47	171,029	46.33
India	62,681	49.24	96,666	49.84	188,079	49.73	[1] 250,425	49.85	340,096	49.75
Java	------	------	------	------	------	------	------	------	2,189	46.28
Mexico	------	------	------	------	------	------	1,755	46.27	2,013	45.31
Philippine Islands	------	------	------	------	12,768	47.16	6,236	48.32	19,741	46.05
U. S. S. R.	120,646	47.61	189,628	47.54	187,286	47.85	[1] 145,325	48.12	64,051	48.06
Undistributed	------	------	------	------	46,505	38.75	[1] 27,441	46.26	[2] 51,812	45.75
	492,000	47.72	563,344	47.72	989,751	46.45	1,131,601	46.54	1,291,168	45.99

[1] Tonnage entered under "Undistributed" comprises ore from India and U. S. S. R.; separation as to source not reported by consumer.
[2] Source of ore not reported by consumer.

Spiegeleisen.—The spiegeleisen produced in 1942 came from four blast-furnace plants, averaged 19 percent manganese, and had an average value of $31.86 per short ton at furnaces. All spiegeleisen in 1942 was manufactured from domestic materials and was made by the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa. and the New Jersey Zinc Co., New York, N. Y.

Ferrosilicon.—Of the total of 712,710 short tons of ferrosilicon produced in 1942, 258,943 tons were produced in blast furnaces, 452,732 tons in electric furnaces, and 1,035 tons as a byproduct in the manufacture of artificial abrasives in electric furnaces. The silicon content of the production in 1942 ranged from 9 to 95 percent and averaged 30 percent. Blast-furnace production averaged about 10 percent silicon.

Ferrophosphorus.—The ferrophosphorus produced in 1942 averaged 24 percent phosphorus, and shipments were valued at $66.21 per short ton f. o. b. furnaces. All was made from domestic materials.

Ferrotungsten.—Production of ferrotungsten in 1942 totaled 14,216,680 pounds (7,108 tons), averaging 79 percent tungsten. The average value at furnaces was $1.899 per pound of contained tungsten and $3,014 per short ton of alloy. All ferrotungsten was made in electric furnaces.

Ferrochromium.—The industrial consumers of ferrochromium reported using 162,904 tons of ferrochromium during 1942.

Ferromolybdenum.—The bulk of the ferromolybdenum produced in 1942 was made by the aluminothermic process. All was produced from domestic ores and averaged 62 percent Mo.

Molybdic oxide, calcium molybdate, and molybdenum compounds.—As these products are used as alloying agents in the production of iron and steel, they are included with ferro-alloys. These compounds averaged 80 percent Mo in 1942. They are considerably less expensive than ferromolybdenum and consequently are used to a greater extent.

Ferrovanadium.—The ferrovanadium produced in 1942 averaged 38 percent V, and the value averaged $2.75 per pound of metal contained, at furnaces. This alloy is produced by electric and aluminothermic processes, using both foreign and domestic ores.

Silicomanganese.—The silicomanganese produced in 1942 averaged 67 percent manganese and was produced in electric furnaces.

Manganese briquets.—During 1942, manganese briquets averaged 56 percent Mn. Manganese briquets are used chiefly in the foundry industry.

Ferrotitanium.—During 1942, the ferrotitanium produced averaged 12 percent Ti. The bulk was made in electric furnaces, but some was produced by the aluminothermic process. Both foreign and domestic ores were consumed in the manufacture of ferrotitanium in 1942. Ferrotitanium is used chiefly as a deoxidizer and scavenger in steel making and is also valuable as an alloying agent in certain steels to prevent intergranular corrosion.

Ferroboron.—One hundred and ninety short tons of ferroboron containing 8 percent B were produced in 1942. Boron finds its main use in special steels as a hardening agent.

Ferrocolumbium.—Columbium additions have a valuable use in preventing intergranular corrosion. The production in 1942 averaged 57 percent Cb.

Zirconium-ferrosilicon.—The zirconium-ferrosilicon produced in 1942 averaged 14 percent Zr. Zirconium is a powerful deoxidizer and scavenger and reduces age hardening, thereby improving deep drawing properties of sheet steel.

FOREIGN TRADE

Imports and exports of the rarer metals are not recorded separately but are grouped as shown in the accompanying tables. Ferromanganese and spiegeleisen comprised most of the imports in both 1941 and 1942.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1941–42, by varieties

Variety of alloy	1941			1942		
	Gross weight (short tons)	Content (short tons)	Value	Gross weight (short tons)	Content (short tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	7,017	5,683	$555,553	14,772	11,617	$1,274,749
Containing not over 1 percent carbon	15	13	1,597	----------	----------	----------
Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	(1)	54	12,405	(1)	5	2,220
Spiegeleisen	4,741	(1)	215,108	1,990	(1)	95,853
Ferrochrome or ferrochromium:						
Containing 3 percent or more carbon	138	88	19,242	9	5	1,598
Containing less than 3 percent carbon	----------	----------	----------	514	436	185,963
Ferrosilicon	18,261	6,190	750,975	15,211	4,394	569,134
Chromium and zirconium silicon and calcium silicide	56	(1)	8,337	30	(1)	10,144
Tungsten and combinations, in lumps, grains, or powder: Tungsten metal (tungsten content)	(1)	18	48,307	(1)	2	7,668

[1] Not recorded.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1941–42, by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1941		1942		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Canada	1,202	$136,029	5,022	$654,219	6,190	$750,975	4,394	$569,134
Norway	13	1,597						
United Kingdom	4,481	419,524	6,595	620,530				
	5,696	557,150	11,617	1,274,749	6,190	750,975	4,394	569,134

Ferro-alloys and ferro-alloy metals exported from the United States, 1941–42, by varieties

Variety of alloy	1941		1942	
	Short tons	Value	Short tons	Value
Ferromanganese and spiegeleisen	5,155	$771,575	7,223	$979,113
Other ferro-alloys [1]	18,908	5,029,802	14,653	6,464,810

[1] Includes ferrosilicon, ferrotungsten, ferrovanadium, and other ferro-alloys.

STEEL

GENERAL FEATURES

Steel production continued at a high rate throughout 1942, furnaces operating at an average of 97 percent of capacity for the year. Capacity for producing steel increased 1,723,000 short tons to reach a new record total of 90,293,000 tons. The data concerning steel operations used by the Bureau of Mines are furnished by the American Iron and Steel Institute. Not included in the statistics is the output from steel foundries that do not produce steel ingots. During 1942 the Bureau of Mines obtained some information to determine the magnitude of this tonnage. There are, in all, about 275 plants producing steel ingots and castings in the United States. In addition to the output of steel shown in the following table, 756,884 tons of basic open hearth and 228,630 tons of basic electric steel were produced for castings. Not known for 1942 is the quantity of bessemer steel, acid open-hearth steel, and acid electric steel produced by independent foundries that produce only castings. This quantity is relatively very small.

Steel capacity, production and percent of operations, 1896–1942, in short tons [1]

[Ingots and steel for castings [2]]

Years	Capacity	Production					Percent of capacity
		Open hearth	Bessemer	Crucible	Electric and all other	Total	
1896	13,441,680	1,454,544	4,390,295	67,972	2,681	5,915,492	44.0
1897	(*)	1,801,712	6,132,353	78,354	3,373	8,015,792	(*)
1898	15,869,560	2,497,927	7,402,099	100,517	4,257	10,004,800	63.0
1899	(*)	3,300,994	8,496,716	113,359	5,571	11,916,640	(*)
1900	(*)	3,805,911	7,486,942	112,629	5,446	11,410,928	(*)
1901	24,039,064	5,215,066	9,758,898	110,335	6,127	15,090,426	62.8
1902	(*)	6,370,256	10,234,967	126,305	9,392	16,740,920	(*)
1903	(*)	6,529,500	9,623,968	114,726	10,981	16,279,175	(*)
1904	28,213,147	6,617,146	8,802,237	93,398	10,293	15,523,074	55.0
1905	(*)	10,047,941	12,254,340	114,501	10,039	22,426,821	(*)
1906	(*)	12,298,063	13,748,930	142,815	16,105	26,205,913	(*)
1907	(*)	12,935,704	13,067,655	146,982	15,764	26,166,105	(*)
1908	38,237,343	8,777,136	6,850,766	71,267	6,868	15,706,037	41.1
1909	(*)	16,233,208	10,450,477	120,238	25,701	26,829,624	(*)
1910	(*)	18,485,050	10,542,305	136,979	61,975	29,226,309	(*)
1911	(*)	17,470,488	8,901,596	109,371	35,783	26,517,238	(*)
1912	(*)	23,274,410	11,567,249	136,099	23,701	35,001,459	(*)
1913	(*)	24,191,923	10,691,191	135,773	38,092	35,056,979	(*)
1914	44,451,977	19,235,646	6,967,348	100,653	30,947	26,334,594	59.2
1915	46,249,146	26,520,594	9,281,679	127,436	79,452	36,009,161	77.9
1916	51,282,314	35,185,278	12,386,124	145,255	189,865	47,906,522	93.4
1917	55,567,555	38,246,760	11,737,555	141,922	341,643	50,467,880	90.8
1918	58,846,418	38,594,518	10,501,384	128,925	573,096	49,797,923	84.6
1919	61,020,669	30,182,537	8,144,149	71,201	433,892	38,831,779	63.6
1920	62,313,591	36,592,522	9,949,057	80,937	566,370	47,188,886	75.7
1921	64,262,027	17,460,578	4,497,851	8,527	190,897	22,157,853	34.5
1922	65,426,682	32,826,061	6,629,614	32,039	387,563	39,875,277	60.9
1923	65,682,014	40,207,616	9,502,179	49,368	577,777	50,336,940	76.6
1924	66,563,515	35,366,632	6,607,541	25,170	484,429	42,483,772	63.8
1925	68,473,222	42,598,627	7,530,837	21,910	689,373	50,840,747	74.2
1926	64,750,035	45,575,016	7,766,716	17,352	729,930	54,089,014	83.5
1927	67,236,117	42,636,535	6,934,734	10,120	746,018	50,327,407	74.9
1928	68,840,912	49,407,631	7,414,618	8,701	898,531	57,729,481	83.9
1929	71,438,516	54,155,235	7,977,210	7,442	1,065,603	63,205,490	88.5
1930	72,985,406	39,255,073	5,639,714	2,523	686,111	45,583,421	62.5
1931	77,257,803	25,210,714	3,386,259	1,733	460,255	29,058,961	37.6
1932	78,780,913	13,336,210	1,715,925	722	270,044	15,322,901	19.5
1933	78,614,403	22,827,473	2,720,246	763	471,747	26,020,229	33.1
1934	78,128,416	26,354,838	2,421,840	595	404,651	29,181,924	37.4
1935	78,451,930	34,401,280	3,175,235	719	606,471	38,183,705	48.7
1936	78,164,300	48,760,463	3,873,472	914	865,150	53,499,999	68.4
1937	78,148,374	51,824,979	3,863,918	1,046	947,002	56,636,945	72.5
1938	80,185,638	29,080,016	2,106,340	7	565,627	31,751,990	39.6
1939	81,828,958	48,409,800	3,358,916	931	1,029,067	52,798,714	64.5
1940	81,619,496	61,573,083	3,708,573	1,024	1,700,006	66,982,686	82.1
1941	[3] 85,158,150	74,389,619	5,578,071	2,313	2,869,256	82,839,259	97.3
1942	[4] 90,293,000	76,501,957	5,553,424	2,010	3,974,540	86,031,931	96.8

[1] American Iron and Steel Institute.

[2] The figures for 1934 and subsequent years include only that portion of the capacity and production of steel for castings used by foundries which were operated by companies producing steel ingots.

*Figures not available.

[3] Average annual capacity as of January 1 and July 1, 1941.

[4] Annual capacity as of January 1, 1943.

Open-hearth steel ingots and castings manufactured in the United States, 1938–42, by States, in short tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1938	1939	1940	1941	1942
New England States	183,297	286,850	322,753	462,754	472,521
New York and New Jersey	1,509,538	2,627,910	3,618,444	4,232,521	4,378,808
Pennsylvania	7,920,816	13,622,272	18,469,170	23,007,147	23,562,866
Ohio	6,016,902	9,913,454	11,769,780	14,746,523	14,769,085
Indiana	3,847,603	6,486,502	8,421,956	10,366,380	10,578,989
Illinois	2,184,251	3,687,874	4,963,457	5,998,679	6,335,946
Other States	7,417,609	11,784,938	14,007,523	15,575,615	16,403,742
	29,080,016	48,409,800	61,573,083	74,389,619	76,501,957

Bessemer-steel ingots and castings manufactured in the United States, 1938–42, by States, in short tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1938	1939	1940	1941	1942
Ohio	1,202,916	1,439,629	1,459,807	2,265,987	2,250,717
Pennsylvania	389,827	1,109,081	1,366,017	1,966,779	1,997,547
Other States	513,597	810,206	882,749	1,345,305	1,305,160
	2,106,340	3,358,916	3,708,573	5,578,071	5,553,424

Steel electrically manufactured in the United States, 1938–42, in short tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1938	524,843	40,784	565,627	1941	2,758,611	110,645	2,869,256
1939	951,522	77,545	1,029,067	1942	3,843,757	130,783	3,974,540
1940	1,608,032	91,974	1,700,006				

The steel output for 1942 includes 11,526,374 short tons of alloy-steel ingots and castings, which represent 13 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 percentage. The output of alloy steels in 1942 increased 40 percent and that of total steel 4 percent over 1941. Of the total alloy-steel output in 1942, 65 percent came from basic open hearths, 5 percent from acid open hearths, 30 percent from electric furnaces, 522 tons from crucible furnaces, and none from bessemer converters.

Production of alloy-steel ingots and castings, 1938–42, by processes, in short tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

Process	1938	1939	1940	1941	1942
Open hearth, basic	1,179,031	2,302,273	3,421,961	[1] 5,306,415	7,524,209
Open hearth, acid	102,089	156,581	252,965	433,240	608,867
Bessemer	13	3,486	3,990	3,890	----------
Crucible	5	231	255	933	522
Electric	372,372	749,384	1,286,716	2,461,651	3,392,776
	1,653,510	3,211,955	4,965,887	[1] 8,206,129	11,526,374

[1] Revised figures.

From the accompanying tables it will be seen that most of the steel made in electric furnaces (85 percent in 1942) 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

Imports and exports of iron and steel products are given in detail in the following tables:

Iron and steel imported for consumption in the United States, 1941–42, by commodities

Commodity	1941		1942 [1]	
	Short tons	Value	Short tons	Value
Semimanufactures:				
Steel bars:				
Concrete reinforcement	6	$321	2	$442
Solid or hollow, n. e. s.	603	67,060	437	67,489
Hollow and hollow drill steel	250	34,897	1	253
Bar iron	17	1,671	1	324
Wire rods, nail rods, and flat rods up to 6 inches in width	119	36,699	57	14,165
Boiler and other plate iron and steel, n. e. s.	73	15,977	226	24,579
Steel ingots, blooms, and slabs	3,939	593,454	6,882	184,260
Billets, solid or hollow	181	15,227	281	34,609
Die blocks or blanks; shafting, etc.	17	7,623	54	13,264
Sheet iron and steel, n. e. s.	53	10,679	28	7,234
Tin plate, terneplate, and tagger's tin	122	31,330	117	27,945
Manufactures:				
Structural iron and steel	357	50,927	141	9,406
Rails for railways	7,672	200,796	14,431	426,607
Pipes and tubes:				
Cast-iron pipe and fittings	1	166	2	729
Other pipes and tubes	1,224	140,545	628	85,743
Wire:				
Barbed	[2]	21	[2]	5
Round wire, n. e. s.	39	9,426	89	10,187
Telegraph, telephone, etc., except copper, covered with cotton, jute, etc.	27	12,005	44	19,065
Flat and steel strips not thicker than ¼-inch and not over 16 inches wide	2,605	1,540,627	210	185,890
Rope and strand	105	21,823	36	9,331
Galvanized fencing wire and wire fencing	1	70	[3]	[3]
Hoop, band, or scroll iron or steel			1	232
Nails	31	9,262	229	11,081
Castings and forgings, n. e. s.	383	79,311	450	182,794

[1] January to November, inclusive; December figures not available at time of publication.
[2] Less than 1 ton.
[3] Not available at time of publication.

Iron and steel exported from the United States, 1941–42

Article	1941		1942	
	Short tons	Value	Short tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	2,314,478	$95,844,101	2,846,958	$92,344,860
Iron and steel bars and rods:				
Iron bars	7,261	743,554	5,098	532,682
Concrete reinforcement bars	170,368	9,589,930	74,917	4,490,185
Other steel bars	409,664	44,383,014	556,842	74,417,961
Wire rods	187,326	9,385,027	145,251	7,497,767
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	26,998	1,330,018	38,818	2,091,794
Other plates, not fabricated	378,171	22,649,187	402,568	27,222,392
Skelp iron or steel	162,524	6,973,459	170,876	7,662,716
Iron and steel sheets, galvanized	118,988	10,561,058	100,411	8,022,475
Steel sheets, black, ungalvanized	480,078	34,474,539	795,380	57,317,348
Iron sheets, black	24,553	2,141,216	14,940	1,120,434
Strip band, and scroll iron or steel:				
Cold-rolled	71,618	7,843,042	129,169	18,547,068
Hot-rolled	107,322	7,020,080	92,855	6,932,489
Tin plate, terneplate, and taggers' tin	397,532	42,835,146	665,387	70,697,155
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material	21,775	2,127,604	27,945	3,319,686
Structural shapes:				
Not fabricated	295,025	14,795,406	191,127	9,318,126
Fabricated	56,820	5,691,559	33,236	3,994,370
Plates fabricated, punched, or shaped	25,392	2,250,925	12,699	1,352,387
Metal lath	3,282	556,857	1,156	198,301
Frames, sashes, and sheet piling	10,111	876,533	4,238	443,529
Railway track material:				
Rails for railways	169,542	7,205,850	299,394	11,514,650
Rail joints, splice bars, fishplates, and tie plates	19,423	1,254,491	31,586	2,126,532
Switches, frogs, and crossings	2,334	350,420	13,297	1,634,292
Railroad spikes	7,724	605,934	6,854	515,938
Railroad bolts, nuts, washers, and nut locks	2,481	434,920	3,751	649,043
Tubular products:				
Boiler tubes	53,518	7,443,724	30,320	4,474,476
Casing and oil-line pipe	141,947	11,857,884	136,826	12,299,547
Seamless black pipe, other than casing and oil line	45,806	5,749,670	61,287	7,122,361
Welded black pipe	86,246	7,917,243	116,014	10,708,501
Welded galvanized pipe	80,505	7,554,467	42,775	4,329,737
Malleable-iron screwed pipe fittings	5,707	1,768,090	5,024	1,893,847
Cast-iron screwed pipe fittings	1,344	326,009	1,430	368,859
Cast-iron pressure pipe and fittings	43,638	2,578,515	16,008	1,246,854
Cast-iron soil pipe and fittings	18,410	1,106,988	5,727	460,664
Riveted-steel or iron pipe and fittings	34,884	7,306,724	115,849	19,076,215
Wire and manufactures:				
Barbed	79,422	6,403,041	162,344	13,137,749
Galvanized wire	63,649	5,810,095	79,988	7,949,678
Iron or steel wire, uncoated	79,740	7,805,269	69,172	9,261,514
Wire rope, and strand	22,595	7,268,137	37,062	14,384,070
Woven-wire fencing and screen cloth	11,301	3,183,111	7,237	2,330,321
All other	27,429	5,017,934	27,728	8,065,208
Nails and bolts (except railroad):				
Wire nails	56,808	4,510,235	23,907	2,219,287
Horseshoe nails	3,130	709,698	795	202,363
All other nails, including tacks and staples	10,229	6,825,278	7,070	1,085,103
Bolts, nuts, rivets, and washers (except railroad)	49,720	11,519,039	33,646	9,884,371
Castings and forgings:				
Horseshoes and calks	851	107,168	71	12,199
Iron and steel, including car wheels and axles	134,059	30,047,323	161,667	40,638,012
Advanced manufactures:				
House heating boilers and radiators	----------	536,189	----------	370,922
Oil burners and parts	----------	1,402,318	----------	989,981
Tools:				
Axes	----------	704,476	----------	514,676
Shovels and spades	----------	667,863	----------	570,362
Hammers and hatchets	----------	661,987	----------	443,109
Saws, wood and metal cutting	----------	4,155,793	----------	5,797,411
All other tools	----------	25,627,925	----------	49,665,540

MANGANESE AND MANGANIFEROUS ORES

By Norwood B. Melcher [1]

SUMMARY OUTLINE

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GENERAL PERSPECTIVE

The unprecedented demand for manganese by the steel industry resulted in a record consumption of manganese ore during 1942. Domestic production (shipments from domestic mines) in 1942, stimulated by higher prices, more than doubled the 1941 output and totaled 190,748 short tons; in 1941 shipments amounted to 87,794 short tons. In addition, 268,764 short tons of ore containing 10 to 35 percent manganese and 1,500,613 short tons of ore containing 5 to 10 percent manganese were shipped during 1942.

Although imports declined 15 percent in 1942, total domestic stocks decreased less than 1 percent and at the end of 1942 were sufficient to last at least 18 months. Because of the favorable continuation of imports during the war and the large stocks, much of the domestic expansion program outlined by the Bureau of Mines before 1942 has been deferred in favor of more critical raw-material programs. However, at the close of 1942 low-grade ores were being stock-piled by the Government for concentrating purposes, and stocks of such ore totaled 298,973 short tons (dry). The bulk of the ore is near Las Vegas, Nev., and in the Butte-Philipsburg area of Montana. Using these ores, the Manganese Ore Co. will produce 100,000 tons of ore annually from the Las Vegas operation, and the Domestic Manganese Co. will produce about 24,000 tons of concentrate from its mill at Butte. These operations are described in detail in this chapter in the section on Domestic Production.

Since the outbreak of war in Europe in 1939, the Bureau of Mines normal program of manganese research has been greatly expedited. By authorization of the Congress, Bureau of Mines and Geological Survey engineers intensified their search for domestic deposits containing manganese and other strategic minerals. In the fall of 1940 a $2,000,000 appropriation was made available to the Bureau for constructing and operating pilot plants to beneficiate low-grade manganese ores, to produce metallic manganese from these ores, and to develop

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

manganiferous deposits. Since 1939 the Bureau has engaged in 37 projects for manganese exploration, has completed 34 of them, and still is working on three. In some projects a number of ore deposits were examined. As a result of this exploration, the estimated reserves of usable manganese ore in the United States have been increased several million tons. The Bureau of Mines believes that application of available processing methods to known ores can make the United States self-sufficient in manganese should imports decline to a point requiring the development of high-cost domestic production.

The electrolytic process, invented and developed by Bureau engineers between 1935 and 1938, extracts high-grade metallic manganese from low-grade ores through leaching and electrolysis. The process, patented and assigned to the United States Government through the Secretary of the Interior, is being used in a commercial plant at Knoxville, Tenn., as well as in the Bureau of Mines pilot plant at Boulder City, Nev.

Several shipments of 99.9-percent manganese from the Boulder City pilot plant have been sent to branches of the Mint at Philadelphia and San Francisco. Bureau metallurgists determined that several alloys using manganese have the physical and chemical properties required as a substitute for the 5-cent coin heretofore made of 75-percent copper and 25-percent nickel. The new coin, containing 9 percent manganese, 35 percent silver, and 56 percent copper, closely approximates the old coin in hardness, appearance, durability, and electrical resistance and may be used in coin-operated machines. Some attempts have been made to substitute less pure manganese, but the results have been unsatisfactory. By eliminating all the nickel formerly used in 5-cent coins, the adoption of the new alloy is releasing approximately 450 tons of this scarce metal and 250 to 350 tons of copper annually for the manufacture of war materials and essential civilian goods.

Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1938–42, in short tons

	1925–29 (average)	1938	1939	1940	1941	1942
Manganese ore:						
Total shipments containing 35 percent or more Mn	66,429	28,359	32,824	44,936	87,794	190,748
Shipments of metallurgical ore	[1] 46,919	19,027	20,810	30,416	73,852	177,966
Shipments of battery ore	19,510	5,554	8,699	10,383	11,399	12,377
Imports for consumption	672,000	541,616	702,384	1,435,928	1,714,581	1,560,940
Ferro-alloys:						
Production of ferromanganese	343,123	272,153	302,524	514,682	580,704	661,338
Imports of ferromanganese [2 3]	[4] 56,661	23,652	37,424	9,601	5,696	11,617
Production of spiegeleisen	106,919	12,668	102,470	114,119	177,915	186,026
Imports of spiegeleisen [2]	8,174	19,318	42,856	17,455	4,741	1,990
Exports of spiegeleisen and ferromanganese	4,221	277	3,274	14,600	5,155	7,223

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.

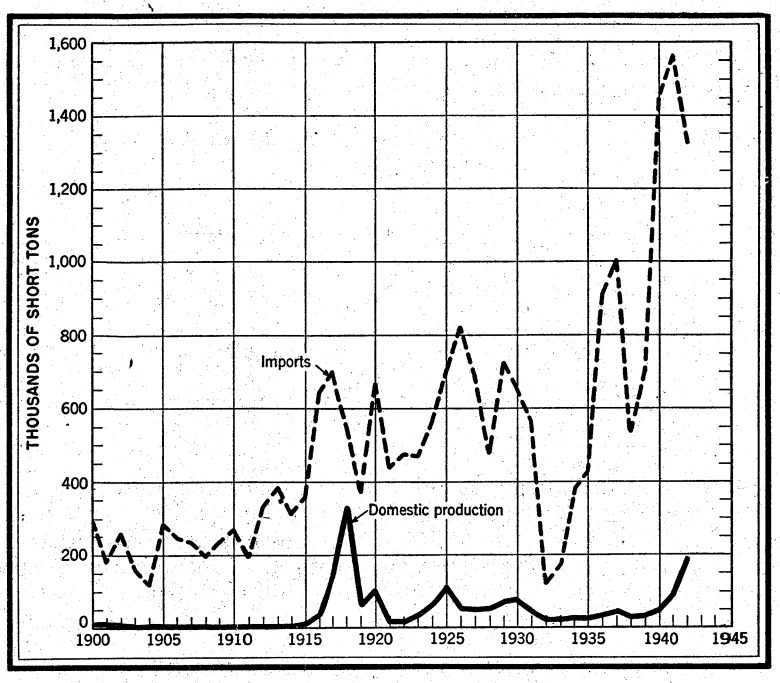

FIGURE 1.—Imports and domestic production (mine shipments) of manganese ore, 1900–1942. Statistics on imports shown in the graph represent general imports for 1900–1933, imports for consumption adjusted for changes in bonded warehouse stocks for 1934–39, and general imports for 1940–42.

Government purchases.—Government purchases of manganese ore proceeded at a high rate in 1942. The Metals Reserve Co. continued to purchase and stock-pile contract manganese ore during 1942, and on December 28, 1942, stock piles in 13 States (chiefly Maryland and Pennsylvania) contained 741,295 short tons of foreign ores and 147,558 short tons of domestic ores. The company also stock-piled noncontract manganese ore at 15 small-purchase depots, and on January 1, 1943, these piles contained 4,875 short tons of domestic ore. Purchases of low-grade ores for future milling increased greatly in 1942 and at the end of the year amounted to 298,973 short tons; most of the low-grade ore was held at Las Vegas, Nev., and at Butte, Mont.

DOMESTIC PRODUCTION [2]

The following table shows the various types of manganiferous materials shipped by domestic producers from 1938 to 1942.

Manganiferous raw materials shipped by producers in the United States, 1938–42, in short tons

Year	Metallurgical ore				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		
1938	19,027	37,655	308,269	43,768	5,554	3,778
1939	20,810	268,289	526,067	144,747	8,699	3,315
1940	30,416	358,406	914,526	172,990	10,383	4,137
1941	73,852	512,162	918,725	282,049	11,399	2,543
1942	177,966	265,663	1,500,613	292,051	15,410	473

Shipments of the various grades of manganese ores during the last 5 years are given, by States, in the following tables. In addition, battery-grade ores were produced in California and Montana; miscellaneous ores came from Alabama, Georgia, Montana, and Virginia; and manganiferous zinc residuum was produced from New Jersey zinc ores.

Metallurgical manganese ore shipped from mines in the United States, 1938–42, by States, in short tons

State	1938	1939	1940	1941	1942	State	1938	1939	1940	1941	1942
Alabama	124	115	64	------	26	New Mexico	627	380	50	------	1,267
Arizona	------	------	348	990	2,946	North Carolina	------	48	------	35	------
Arkansas	3,345	6,009	6,808	5,015	4,132	Pennsylvania	------	------	------	------	22
California	------	------	177	2,600	10,112	South Dakota	------	------	------	------	81
Colorado	------	------	251	190		Tennessee	4,035	8,183	7,821	4,394	2,247
Oklahoma	------	------	------	40	589	Utah	------	56	30	43	970
Oregon	------	------	------	85		Virginia	1,472	532	1,168	4,983	11,024
Georgia	3,425	2,964	4,001	4,893	4,890	Washington	------	11	------	1,588	10,660
Idaho	------	------	------	34	------	West Virginia	63	------	245	2,458	2,240
Missouri	------	------	------	12	239						
Montana	5,936	2,512	9,218	43,555	120,409		19,027	20,810	30,416	73,852	177,966
Nevada	------	------	235	2,937	6,112						

Ferruginous manganese ore shipped from mines in the United States, 1938–42, by States, in short tons

State	1938	1939	1940	1941	1942	State	1938	1939	1940	1941	1942
Alabama	399	581	383	------	206	Nevada	------	------	5,167	8,913	2,743
Arizona	------	------	------	17	------	N. Carolina	------	57	213	174	------
Arkansas	3,894	2,206	1,204	3,381	14,067	Oklahoma	------	------	------	56	------
California	------	------	97	464	4,659	Tennessee	511	329	2,606	1,865	916
Colorado	734	8,418	3,699	------	89,053	Texas	------	------	------	------	142
New Mexico	6,824	35,839	41,255	65,483		Utah	------	293	2,354	551	78
Georgia	3,144	8,015	11,298	6,715	10,514	Virginia	1,870	5,134	5,020	4,375	3,905
Idaho	------	183	351	390	------	Washington	------	------	------	7	------
Massachusetts	258	727	2,128	4,480	3,301	W. Virginia	------	------	------	448	560
Michigan	------	------	------	------	34,643						
Minnesota	19,515	204,131	278,580	409,855	88,509		37,655	268,289	358,406	512,162	268,764
Montana	506	2,376	4,051	4,988	15,468						

[2] Throughout chapter, unless otherwise indicated, percentages expressing manganese content of ores refer to ores in natural (undried) state.

Manganiferous iron ore shipped from mines in the United States, 1938–42, by States, in short tons

State	1938	1939	1940	1941	1942
Alabama					162
Georgia			230	1,192	
Michigan	17,984		20,851		
Minnesota	290,285	526,067	893,359	917,533	1,500,451
Virginia			86		
	308,269	526,067	914,526	918,725	1,500,613

Manganese and manganiferous ores shipped from mines in the United States in 1942, by States

	Ore containing 35 percent or more Mn				Ore containing 10 to 35 percent Mn				Ore containing 5 to 10 percent Mn			
		Short tons				Short tons				Short tons		
	Shippers	Gross weight	Manganese content	Value	Shippers	Gross weight	Manganese content	Value	Shippers	Gross weight	Manganese content	Value
Metallurgical:												
Alabama	1	26	10	(1)	1	174	31	(1)	1	162	8	(2)
Arizona	14	2,946	1,220	$73,579								
Arkansas	7	4,132	1,409	113,678	9	14,067	2,931	$87,576				
California	[3]25	10,112	4,479	302,701	2	1,670	412	13,641				
Colorado	1	(1)	(1)	(1)	1							
Georgia	[4]10	4,890	1,887	99,005	[5]10	10,478	2,847	98,827				
Massachusetts					1	3,301	660	(1)				
Michigan					1	34,643	4,542	(1)				
Minnesota					1	88,509	13,401	(1)	7	1,500,451	119,616	[2]$3,384,654
Missouri	1	239	105	(1)								
Montana	[4]2	120,409	72,396	(1)	2	15,468	4,105	(1)				
Nevada	3	6,112	2,168	(1)	1	2,743	850	(1)				
New Mexico	4	1,267	547	(1)	2	89,009	11,377	(1)				
Oklahoma	1	(1)	(1)	(1)								
Oregon	1	(1)	(1)	(1)								
Pennsylvania	1	22	8	(1)								
South Dakota	1	81	31	(1)								
Tennessee	9	2,247	806	54,820	3	916	237	6,850				
Texas					2	142	31	(1)				
Utah	4	970	379	21,650	1	78	24	(1)				
Virginia	[4]14	11,024	4,278	240,667	5	3,905	619	18,752				
Washington	1	10,660	5,389	(1)								
West Virginia	1	2,240	896	(1)	1	560	140	(1)				
Undistributed [6]		589	216	5,058,555				1,203,831				
Total metallurgical	101	177,966	96,224	5,964,655	43	265,663	42,207	1,429,477	8	1,500,613	119,624	3,384,654
Battery:												
California	[3]5	2,856	1,147	518,123	6	3,033	853	(7)				
Montana	2	9,521	4,143									
Total battery	7	12,377	5,290	518,123	6	3,033	853	(7)				
Miscellaneous:												
Alabama					1	32	9	(7)				
Georgia	[4]1	27	9	10,896	[5]1	36	9	(7)				
Montana	[4]1	156	57									
Virginia	[4]16	222	84									
Total miscellaneous	18	405	150	10,896	2	68	18	(7)				
Grand total	117	190,748	101,664	6,493,674	50	268,764	43,078	1,481,948	8	1,500,613	119,624	3,384,654

[1] Included under "Undistributed."
[2] Value for Alabama included with Minnesota.
[3] 2 producers in California shipped both metallurgical and battery ore.
[4] 1 producer in Georgia, 1 in Montana, and 5 in Virginia shipped both metallurgical and miscellaneous ore.
[5] 1 producer in Georgia shipped both metallurgical and miscellaneous ore.
[6] Includes entries indicated by "(1)" above.
[7] Value included in grand total.

Alabama.—Only one shipment of metallurgical-grade manganese ore was made from Alabama during 1942; it came from the Cobalt Hill mine in Cherokee County. In addition, a small quantity of miscellaneous-grade ore containing less than 35 percent manganese was shipped from Etowah County during the year, and some ferruginous ore came from Calhoun County.

A study of the concentration of manganese-bearing ores from Walnut Grove, Ala., has been made by Johnston, Fine, and Shelton.[3]

Arizona.—A total of 2,946 short tons of metallurgical ore was shipped from mines in Arizona during 1942. The largest producer was the Black Warrior mine in the Artillery Peak district. Shipments from this mine were made to the Metals Reserve Co. and totaled 543 short tons. Other shipments of considerable size came from Coconino and Gila Counties. Fourteen shippers supplied the State total in 1942.

Arkansas.—The effect of the price ceiling was hard-felt in Arkansas during 1942. Production of manganese ore dropped to 4,132 short tons from 5,015 short tons in 1941. The operators could not pay for assaying before shipping and could not ship without knowing what the impurity penalty would be. Consequently, shipments of ferruginous manganese ore increased greatly from 3,381 short tons in 1941 to 14,067 short tons in 1942. In addition, 8,014 short tons of ferruginous manganese ore were shipped from mines to Government stock piles for later concentration. The ferruginous manganese ore in the Batesville stock pile on January 1, 1943, totaled 12,672 short tons (dry) averaging 26.45 percent manganese.

A study of the beneficiation of wad ore from the Ayedalotte property at Batesville has been made by Shelton, Fine, and Fisher.[4]

California.—Twenty-eight shippers from 17 counties supplied the total of 10,112 short tons of metallurgical ore and 2,856 short tons of battery ore containing 35 percent or more (natural) manganese. Among the larger producing mines in 1942 were the Whedon mines in Imperial County, the Pine Ridge, Barker, and Jones (Black Wonder) mines in Santa Clara County, the Buckeye and Tiptop mines in Stanislaus County, and the Manganese Queen and J. M. McKnight Group in Trinity County. An extensive program by the Geological Survey and the Bureau of Mines was under way in 1942 to investigate and evaluate deposits of manganese-bearing ores in California. Results of these investigations have not yet been made available to the public. The Bureau of Mines[5] examined the Arlington Manganese Claims in Riverside County and recorded the findings in a war minerals report.

Colorado.—The Pershing mine in Saguache County supplied the manganese ore shipped from Colorado during 1942. In addition, some ferruginous manganese ore was shipped from Gunnison County.

Georgia.—Georgia was the sixth-largest manganese ore-producing State in 1942. Of the total of 4,917 short tons shipped during the year, 4,715 tons came from the Cartersville district. This district

[3] Johnston, T. L., Fine, M. M., and Shelton, S. M., Manganese Investigations—Metallurgical Division, 11. Ore-Dressing Studies of Manganese Ores. Concentration of Manganese-Bearing Ore from the Bynum Property, Walnut Grove, Ala.: Bureau of Mines Rept. of Investigations 3637, 1942, 10 pp.

[4] Shelton, S. M., Fine, M. M., and Fisher, R. B., Manganese Investigations—Metallurgical Division. 17. Ore-Dressing Studies of Manganese Ores. Concentration of Wad Ore from the Ayedalotte Property, Batesville, Ark.: Bureau of Mines Rept. of Investigations 3652, 1942, 17 pp.

[5] Bureau of Mines, Arlington Manganese Claims, Riverside County, Calif.: War Minerals Report 92, 1943, 11 pp.

has shipped 205,600 short tons since operations began in 1866. The rest of the manganese ore shipped from Georgia in 1942 came from Lincoln County.

A Bureau of Mines proposal to exhaust the Cartersville manganese reserves in about 2 years during the present emergency was rejected by the War Production Board because of equipment shortages.

Massachusetts.—Anson G. Betts shipped ferruginous manganese ore from the Taconic mine in Hampshire County.

Michigan.—Ferruginous manganese ore totaling 34,643 short tons and averaging 13.11 percent (natural) manganese was shipped from the Bengal mine in 1942.

Minnesota.—What is believed to be the first manganiferous ore from the Mesabi range was shipped during 1942; the Corsica mine yielded 33,880 short tons averaging 6.49 percent (natural) manganese, and the Alpena mine shipped 10,765 short tons averaging 6.31 percent (natural) manganese. The rest came from the Alstead-Hillcrest Group, Hopkins, Louise, Merritt, Mahnomen, and Sagamore mines in Crow Wing County.

Fine and others[6] and Anderson[7] have studied the beneficiation of these ores.

Missouri.—The output of manganese ore from Missouri came from the Rocky Creek mine in Shannon County.

Montana.—Sixty-eight percent of the total metallurgical manganese ore and 77 percent of the high-grade battery ore shipped from mines in 1942 came from Montana. By far the largest operation in the State was the Manganese Reduction Works of the Anaconda Copper Mining Co. at Butte. In 1942 the ore was supplied by the Emma, Travona, and Anselmo mines. Battery-grade ore was shipped by the Moorlight Mining Co. and American Machine & Metals, Inc., from the Philipsburg district.

A Bureau of Mines proposal to erect a 400-ton custom mill at Butte, to treat manganese ores produced by several mines in that area, was approved by the Facility Review Committee of the War Production Board in March 1943.

The mill is to be constructed by the Domestic Manganese Co., which applied for a $250,000 loan from the Reconstruction Finance Corporation to finance the project. The Bureau of Mines in its exploratory work had drilled more than 10,000 feet of test holes, had taken many samples, and had tested the contemplated milling method. Known reserves of the four active mines in the area total about 175,000 tons of ore containing about 23 percent manganese. When milled and nodulized, the ore averages 51 to 59 percent manganese.

Under the contemplated program, the ore delivered to the mill will be purchased by the Metals Reserve Co., which has been buying ore for stock-piling in the Butte-Philipsburg region. The Domestic Manganese Co. proposes to mill and nodulize the stock-piled ore with the current production of the mines. When in full operation, the mill will produce about 2,000 tons of high-grade nodules per month. It is estimated that the milling plant can be constructed in about 90 days

[6] Fine, M. M., Shelton, S. M., and Zadra, J. B., Manganese Investigations—Metallurgical Division. 9. Ore-Dressing Studies of Manganese Ores. Concentration of Manganiferous Iron Ore from the Armour No. 1 Mine, Ironton, Minn.: Bureau of Mines Rept. of Investigations 3624, 1942, 13 pp.

[7] Anderson, C. Travis, and associates, Manganese Investigations—Metallurgical Division. 14. Hydrometallurgical Studies of Manganese Ores. Laboratory Experiments on Sulfur Dioxide-Sulfuric Acid Leaching of Black and Brown Manganiferous Ores of Cuyuna Range, Minn.: Bureau of Mines Rept. of Investigations 3649, 1942, 38 pp.

and that its rated capacity of 400 tons of crude ore a day will be ample to handle the output of mines now producing and to accommodate any new operations in the field.

Nevada.—Manganese ore and ferruginous manganese ore were shipped from the Black Diablo mine in Humboldt County in 1942. Relatively small shipments were made from the Black Rock mine in Lander County and the Last Hope mine in White Pine County.

The Manganese Ore Co., subsidiary of the M. A. Hanna Co. of Cleveland, is developing claims in the Las Vegas Wash, about 18 miles southeast of Las Vegas, Nev., which will be one of the largest domestic producers of high-grade manganese ore. Although the property is popularly described as the Three Kids mine and operations are actually in the same vicinity, there is no activity at the old Three Kids. About 100,000 tons of concentrates will be produced annually when full operations have begun, but it is believed that only about half that quantity will be shipped in 1943. As the analysis of the ore as mined is not consistent, a bedding system is necessary. About 250,000 tons of ore were mined in 1942, averaging 18.86 percent (natural) manganese.

New Mexico.—Shipments were made from Dona Ana, Grant, Luna, and Valencia Counties in 1942. The largest producing mine was the Luna in Luna County. The shipment statistics given for New Mexico in the tables do not include 6,508 tons (dry) of ore shipped to Deming for subsequent concentration.

Oklahoma.—A small quantity of ore averaging 42.4 percent manganese was shipped from the Lucky 13 mine in Coal County during 1942.

Oregon.—The output from Oregon in 1942 came from the McAdams property in Coos and Curry Counties and averaged 44 percent manganese.

Pennsylvania.—J. Harry Simon produced the manganese ore shipped from Pennsylvania in 1942 from Sherman Valley, Bedford County.

South Dakota.—The North Star Manganese Producers shipped manganese ore from the August Schedlin mine in Lawrence County during 1942.

Tennessee.—A considerable decrease in usable manganese ore shipments from Tennessee was apparent in 1942. Most of the ore came from the Embree mine in Unicoi County; however, shipments were also reported from Blount, Carter, Johnson, and Sevier Counties.

Texas.—Two small lots of ferruginous manganese ore were shipped from Texas in 1942 for metallurgical purposes.

A study of the beneficiation of manganese-bearing ores from the Mayfield property at Van Horn has been made by Zadra and others.[8]

Utah.—Four shippers in Emery, Grand, and Juab Counties supplied the Utah total of 970 short tons of metallurgical ore and 78 short tons of ferruginous manganese ore during 1942.

Virginia.—Virginia was second only to California in number of shippers in 1942. Nine concerns shipped metallurgical-grade ore, 11 shipped miscellaneous-grade, and 5 shipped ores of both grades; in addition, 5 concerns shipped ferruginous manganese ore during the year. Shipments of manganese ore were made from Augusta, Bath, Bland, Campbell, Craig, Roanoke, Smyth, and Washington Counties.

Washington.—The Sunshine Mining Co. (second-largest shipper in

[8] Zadra, J. B., Fine, M. M., Shelton, S. M., and Johnston, T. L., Manganese Investigations—Metallurgical Division. 13. Ore-Dressing Studies of Manganese Ores. Concentration of Manganese-Bearing Ore from the Mayfield Property, Van Horn, Tex.: Bureau of Mines Rept. of Investigations 3632, 1942, 18 pp.

the United States in 1942) shipped from the Crescent mine in Clallam County the State total of 10,660 short tons of metallurgical ore, averaging (dry) 52.12 percent manganese.

West Virginia.—The Appalachian Ores Co. shipped 2,240 short tons of metallurgical ore from the Sweet Springs mines in Monroe County.

IMPORTS OF MANGANESE ORE

General imports of manganese ore containing 35 percent or more manganese decreased 15 percent from 1941 and comprised 7,963 short tons of battery ore and 1,316,361 short tons of other grades, chiefly for metallurgical use. In addition, 7,146 short tons of ferruginous manganese ore containing 2,086 short tons of manganese were imported during the year; of this quantity 4,413 tons containing 1,280 tons of manganese came from the Arabia Peninsular States, 2,240 tons containing 640 tons of manganese from Anglo-Egyptian Sudan, 490 tons containing 166 tons of manganese from Mexico, and 3 tons containing less than one-half ton of manganese came from Cuba. The bulk of the battery ore in 1942 came from Gold Coast (7,840 short tons containing 4,164 short tons of manganese); however, 67 short tons containing 36 short tons of manganese came from Canada, and 56 short tons containing 22 short tons of manganese came from Mexico.

Imports of manganese ore for consumption, which include ore withdrawn from bonded warehouses irrespective of date of entry, comprised 3,682 tons of battery ore containing 2,216 tons of manganese and valued at $86,372 and 1,557,258 tons of other grades containing 764,183 tons of manganese and valued at $22,922,524; in addition, 7,146 tons of ferruginous manganese ore were imported.

The accompanying table shows the details of imports in 1941 and 1942 of ore of all grades except ferruginous manganese.

Manganese ore (35 percent or more Mn) imported into the United States, 1941–42, by countries

Country	General imports [1] (short tons)				Imports for consumption [2]					
					Short tons				Value	
	Gross weight		Mn content		Gross weight		Mn content			
	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942
Belgian Congo	28,361	2,224	14,181	1,101	-------	2,870	-------	1,546	-------	$31,908
Brazil	433,830	277,410	183,723	117,409	353,850	326,469	156,711	147,908	$3,367,812	3,327,210
Chile	19,191	1	9,046	-------	18,305	4,462	8,669	2,113	366,012	68,542
Cuba	272,614	149,708	129,896	73,098	272,614	149,708	129,896	73,098	6,353,222	3,748,261
Gold Coast	75,823	134,194	39,636	68,481	222,776	189,236	113,737	95,698	3,224,209	2,747,845
India [3]	360,910	493,197	181,571	248,695	433,337	585,491	219,756	301,777	6,270,579	8,444,228
Mexico	4,272	45,118	1,892	21,089	1,054	35,205	515	16,270	26,962	642,662
Netherlands Indies	10,363	8,059	5,525	4,266	9,233	9,067	4,994	4,758	250,463	203,875
Philippine Islands	63,894	-------	30,797	-------	63,894	-------	30,797	-------	1,000,460	-------
Union of South Africa	292,739	213,641	136,936	97,408	306,599	233,650	142,838	110,093	3,829,070	3,353,822
U. S. S. R.	-------	-------	-------	-------	32,685	17,769	16,929	9,200	393,370	277,216
Other countries	136	772	72	366	234	7,013	114	3,938	3,672	163,327
	1,562,133	1,324,324	733,275	631,913	1,714,581	1,560,940	824,956	766,399	25,085,831	23,008,896

[1] Comprises ore received in the United States during year; part went into consumption, and remainder entered bonded warehouses.
[2] Comprises receipts during year for consumption and ore withdrawn from bonded warehouses during year (irrespective of time of importation).
[3] India and Dependencies (British India).

CONSUMPTION AND STOCKS OF MANGANIFEROUS RAW MATERIALS

The total consumption of manganese ore in 1942 increased 13 percent over 1941 and amounted to 1,481,672 short tons; of this total, 1,435,388 tons or 97 percent was of foreign origin. Industrial stocks of manganese ore on December 31 were 26 percent less in 1942 than in 1941.

The accompanying table shows actual consumption of manganese ore (containing 35 percent or more manganese, natural) and alloys during 1942 and stocks at the end of the year.

Manganese ore and manganese alloys consumed and in stock [1] in the United States in 1942, gross weight in short tons

	Consumed	In stock Dec. 31, 1942 [1]	
		At plant (including bonded warehouses)	In bonded warehouses
Manufacturers of manganese alloys:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural)	24,407	8,495	
Over 47 percent Mn (natural)	2,576	5,875	
Foreign	1,384,255	818,870	423,866
	1,411,238	833,240	423,866
Ferromanganese		64,276	52,842
Spiegeleisen		9,581	
Silicomanganese		746	
Manganese briquets		621	
Manufacturers of iron and steel:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural)	4,422	2,120	
Over 47 percent Mn (natural)	2,566	707	
Foreign	22,884	7,220	
	29,872	10,047	
Ferromanganese	665,299	145,433	
Spiegeleisen	181,052	78,651	
Silicomanganese	46,694	4,547	
Manganese briquets	3,482	879	
Manufacturers of dry cells:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural)	3,099	6,975	
Over 47 percent Mn (natural)	9,157	2,406	
Foreign	24,246	19,272	11,215
	36,502	28,653	11,215
Manufacturers of chemicals: [2]			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural)	27	315	
Over 47 percent Mn (natural)	30	1,556	
Foreign	4,003	11,424	
	4,060	13,295	
Brokers and dealers:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural)		192	
Over 47 percent Mn (natural)			
Foreign		317	
		509	
Ferromanganese		338	
Grand total:			
Manganese ore: [2]			
Domestic:			
35 to 47 percent Mn (natural)	31,955	18,097	
Over 47 percent Mn (natural)	14,329	10,544	
Foreign	1,435,388	857,103	435,081
	1,481,672	885,744	435,081
Ferromanganese	665,299	210,047	52,842
Spiegeleisen	181,052	88,232	
Silicomanganese	46,694	5,293	
Manganese briquets	3,482	1,500	

[1] Excluding Government stocks.
[2] Data for manufacturers of chemicals cover 4 months, September to December, only.

The accompanying table shows ores available for consumption in the United States in 1942 but does not consider consumer or Government stocks at the beginning and end of the year.

Indicated consumption of manganiferous raw materials in the United States in 1942

	Ore containing 35 percent or more Mn		Ore and residuum containing 10 to 35 percent Mn		Ore containing 5 to 10 percent Mn	
	Short tons	Mn content (percent)	Short tons	Mn content (percent)	Short tons	Mn content (percent)
Domestic shipments	190,748	53.3	560,815	14.9	1,500,613	8.0
Imports for consumption	1,560,940	49.1	7,146	29.2	[1] 1,780	6.2
Total available for consumption	1,751,688	49.6	567,961	15.1	1,502,393	8.0

[1] Estimated.

METALLURGICAL INDUSTRY

The bulk of the manganese ore (95 percent in 1942) used in the United States is for the manufacture of manganese alloys, and virtually all alloys are consumed by the iron and steel industry. During 1942 steel producers consumed 12.4 pounds of metallic manganese per ton of steel produced; of this, 11.2 pounds was in the form of ferromanganese, 0.6 pound as spiegeleisen, and 0.6 pound as silicomanganese. Ferromanganese producers used an average of 1.952 short tons of manganese ore per ton of ferromanganese produced.

Ferromanganese.—The domestic output of ferromanganese in 1942, which increased 14 percent over 1941, was produced at the following plants:

Bethlehem Steel Co., Johnstown, Pa.
Colorado Fuel & Iron Corporation, Pueblo, Colo.
E. J. Lavino & Co., Reusens, Va., and Sheridan, Pa.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.
Tennessee Coal, Iron & Railroad Co., Holt, Ala.
Carnegie-Illinois Steel Corporation, Etna and Clairton, Pa., and Gary, Ind.
Electro-Metallurgical Co., Alloy, W. Va., and Niagara Falls, N. Y.
Tennessee Products Corporation, Rockdale and Rockwood, Tenn.

In addition to the foregoing plants, shipments were made by the Keokuk Electro-Metals Co., Keokuk, Iowa.

Most of the ferromanganese produced in this country is made from foreign ores, as shown in the accompanying table.

Ferromanganese and spiegeleisen imported into and made from domestic and imported ores in the United States, 1941–42, in short tons

	1941		1942	
	Alloy	Manganese	Alloy	Manganese
Ferromanganese:				
Imported	7,032	5,696	14,772	11,617
Domestic production	580,704	461,539	661,338	522,553
From domestic ore [1]	21,926	17,795	12,335	10,514
From imported ore [1]	558,778	443,744	649,003	512,039
Total	587,736	467,235	676,110	534,170
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported		3.81		1.97
Number of plants making ferromanganese	12		13	
Spiegeleisen:				
Imported	4,741	[1] 949	1,990	[1] 398
Domestic production	177,915	28,679	186,026	36,071
From domestic ore	175,543	28,297	186,026	36,071
From imported ore	2,372	382		
Total	182,656	29,628	188,016	36,469
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported		95.51		98.91
Number of plants making spiegeleisen	5		4	
Total available supply of metallic manganese in ferromanganese and spiegeleisen		496,863		570,639
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		1.34		2.11
Ferromanganese made from imported ore		89.31		89.73
Spiegeleisen made from imported ore		.08		
Ferromanganese made from domestic ore		3.58		1.84
Spiegeleisen made from domestic ore		5.69		6.32
Ferromanganese and spiegeleisen made from domestic ore		9.27		8.16
Spiegeleisen made and imported		5.96		6.39
Total open-hearth, Bessemer, and electric steel	82,836,946		86,029,921	

[1] Estimated.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1938–42

Year	Ferromanganese produced			Materials consumed (short tons)				Manganese ore used per ton of ferromanganese made (short tons)
	Short tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Short tons	Foreign	Domestic			
1938	272,153	78.65	214,036	466,746	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	[1] 8,868	1.923
1941	580,704	79.48	461,539	1,122,187	9,414	5,166	6,031	1.949
1942	661,338	79.01	522,553	1,273,596	17,572	19,545	4,634	1.952

[1] Corrected figures.

Manganese ore used in manufacture of ferromanganese in the United States, 1938–42, by sources of ore

Source of ore	1938		1939		1940		1941		1942	
	Gross weight (short tons)	Mn content (percent)	Gross weight (short tons)	Mn content (percent)	Gross weight (short tons)	Mn content (percent)	Gross weight (short tons)	Mn content (percent)	Gross weight (short tons)	Mn content (percent)
Domestic	25,254	53.20	-------	-------	13,419	55.89	9,414	41.61	17,572	39.69
Foreign:										
Africa	171,022	48.99	144,734	48.14	233,370	45.89	221,940	47.11	274,450	46.61
Brazil	71,747	41.44	65,278	43.75	189,389	42.39	328,769	42.29	342,538	41.55
Chile	-------	-------	959	48.16	6,076	46.13	4,715	45.81	5,677	46.64
Cuba	40,650	48.07	66,079	48.16	112,859	48.59	135,581	48.47	171,029	46.33
India	62,681	49.24	96,666	49.84	188,079	49.73	[1] 250,425	49.85	340,096	49.75
Java	-------	-------	-------	-------	-------	-------	-------	-------	2,189	46.28
Mexico	-------	-------	-------	-------	-------	-------	1,755	46.27	2,013	45.31
Philippine Islands	-------	-------	-------	-------	12,768	47.16	6,236	48.32	19,741	46.05
U. S. S. R.	120,646	47.61	189,628	47.54	187,286	47.85	[1] 145,325	48.12	64,051	48.06
Undistributed	-------	-------	-------	-------	46,505	38.75	[1] 27,441	46.26	[2] 51,812	45.75
	492,000	47.72	563,344	47.72	989,751	46.45	1,131,601	46.54	1,291,168	45.99

[1] Tonnage entered under "Undistributed" comprises ore from India and U. S. S. R.; separation as to source not reported by consumer.
[2] Source of ore not reported by consumer.

Shipments of ferromanganese in 1942 increased 6 percent over 1941. The record of shipments for the past 5 years is as follows:

Ferromanganese shipped from furnaces in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	250,566	$19,144,884	1941	619,395	$69,378,004
1939	332,227	24,137,211	1942	659,219	82,726,298
1940	503,291	42,755,485			

Imports for consumption and exports increased 110 and 39 percent, respectively, over 1941. Ferromanganese imported in 1942 totaled 14,772 short tons, all containing not less than 4 percent carbon.

Ferromanganese imported into and exported from the United States, 1938–42

Year	Imports for consumption			Exports [1]	
	Gross weight (short tons)	Mn content (short tons)	Value	Gross weight (short tons)	Value
1938	29,409	23,652	$1,770,948	277	$18,799
1939	46,175	37,424	2,935,214	3,274	247,798
1940	11,613	9,601	1,321,369	14,600	1,366,087
1941	7,032	5,696	557,150	5,155	771,575
1942	14,772	11,617	1,274,749	7,165	976,923

[1] 1938–41: Includes spiegeleisen; not separately classified prior to July 1, 1941.

Imports of ferromanganese in 1941 and 1942, by countries, are shown in the following table.

Ferromanganese imported for consumption in the United States, 1941–42, by countries

Country	1941		1942	
	Mn content (short tons)	Value	Mn content (short tons)	Value
Canada	1,202	$136,029	5,022	$654,219
Norway	13	1,597		
United Kingdom [1]	4,481	419,524	6,595	620,530
	5,696	557,150	11,617	1,274,749

[1] United Kingdom of Great Britain and Northern Ireland.

The quoted price per short ton of ferromanganese was increased from $111.90 to $125.58 May 1, 1942, in compliance with Office of Price Administration Price Regulation 138. No further change was in prospect at the close of 1942.

Prices per short ton of ferromanganese in the United States, 1940–42, by months [1]

Month	1940	1941	1942	Month	1940	1941	1942
January	$94.04	$111.90	$111.90	July	$111.90	$111.90	$125.58
February	94.04	111.90	111.90	August	111.90	111.90	125.58
March	94.04	111.90	111.90	September	111.90	111.90	125.58
April	94.04	111.90	111.90	October	111.90	111.90	125.58
May	94.04	111.90	125.58	November	111.90	111.90	125.58
June	94.04	111.90	125.58	December	111.90	111.90	125.58

[1] Steel, vol. 112, January 4, 1943.

Spiegeleisen.—Domestic production of spiegeleisen in 1942 increased 5 percent over 1941 and 63 percent over 1940.

Spiegeleisen produced and shipped in the United States, 1938–42

Year	Produced (short tons)	Shipped from furnaces		Year	Produced (short tons)	Shipped from furnaces	
		Short tons	Value			Short tons	Value
1938	12,668	27,932	$728,830	1941	177,915	181,177	$5,793,481
1939	102,470	94,908	2,484,042	1942	186,026	186,163	5,931,728
1940	114,119	119,512	3,487,565				

Spiegeleisen was manufactured at the following plants during 1942:

Carnegie-Illinois Steel Corporation, Clairton and Duquesne, Pa., and South Chicago, Ill.
New Jersey Zinc Co., Palmerton, Pa.

All the spiegeleisen produced in the United States in 1942 was made from domestic raw materials. Imports of spiegeleisen for consumption decreased 58 percent from 1941; the total supply came from Canada.

Spiegeleisen imported for consumption in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	19,318	$625,480	1941	4,741	$215,108
1939	42,856	1,329,814	1942	1,990	95,853
1940	17,455	638,732			

The prices of spiegeleisen (20 percent) at producers' furnaces as quoted by Steel were constant at $32.14 a short ton throughout 1942.

Manganiferous pig iron.—Precise data on consumption of manganiferous ores in the production of manganiferous pig iron are not available. However, 1,500,613 short tons of domestic ore containing 5 to 10 percent manganese and 557,498 short tons containing 2 to 5 percent manganese were shipped during 1942. A small quantity (1,780 short tons) of foreign manganiferous iron ore and 13,950 short tons of foreign ferruginous manganese ore were also consumed in the manufacture of pig iron.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1940–42, in short tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1940	1941	1942	1940	1941	1942
Africa	206					
Asia: Palestine	40,397					
Australia				13,334	2,265	790
Brazil	836	8,313	9,173			
Cuba			4,777			
Sweden				586		990
	41,439	8,313	13,950	13,920	2,265	1,780

BATTERY INDUSTRY

Shipments of battery ore containing over 35 percent manganese amounted to 12,377 short tons in 1942, and shipments of ore containing less than 35 percent manganese for battery manufacture totaled 3,033 short tons. It is believed that 1942 was the first year in which ferruginous manganese ore was purchased for this purpose. During 1942 the battery industry consumed 12,256 short tons of domestic ore and 24,246 short tons of foreign ore compared with 11,642 and 26,342 short tons, respectively, in 1941.

Manganese ore for battery use should have a high content of available oxygen with minimum iron and be relatively free from such metals as arsenic, copper, nickel, or cobalt, which are electronegative to zinc.

MISCELLANEOUS INDUSTRIES

During the last 4 months of 1942, 4,060 short tons of manganese ore were consumed in the chemical industries. Virtually all the chemical ore used in this country is of foreign origin; of the total consumed in 1942, only 57 short tons were of domestic origin. Chemical-grade ore has a great many uses, but most of it is used for photography, fertilizers, and coloring agents in paints and ceramics.

PRICES

Prices of manganese ore (except battery ore) are upon a unit basis, the unit being 1 percent of a long ton (22.4 pounds) of contained manganese. Prices of battery-grade ore are quoted upon a per-ton basis, with a minimum requirement of manganese dioxide.

Ferromanganese.—Standard ferromanganese containing 75 to 85 percent manganese was placed under formal price regulations on May 1, 1942. A price of $135.00 per long ton ($120.50 per short ton) f. o. b. Atlantic Seaboard, except for two Southern producers for whom the price is established on an f. o. b. furnace basis, was made effective in this order. This price represented an increase of $15.00 per long ton over the price which had prevailed since October 1–15, 1941. Other than manganese, standard ferromanganese was defined as metal containing a maximum of 1.25 percent silicon, 0.50 percent phosphorus, 7.50 percent carbon, and 0.05 percent sulfur. The maximum prices by grades were established as follows:

Kind or grade:	*Maximum price per long ton*
Containing 78–82 percent manganese	$135.00.
Containing less than 78 percent manganese but not less than 75 percent.	$135.00 less $1.70 for each 1 percent of manganese below 78 percent.
Containing more than 82 percent manganese but not more than 85 percent.	$135.00 plus $1.70 for each 1 percent of manganese in excess of 82 percent.

Manganese ore.—Maximum Price Regulation 248 was released October 27, 1942 (effective November 9, 1942), fixing the price of all manganese ore except battery and chemical ore at the following long-ton unit rates:

85 cents f. o. b. railroad cars Mobile and New Orleans.
90 cents f. o. b. railroad cars Norfolk, Baltimore, Philadelphia, and New York.
96 cents f. o. b. railroad cars Fontana, Calif.; Pueblo, Colo.; and Provo, Utah.

These prices are for metallurgical ore of a base analysis of manganese 48 percent, iron 6 percent, silica plus alumina 11 percent, and phosphorus not over 0.18 percent upon a dry basis. Premiums and penalties due to variation of analysis are as follows:

Premiums

Manganese content above 48 percent: ½ cent for each 1 percent.
Iron content below 6 percent: ½ cent for each 1 percent.
Silica plus alumina content below 11 percent: Nothing.
Phosphorus below 0.18 percent: Nothing.

Penalties

Manganese content:
- Below 48 percent: 1 cent for each 1 percent down to and including 44 percent.
- Below 44 percent: 4 cents, plus 1½ cents for each 1 percent down to and including 40 percent.
- Below 40 percent: 10 cents, plus 2 cents for each 1 percent down to and including 35 percent.

Iron content:
- Above 6 percent: 1 cent for each 1 percent up to and including 8 percent.
- Above 8 percent: 2 cents, plus ¾ cent for each 1 percent.

Silica plus alumina content:
- Above 11 percent: 1 cent for each 1 percent up to and including 15 percent
- Above 15 percent: 4 cents plus ¾ cent for each 1 percent.

Phosphorus content:
- Above 0.18 percent: ⅛ cent for each 0.01 percent.

The above premiums and penalties are applied pro rata to variations of a fraction of 1 percent.

Amendment 1 to Price Regulation 248 was issued November 30, 1942 (effective December 1, 1942), exempting metallurgical manganese ore with a manganese content of 40 percent or less. Previously ore of 35 percent or less manganese content was exempt.

The average mine value reported for ore containing 35 percent or more manganese during 1942 was about 72 cents per long-ton unit. 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 Philippine Islands, which enters duty free.

Domestic prices of imported metallurgical manganese ore in 1942, in cents per long-ton unit

[C. & 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	$0.630	$0.788	Cuban (not dutiable):		
Chilean, 47–48 percent Mn	.650	.788	50–52 percent Mn	$0.780	$0.915
South African, 50–52 percent Mn	(1)	.788	45–47 percent Mn	(1)	.900

[1] Not quoted.

According to Engineering and Mining Journal, prices for chemical ores per long ton in carlots at the end of 1942 were as follows: Domestic, containing 70 to 72 percent MnO_2, $45 to $50; Brazilian or Cuban, 80 percent, $55; Javan or Caucasian, 85 percent, $70 to $75.

WORLD PRODUCTION

Brazil.—The bulk of the manganese ore from Brazil comes from the Morro da Mina mine in the Lafayette district in Minas Geraís and the Urucum mine in Matto Grosso. During 1942, a total of 277,410 short tons was imported into the United States from Brazil, compared with 433,830 short tons in 1941. Brazil was our second-largest supplier in 1942.

Chile.—Production in Chile amounted to 32,692 short tons of 46- to 49-percent ore in 1942. Virtually none reached the United States during the year.

Cuba.—The Cuban American Managanese Corporation produced 198,286 long dry tons at the Isabelita mine in Oriente Province and shipped 159,686 long tons from Santiago and Antilla during the year. Stocks of ore at the mine and mill totaled 51,565 long tons at the close of the year.

French Morocco.—During the first 6 months of 1942, exports totaled 15,762 short tons.

Gold Coast.—Production in Gold Coast totaled 488,322 short tons in 1940 and 549,922 short tons in 1941. Stocks on hand October 31, 1942, at ports were 78,000 short tons and at mines 170,000 short tons.

India and Dependencies.—India was probably the world's largest producer of manganese ore in 1942—about 1,000,000 tons of ore is produced annually. During 1942 the United States received 493,197 short tons of ore from that country.

Turkey.—The production of manganese ore from Turkey comes from the Afyon and Eskisehir regions. During 1941 the output totaled

1,499 short tons and during the first 6 months of 1942, 569 short tons. The ore averaged 47 to 48 percent manganese.

Union of South Africa.—Data for only the first 11 months of 1941 and 1942 are available. During these respective periods, 460,161 and 404,462 short tons were produced.

U. S. S. R.—The Soviet Union continued to be a leading nation in manganese-ore production, but because of enemy occupation production dropped considerably in 1942—probably to less than 1,000,000 tons.

Manganese ore produced in principal countries of the world, 1938–42, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	Percent Mn	1938	1939	1940	1941	1942
North America:						
Canada (shipments)			359	138	(2)	638
Costa Rica		304	(3)	(2)	(2)	(2)
Cuba	36–50+	123,844	102,415	119,852	191,937	201,468
Mexico	40+	117	27	307	979	11,493
United States:						
Continental (shipments)	35+	25,727	29,777	40,767	79,646	173,043
Puerto Rico (exports)	48–51	1,039				
South America:						
Argentina [4]	35–38	437	651	710	1,476	(2)
Bolivia (exports)	50		500		(2)	272
Brazil	38–50	306,025	257,752	313,391	[5] 437,402	[5] 306,241
Chile	40–50	19,319	12,550	11,620	35,815	29,658
Peru		24	96	283	(2)	(2)
Europe:						
Bulgaria	30–45	1,887	944	2,000	(2)	(2)
Germany	30+	163	(3)	(2)	(2)	(2)
Greece	30+	7,075	11,178	(2)	(2)	(2)
Hungary	35–48	22,221	(3)	(2)	(2)	(2)
Italy	34–37	48,282	54,100	(2)	(2)	
Portugal	40+	1,008	353	1,059	1,815	6,820
Rumania	30–36	60,256	41,546	(2)	(2)	(2)
Spain		1,319	4,711	5,865	9,923	19,690
Sweden	30–50	5,347	5,934	(2)	(2)	(2)
U. S. S. R.	41–48	2,272,800	(3)	2,800,000	[6] 3,000,000	(2)
Yugoslavia	32–38	3,759	5,655	(2)	[7] 4,724	(2)
Asia:						
China (exports)	45–46	1,247	1	(2)	(2)	(2)
India:						
British	47–52	983,464	858,220	(2)	[6] 1,000,000	(2)
Portuguese	42–50+	9,478	8,204	6,525	(2)	(2)
Indochina		2,214	2,440	[6] 2,000	(2)	(2)
Japan	49–51	[6] 80,000	(3)	(2)	(2)	(2)
Netherlands Indies	50–55	9,687	12,074	11,569	(2)	(2)
Philippine Islands	45–50	58,143	29,394	52,166	[8] 33,664	(2)
Turkey	30–50	2,186	3,339	460	1,360	[6] 1,000
Unfederated Malay States	30	32,483	31,952	11,702	(2)	(2)
Africa:						
Belgian Congo	56	7,725	(3)	18,369	(2)	[6] 36,000
Egypt	30+	153,112	119,882	64,912	2,175	[6] 9,000
Gold Coast	50+	408,452	388,131	442,998	498,881	(2)
Morocco:						
French	40–50+	86,597	50,803	(2)	(2)	[8] 14,299
Spanish	38	152	(3)	(2)	(2)	(2)
Northern Rhodesia	30–48	2,779	3,018	(2)	(2)	(2)
Union of South Africa	30–51	551,739	419,697	412,071	[9] 417,451	[9] 366,922
Oceania:						
Australia:						
New South Wales		221	148	1,024	1,485	(2)
Queensland		382		387	209	(2)
South Australia			7	10,827	11,406	(2)
New Zealand		91	494	996	764	(2)
Papua			55	198	408	(2)
		5,291,000	5,169,000	(2)	(2)	(2)

[1] In addition to countries listed, Belgium produces 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] Estimate included in total.

[4] Shipments by rail and river.

[5] Exports.

[6] Estimated.

[7] Croatia only.

[8] Exports January to June, inclusive.

[9] January to November, inclusive.

CHROMITE

By Frederick Betz, Jr.

SUMMARY OUTLINE

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SUMMARY

The substantial increase in domestic chromite shipments to an all-time record of 112,876 short tons was an outstanding feature of the chromite industry in 1942—an achievement made possible through the opening of the Montana deposits, from which no commercial production had previously been realized. This large output represents the fruition of efforts by Government agencies to free the United States from complete dependence on foreign sources for its chromite supply. It must be remarked, however, that the quality of domestic chromite tends to offset in part the volume of shipments, as much of the product was unsuitable for metallurgical use. Concomitantly with the stimulation of domestic production, the Government has continued to develop its stock-piling program, whereby adequate supplies of foreign chromite are being procured to fulfill wartime requirements. The Government also undertook to correlate supply with requirements by placing chromium under complete allocation in 1942.

Salient statistics of chromite (ores and concentrates) in the United States, 1940–42

	1940	1941	1942
Shipments from domestic mines—			
By grades:			
45 percent Cr_2O_3 minimum, short tons	267	4,800	18,986
35 to 45 percent Cr_2O_3, do	2,400	9,208	76,108
Less than 35 percent Cr_2O_3, do	315	251	17,782
Total:			
Short tons	2,982	14,259	112,876
Value	$28,784	$274,062	$2,994,081
Imports for consumption:			
Short tons	736,612	1,115,292	980,487
Value	$8,754,770	$12,618,581	$14,184,159
Exports:			
Short tons	[1]	[2] 1,906	4,743
Value	[1]	[2] $72,409	$163,420

[1] Data not available.
[2] Figures cover July to December; not separately classified before July.

The U. S. S. R. is assumed to be the world's leading chromite producer. Next in order of importance are Southern Rhodesia, Union of South Africa, and Cuba. Thus the United Nations command the chief sources of supply. The Axis Nations control the output of continental Europe, which includes, as relatively important producers, Yugoslavia and Greece; they have also acquired the resources of the Philippine Islands, which in recent years had developed a significant production. With the little information at hand, it seems safe to estimate the Axis supply at not more than one-fourth the total world output. In the struggle to obtain larger supplies of chromite, Germany has made strenuous efforts to obtain the production of Turkey by trade negotiation. It is still doubtful whether this has actually been accomplished.

WAR REGULATIONS

Delivery of ferrochromium, other chromium alloys, and chromium metal was placed under Government control by the Office of Production Management in November 1941. The use of ferrochromium was limited to 2 tons per month without specific authorization in January 1942. The War Production Board extended allocation in February by requiring an application for all consumption of metallurgical chromium products.

The quantity of chromite that can be used in the manufacture of chromium chemicals has been restricted since November 1941, and the consumption of chromium chemicals has been controlled since March 1942.

A more detailed discussion of Government regulations appears in the chapter on Chromite in Minerals Yearbook, 1941.

MARKET AND PRICES

The Metals Reserve Co. has become the principal purchaser of domestic chromite since its buying program was announced in November 1941. Originally this Government agency undertook to contract for lots of 5,000 to 10,000 long tons of ore produced in continental United States, but in December 1941 the minimum size of contracts was lowered to 1,000 tons. In March 1942 the program was extended to include the purchase of trucklots of chromite produced in Oregon and northern California at nearby depots, with the object of encouraging production from small deposits in this region and providing an easily accessible market. Deliveries of ore to purchase depots in small lots did not constitute fulfillment of contracts. As defined in June 1942, small lots consisted of not less than 10 tons, the minimum quantity for which payment was to be made upon delivery. On September 10 the terminating date of the small-lot purchasing program was moved from April 1, 1943, to December 31, 1943.

The purchasing schedules have undergone several revisions with respect to type of material acceptable, grade and size of ore, and prices. Three grades, specifications for which are summarized in the accompanying table, were listed in 1942 schedules. The original minimum for Low-Grade A and B ore was 40 percent Cr_2O_3, but in the May 1942 revision of the schedule a minimum of 35 percent in these grades became acceptable.

The grades and prices (f. o. b. stock pile designated by buyer) established by Metals Reserve Co. follow:

	High-Grade	Low-Grade	
		A	B
Grade specifications:			
Cr_2O_3, percent minimum	45.00	40.00	40.00
SiO_2, percent maximum	11.00	13.00	None
P, do	.20	.50	None
S, do	.50	1.00	None
Cr:Fe ratio, minimum	2.5:1	2.0:1	None
Prices:			
Base, per long dry ton	$40.50	$28.00	$24.00
Premiums:			
Per unit Cr_2O_3 above minimum	.90	.90	.60
Per tenth increase in Cr:Fe from minimum to 3:1	1.50	1.50	----------
Penalties (applicable to Low-Grade A and B only):			
Per unit Cr_2O_3 to 35 percent minimum	----------	1.40	1.20

Imported ores were given nominal quotations in E&MJ Metal and Mineral Markets during the first 10 months of 1942. Metallurgical-grade Indian and African ore (48 percent Cr_2O_3, Cr:Fe=2.8:1) was quoted at $39 per long ton, c. i. f. Atlantic ports, and Brazilian ore (48 percent, Cr:Fe=3:1) was priced at $41.

On November 3, 1942, the Office of Price Administration issued Maximum Price Regulation 258 for chromite ores. As explained in the memorandum accompanying the order, the ceilings are approximately at the levels prevailing during the first 6 months of 1942 for metallurgical and chemical ores and between the first half of 1942 and early November prices for refractory ores. The regulation, which became effective November 9, does not apply to sales of chrome ore to the Government or to sales where the contract of sale is made and title vests in the buyer while the ore is outside the continental United States. However, sales by Government agencies to private purchasers are included in the regulation. As a result, the Metals Reserve Co. may establish any price to stimulate domestic production and assure importation of adequate supplies of foreign ore. The maximum base prices are fixed f. o. b. railroad cars at various favorable basing points for industrial users (for example, New York, Philadelphia, Baltimore).

Maximum prices of chromite established by Office of Price Administration, effective November 9, 1942

Metallurgical-chemical ores:	
Analysis: Base—48 percent Cr_2O_3 and Cr:Fe=3.0:1; minimum—25 percent Cr_2O_3.	
Prices:	
Base, per long ton	[1] [2] $43.50
Premiums for—	
Increase in Cr_2O_3 above 48 percent, per long-ton unit	.90
Increase in Cr:Fe to 3.5:1, per tenth	1.25
Penalties for —	
Decrease in Cr_2O_3 to 25 percent, per long-ton unit	.90
Decrease in Cr:Fe to 2.0:1, per tenth	1.25
Refractory ores:	
Analysis: Minimum—25 percent Cr_2O_3.	
Base prices: [3]	
Lump ore (in bulk), per long ton	31.00
Ground ore, 24-mesh or coarser (in bulk), per short ton	36.50

[1] For Montana ores and concentrates only, base price is f. o. b. railroad cars at Columbus, Mont., with allowance to buyer for actual freight not in excess of $7.00 per long ton.
[2] Increase of $3.50 per long ton is allowed for sales and deliveries in lots of 1 carload or less.
[3] Quantity and packing differentials are provided; see Maximum Price Regulation 258 for details.

The Office of Price Administration also ordered that a maximum export premium of $6 per long ton might be charged on an export

sale of domestic chrome ore and concentrates containing 38 to 44 percent Cr_2O_3 as of November 9.

UNITED STATES

PRODUCTION IN 1942

The domestic production of chromite in terms of shipments from mines reached the unprecedented total of 112,876 short tons in 1942 or almost 8 times as much as in 1941. The previous record of 92,322 tons was made in 1918. In establishing the new record, Montana contributed over half the total. This is all the more remarkable as no shipments of chromite have ever been reported from Montana before. California produced 40 percent of the total, and the remainder was shipped from deposits in Oregon, Idaho, and Washington.

The average grade of chromite (ore and concentrates) shipped in 1942 was 39 percent Cr_2O_3. The highest average grade was produced in California (44 percent Cr_2O_3). Although Montana was the leading producer, the product was lowest in grade, averaging only 36 percent Cr_2O_3. Of the total shipments, 17 percent contained a minimum of 45 percent Cr_2O_3, 67 percent ranged in Cr_2O_3 content from 35 to 45 percent, and 16 percent contained less than 35 percent Cr_2O_3.

There were 150 shippers, and almost three-quarters of them operated in California. Two shippers in Montana and 11 in California supplied 90 percent of the total. Less than 30 percent of the shippers, all with production of over 100 tons, contributed 97 percent of the total.

Chromite (ore and concentrates) shipped from mines in the United States, 1900–1942

Period	Shipments from mines (short tons)					Total value
	California	Maryland and North Carolina	Oregon	Other States [1]	Total	
1900–1904	1,228				1,228	$15,852
1905–1909	1,119			423	1,542	23,345
1910–1914	1,442	95			1,537	18,680
1915	3,675				3,675	36,744
1916	49,009	100	3,471	100	52,680	726,243
1917	41,187	210	7,506	70	48,973	1,049,400
1918	70,725	533	20,669	395	92,322	3,955,567
1919	3,664	77	603	1,344	5,688	129,302
1920–1924	2,194	217	1,535	147	4,093	60,004
1925–1929	1,451	93			1,544	28,030
1930–1934	1,921				1,921	23,812
1935–1939	8,000		435		8,435	81,651
1940	2,713		269		2,982	28,784
1941	13,419		840		14,259	274,062
1942	44,873		2,683	65,320	112,876	2,994,081
	246,620	1,325	38,011	67,799	353,755	9,445,557

[1] Idaho, Montana, Washington, and Wyoming.

California.—The new Grey Eagle mill of the Rustless Mining Corporation in Glenn County was the largest chromite producer in California in 1942. Production began in February and during the year totaled 11,153 tons of concentrates, averaging 46 percent Cr_2O_3 and 11 percent Fe. A roughly tabular mass about 800 feet long and 4 to 50 feet thick is now being mined. High-grade ore in stringers, streaks, and bands occurs in serpentinized dunite. Chromite is also disseminated through the host rock. The deposit is cut by faults,

which add difficulty to the mining operation. Allen[1] distinguishes at least six separate bodies in the Grey Eagle deposit. The crude ore ranges in grade from 5 to 25 percent Cr_2O_3. The mill heads averaged 12 percent Cr_2O_3 in 1942.

Flow sheets of the mill, which has a 200-ton capacity, and a description of both the mining and milling operation have been published.[2]

The Pilliken mine in Eldorado County was the leading producer of chromite in the United States from 1938 to 1941, inclusive. In 1942, the operation ranked fourth among domestic producers. The Pilliken deposit was mined during World War I. After a long period of virtual inactivity, United States Chrome Mines, Inc., erected a mill in 1937. The property was leased by the Rustless Mining Corporation from 1939 to 1942. The owners resumed operation in September 1942 and are rehabilitating the mill.

Total shipments from the Pilliken mine during the entire period of production have been about 30,000 tons. Over 8,000 tons consisted of shipping ore containing about 43 percent Cr_2O_3, and the remainder was composed of concentrates, which in 1942 averaged 42 percent Cr_2O_3 and 18 percent FeO.

High-grade lenses of irregular shape and distribution, containing 40 to 50 percent Cr_2O_3, were mined in the past, according to Wells,[3] who states that the future of the operation depends on blocking out large tonnages of milling ore, which carries about 10 percent Cr_2O_3.

In San Luis Obispo County the Castro mine was put into operation during 1942. Castro Chrome Associates, which operates the mine, erected a 125-ton mill at Goldtree Siding and began producing concentrates in May. The 1942 output amounted to 5,552 short tons averaging 41 percent Cr_2O_3 and with a Cr:Fe ratio of 2.5:1. The Bureau of Mines and Geological Survey have explored the Castro and nearby deposits.[4] The production from the district since 1870 has been about 50,000 tons of lump ore and about 7,000 tons of concentrates. Present reserves consist almost entirely of disseminated milling-grade ore. The crude ore mined in 1942 assayed about 20 percent Cr_2O_3.

The High Plateau mine in Del Norte County, operated by Eugene R. Brown, is the leading domestic producer of high-grade ore. According to an analysis published by Allen,[5] the ore contains 53.63 percent Cr_2O_3 and 13.75 percent FeO. In the same county, Tyson Chrome Mines, Ltd., shipped 1,521 short tons of ore averaging 42.3 percent Cr_2O_3 from the French Hill mine. Siskiyou County was the most active producing area in California, with over 20 shippers. The Cyclone Gap and Coggins mines, operated by J. K. Remsen, and the Come-Back mine (operators, Isgrig & Lilley) produced most from this county. Other properties in California with significant output were the McLaughlin & Applegarth mine in Tehama County, the Rivers mine of D. R. Moroney in Humboldt County, and the Victory

[1] Allen, J. E., Geological Investigation of the Chromite Deposits of California: California Jour. Mines and Geol., vol. 37, No. 1, January 1941, pp. 133–134.

[2] Huttl, J. B., California's Chromite Assumes New Importance: Eng. and Min. Jour., vol. 143, No. 10, October 1942, pp. 43–46.
Mining World, California Chrome—Rustless Iron & Steel Corporation's Grey Eagle Mine: Vol. 4, No. 8, August 1942, pp. 3–8.

[3] Wells, F. G., and others, Chromite Deposits of the Pilliken Area, Eldorado County, Calif.: Geol. Survey Bull. 922–O, 1941, pp. 417–460.

[4] Department of Interior Information Service, Chromite Deposits near San Luis Obispo, Calif.: Press Notice 8533, December 1942, 2 pp.

[5] Allen, J. E., Work cited in footnote 1, pp. 117–118.

Chrome mine in Placer County. The last operation was described briefly by Huttl.[6] Space limitation precludes mention of the more than 100 additional producing properties in California.

Montana.—The development of the Stillwater deposits in Montana is the largest project yet undertaken to procure chromite from domestic sources. Explored by Government agencies since 1939, the equipment of a mine and construction of a mill were begun in 1941. The Anaconda Copper Mining Co., designated as operators for the Government, produced the first concentrates in the 400-ton Benbow mill in March 1942. In the 10 months of operation during 1942 the output of the Benbow mill exceeded the recorded annual production from any domestic chromite property.

The Stillwater Complex is a stratiform body of ultramafic igneous rocks, 30 miles long and 1 to 5 miles wide. It contains chromite deposits in lenses and discontinuous layers that form horizons paralleling the layering of the complex. No high-grade ore is known to occur in the complex, according to Peoples and Howland,[7] who have studied the deposits in detail. All the ore contains less than 40 percent Cr_2O_3.

The second-largest chromite operation in the United States in 1942 was also in Montana. The United States Vanadium Corporation mined ore from deposits in the vicinity of Red Lodge, Carbon County, beginning in October 1941. The chromite occurs in small serpentine intrusions on Hellroaring, Line Creek, and Silver Run Plateaus. Unlike the Stillwater deposits, those near Red Lodge are podlike. The grade of the ore ranges from about 40 to less than 25 percent Cr_2O_3, and the maximum Cr:Fe ratio is approximately 1.5:1. A mill was built at Red Lodge, and concentrates were first produced in March 1942. The milling operation was briefly described by Conwell.[8]

Oregon.—There were no large chromite producers in Oregon. Production increased from 840 short tons in 1941 to 2,683 tons in 1942. The Celebration mine in Grant County, operated by Hazeltine, Davis, and Byram, was the leading producer, with almost 500 short tons shipped. Next in order of shipments were the Sourdough and Hanenkrats mines of the Rustless Mining Corporation. The Sourdough mine in Curry County shipped 339 tons of chromite averaging 42.5 percent Cr_2O_3. The Hanenkrats mine in Grant County produced 248 tons of 40-percent ore. These three mines, with the Oregon Chrome and Black Beauty properties in Josephine County, supplied more than half of the output of the State.

Other States.—In Idaho, production of chromite was reported for the first time. The ore was produced from an occurrence south of Riggins in Idaho County by A. Brandenthaler, who also conducted an operation in Baker County, Oreg. Production in Washington was limited to the Fortune Creek mine in Kittitas County, from which a small shipment was made by the Skipper Chrome Mining Co. In Alaska, the Chrome Queen Mining Co. produced ore on Red Mountain, Kenai Peninsula, but no shipments were made before the end of the year.

[6] Huttl, J. B., Work cited in footnote 2, p. 46.
[7] Peoples, J. W., and Howland, A. L., Chromite Deposits of the Eastern Part of the Stillwater Complex, Stillwater County, Mont.: Geol. Survey Bull. 922-N, 1940, pp. 371-416.
[8] Conwell, C. N., Chrome Deposits at Red Lodge, Mont.: Mining Jour., vol. 26, No. 1, May 30, 1942, pp. 6-7.

EXPLORATION AND DEVELOPMENT

The large increase in domestic chromite production in 1941 and 1942 attests the amount of development in the last 2 years by private enterprise and Federal agencies. A few of the larger projects that have matured into active operations have been mentioned. In the near future important production is expected from the Mouat-Sampson deposit in the Stillwater district of Montana and from the Oregon beach sands. The Anaconda Copper Mining Co., agent for the Government, began mining on the Mouat-Sampson claims in the Stillwater Complex and prepared for concentrating the ores by building a mill to operate in 1943. This output will augment that from the Benbow mine and mill. In Oregon, beach sands in Coos County are the source of chromite that several companies plan to mine. The Krome Corporation has done experimental work since 1941 in this area. A concentrator is being erected at Bandon, Oreg., and a secondary chemical plant was planned at Marshfield. Two other companies—Humphreys Gold Corporation and Porter Bros. Corporation—were also actively engaged in developing production of chromite from the beach sands. In Alaska, preparations were made by the Alaska Juneau Mining Co. to mill chromite.

In 1942 the Bureau of Mines carried on an extensive development campaign throughout the Stillwater Complex in Montana. The Benbow and Mouat deposits were diamond-drilled, and further trenching and sampling of other areas were completed. As a result, several years' supply of chromite has been indicated ahead of present mining plans. Properties were also examined in California, Oregon, Georgia, and Alaska.

The Geological Survey continued its detailed studies of the Stillwater Complex, Mont.; John Day district, Oreg.; Claim Point and Red Mountain, Alaska; and Oregon beach sands. The Red Lodge (Mont.) and Knik Valley (Alaska) deposits were mapped, and a magnetic survey was made of some of the Red Lodge deposits. Many brief examinations were also made, mainly in the Pacific States and Alaska, and inventories of the deposits of several counties in California were prepared. Two reports [9] on work previously done in the Red Bluff Bay area, Alaska, and in Stanislaus County, Calif., were published during the year.

Mineral dressing of Oregon beach sands was given special attention by the Bureau of Mines. Methods were developed by which concentration of chromite in products containing more than 40 percent Cr_2O_3 can be made and other valuable minerals, such as zircon and garnet, recovered.[10] Tests have shown that the Oregon beach chromite concentrates with low Cr : Fe ratio can be improved to a metallurgical-grade product by the Bureau of Mines reducing-roast acid-leach process. Pilot-plant tests with this process on Montana concentrates were started at Boulder City, Nev.

[9] Guild, Philip W., and Balsley, J. R., Jr., Chromite Deposits of Red Bluff Bay and Vicinity, Baranof Island: Geol. Survey Bull. 936-G, 1942, pp. 171-187.
Hawkes, H. E., Jr., Wells, F. G., and Wheeler, D. P., Jr., Chromite and Quicksilver Deposits of the Del Puerto Area, Stanislaus County, Calif.: Geol. Survey Bull. 936-D, 1942, pp. 79-110.

[10] Dasher, John, Fraas, Foster, and Gabriel, Alton, Mineral Dressing of Oregon Beach Sands, 1. Concentration of Chromite, Zircon, Garnet, and Ilmenite: Bureau of Mines Rept. of Investigations 3668, 1942, 19 pp.

USES AND CONSUMPTION

The market for chromite is created largely by the steel industry, which utilizes beneficial qualities imparted by the element chromium in certain alloy steels. Chromium is also employed in certain cast irons and nonferrous alloys. In addition to its value as a source of an alloying element, chromite is used widely for its refractory properties, especially in steel-making furnaces. Other applications of chromite are in chromium plating, pigments, dyes, and tanning.

Chromite is generally subjected to conversion (chemical or physical) processes to render it commercially usable. The most important of the initial conversion products is ferrochromium. This alloy is produced in various grades, which may be separated into two main groups upon the basis of carbon content. High-carbon ferrochromium, as sold in the United States, contains 4 to 6 percent C, whereas low-carbon grades range from 0.6 to 2 percent in maximum carbon. The chromium content of the alloy is roughly 60 to 70 percent, with higher percentages in the low-carbon grades.

As a refractory material, chromite is used in the form of bricks, cements, and plastics and also as crude lump or ground ore. In chemical applications the main raw materials made from chromite are sodium and potassium bichromate.

The consumption of chromite usually is measured at the point at which the ore is converted to one of the products mentioned above.

New supply and distribution of chromite (ore and concentrates) in the United States, 1940–42, in short tons

	1940	1941	1942
New supply:			
Domestic ore and concentrates	2,982	14,259	112,876
Imports for consumption	736,612	1,115,292	980,487
Total new supply	739,594	1,129,551	1,093,363
Distribution:			
Consumption	562,915	800,402	891,952
Exports	(1)	[2] 1,906	4,743
Total distribution	[3] 562,915	[3] 802,308	896,695

[1] Data not available.
[2] Figures cover July to December; not separately classified before July.
[3] Incomplete; see footnote 2.

The ore consumed can be classified into three grades, corresponding to the main categories of use. Chemical composition and physical properties distinguish these grades. The largest quantity consumed is metallurgical grade, followed in order by refractory and chemical grades. In 1942 metallurgical and refractory ores constituted 87 percent of the total chromite used, and chemical ore comprised only 13 percent. The Bureau of Mines has conducted monthly surveys of chromite consumption (and also production) since 1939, originally for Federal defense agencies and now for the War Production Board. This record is probably the most complete ever made of the chromite industry in the United States and has proved of vital importance in maintaining a continual record of supply of a strategic mineral under allocation. The total consumption, 1940–42, is given in the accompanying table. Stocks of all grades of chromite owned by industry and

the Government aggregated over 1,250,000 tons at the end of 1942. Industry stocks have declined progressively in the last three years, but Government stocks increased greatly. In 1942, the Government stocks exceeded those in private control.

IMPORTS AND EXPORTS [11]

Chromite imports in 1942 fell short of the record set in 1941 by 12 percent. Southern Rhodesia and Union of South Africa continued to be the main sources. Significant was the entry of U. S. S. R. into the list of countries from which chromite was obtained. The increase in imports from Turkey and Canada was also noteworthy.

No chromium compounds have been imported since 1939. A table showing imports of such compounds from 1937 to 1939 is given in Minerals Yearbook, Review of 1940, page 591. Ferrochromium imports in 1942 came from Canada only. They totaled, in terms of chromium contained, 6 short tons of grades containing 3 percent or more carbon and 436 tons of grades with less than 3 percent carbon. No chromium metal was imported in 1942. Imports of ferrochromium and chromium metal from 1937 to 1941 are shown in a table in the chapter on Chromite in Minerals Yearbook, 1941.

Exports of chromite were first recorded separately by the Department of Commerce for July 1941; in the latter half of 1941 they totaled 1,906 short tons. During 1942, 4,743 tons were exported, largely to Canada.

Crude chromite imported into the United States for consumption, 1938–42, by countries

Country	Gross weight (short tons)				1942		
					Short tons		Value
	1938	1939	1940	1941	Gross weight	Cr_2O_3 content	
North America:							
Canada	2	1	209	393	13,705	6,633	$372,696
Cuba	44,273	73,922	58,190	179,944	137,826	48,396	1,330,706
Other	66	2,130					
South America: Brazil			3,125	6,005	6,468	2,983	84,146
Europe:							
Greece	11,200	12,320	15,726	2,199			
Yugoslavia	3,360	1,120	1,120				
Asia:							
India	4,537	18,444	36,561	10,910	21,316	10,604	589,272
Philippine Islands	87,621	80,544	175,354	288,411	30,475	12,668	277,310
Turkey	22,839	18,628	78,491	61,845	117,396	56,032	2,297,242
U. S. S. R.					30,061	15,607	1,200,320
Africa [1]	188,495	132,421	319,826	475,377	541,683	253,615	6,621,994
Oceania:							
Australia			6				
New Caledonia [2]	31,942	16,082	48,004	90,208	81,557	43,292	1,410,473
	394,335	355,612	736,612	1,115,292	980,487	449,830	14,184,159

[1] Originated in Southern Rhodesia, Union of South Africa, and Sierra Leone; includes small amount in 1942 probably not produced in Africa. Recorded by Department of Commerce as imported from Union of South Africa, "Other British South Africa," "Other British West Africa," Mozambique, and Anglo-Egyptian Sudan.

[2] Recorded by Department of Commerce as French Oceania.

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

WORLD PRODUCTION

The progress of chromite production in foreign countries is difficult to appraise in wartime. The lack of information on production in the Axis-controlled countries is especially marked, but the same dearth of data is also noted for some of the United Nations. Thus, the level of production in U. S. S. R. is a matter of conjecture, although estimates suggest that that country is now and may well have been for several years the leading world producer. Reference to the accompanying world production table will show that no official statistics are available for any European or Asiatic country in 1941 and 1942. Not only is there an absence of statistics, but published comments on mining operations and developments are scarce. Next in order of output to U. S. S. R. are Southern Rhodesia, Union of South Africa, and Cuba. Turkey probably followed Cuba and slightly exceeded the United States in production during 1942. U. S. S. R. and Southern Rhodesia are the leaders in quantity of chromite produced and also in quantity of metallurgical ore. Union of South Africa is known as a source of chemical-grade chromite, whereas Cuba is principally a producer of refractory ore.

World production of crude chromite, 1938–42, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942
North America:					
Canada			304	2,152	6,113
Cuba	33,598	59,562	52,347	163,175	[1] 278,000
Guatemala	569	564	136	697	529
Mexico				12	17
United States (shipments)	825	3,672	2,705	12,935	102,399
South America: Brazil (exports)	934	3,554	4,572	5,944	5,776
Europe:					
Albania	[2]	[1] 3,000	[2]	[2]	[2]
Bulgaria	1,745	4,251	6,000	[2]	[2]
Greece	42,464	57,091	[4] 33,118	[2]	[2]
Norway	508	371	[2]	[2]	[2]
United Kingdom (shipments)	721	[2]	[5] 1,118	[2]	[2]
Yugoslavia	58,470	59,527	[6] 58,512	[2]	[2]
Asia:					
Cyprus (shipments)	5,667	[2]	4,775	[2]	[2]
India, British	44,858	49,925	[2]	[2]	[2]
Japan	[2]	[2]	[2]	[2]	[2]
Philippine Islands (exports)	66,911	126,749	194,393	[1] 300,000	[2]
Syria and Lebanon	500	[2]	[2]	[2]	[2]
Turkey	213,630	191,644	[4] 110,037	[1] 100,000	[2]
U. S. S. R.	[2]	[2]	[2]	[2]	[2]
Africa:					
Sierra Leone	505	10,755	17,777	[2]	[2]
Southern Rhodesia	186,019	139,083	[2]	[7] 322,000	[7] 335,000
Union of South Africa	176,561	160,014	163,646	141,884	[8] 301,073
Oceania:					
Australia: New South Wales	967	108	508	356	610
New Caledonia	52,216	52,000	55,790	[1] 45,720	[1] 71,120
	[7] 1,128,000	[7] 1,167,000	[7] 1,300,000	[7] 1,750,000	[2]

[1] Estimated.
[2] Estimate included in total.
[3] Data not available.
[4] Exports.
[5] Fiscal year ended July 31, 1940.
[6] January to October, inclusive.
[7] Partly estimated.
[8] January to November, inclusive.

Brazil.—The main deposits in Brazil are in the State of Baía The Cascabulhos, Pedrinhas, and Campinhos deposits near Campo Formoso and occurrences near Santa Luzia and Saúde contain the greater part of the reserves now known. Production has been small, probably slightly over 50,000 metric tons since 1918. Inadequate

rail facilities to the port of Baía have hampered development, as has the lack of water for milling in the Campo Formoso area.

A comprehensive discussion (with maps and analyses) of the chromite deposits in Baía was published in 1942 by Capper A. de Souza.[12] Reserves of high-grade ore at Cascabulhos and Pedrinhas are now estimated at 6,740 metric tons and probable ore is placed at 32,740 tons. For the entire Campo Formoso area, there are also estimated to be about 200,000 tons of low-grade ores to a depth of 25 meters.

Bulgaria and Yugoslavia.—The chromite deposits of the Skoplje region are included in the territory annexed by Bulgaria in the wartime dissolution of Yugoslavia. The addition of these resources will make Bulgaria the largest producer of chromite in Europe, assuming that the output is maintained at the former level. Pre-war Bulgaria was a very minor producer, mainly from deposits in the Krumovgrad district. The country's total output was 6,000 metric tons in 1940; Yugoslavia, on the other hand, produced about 60,000 tons of chromite annually.

The Skoplje region contributed 97 percent of the total output of Yugoslavia before the war.[13] Allatini Mines, Ltd., a British firm, was the leading producer, operating several properties, including the Orašje mine and a washing plant at Raduša with a daily capacity of 100 tons of ore. A new plant was planned, probably near Skoplje, to treat ores from both Yugoslavia and Greece. The shipping product included high-grade ore, concentrates, and grained ore (defined [14] as "a coarse granular product, eliminated in the earlier stages of concentration, which is used as a refractory"). Small deposits, grading 25 to 30 percent Cr_2O_3, in serpentinized peridotite bodies predominate. The iron content ranges from 12 to 16 percent, and in the concentrates SiO_2 ranges from 4 to 6 percent. A detailed discussion of the Skoplje deposits summarized from various studies is presented by Sampson.[15]

It is to be assumed that present operations are controlled by Germany, not only in the case of the Yugoslav deposits but also in those of Bulgaria proper. The supply from Yugoslavia is not as great as statistics of mine production would indicate, as most of the ore was concentrated. Approximately one-fourth of the crude ore is of shipping grade and part of this was treated with the washing ore.

Canada.—What has been called the greatest mineral discovery of the year in Canada was the finding of chromite in the Bird River area of southeastern Manitoba during the summer of 1942.[16] Samples of the chromite had been assayed in 1935, but no interest was evinced in the occurrence at that time. The chromite-bearing rock occurs near Bird Lake and to the north near Euclid and Maskwa Lakes. Three chromite zones, several thousand feet long and having a total width of 100 feet, are recognized in a peridotite mass. The main occurrences west of Bird Lake are apparently separated by faulting of an anticlinal structure. The tonnage of ore is said to be extremely large,

[12] Capper A. de Souza, H., Cromo na Baía: Depto. Nac. Prod. Min., Brazil, Bull. No. 54, 1942, 110 pp.
[13] Mensebach, W., Bulgariens Zuwachs an Chromerzen: Metallwirtschaft, vol. 21, No. 25/26, June 26, 1942, pp. 386–387.
[14] Allen, R., and Howling, G. E., Chrome Ore and Chromium: Imperial Inst., 1940, p. 75.
[15] Sampson, E., Chromite Deposits in Ore Deposits as Related to Structural Features: Princeton Univ. Press, 1942, pp. 110–125.
[16] de Wet, J. P., Chromite in Southeastern Manitoba: Canadian Min. Jour., vol. 63, No. 10, October 1942, pp. 657–658. Manitoba Chromite Find: Canadian Min. Jour., vol. 63, No. 11, November 1942, pp. 721–722. Mining in Manitoba in 1942; Canadian Min. Jour., vol. 64, No. 2, February 1943, pp. 74–80. Northern Miner, Important Chrome Find in Manitoba: Vol. 28, No. 24, September 3, 1942, pp. 1–2.

but the grade is low. The crude ore contains 16 to 20 percent Cr_2O_3, and preliminary tests indicate a possible concentrate of 36 to 40 percent with a Cr:Fe ratio of 1.25:1. At Euclid Lake the chromite bands are 26 feet wide, and the grade is reported to be higher than at Bird Lake.

The principal development work at Bird Lake has been done by God's Lake Gold Mines, Ltd., Gunnar Gold Mines, Ltd., and the Hudson Bay Mining & Smelting Co. Drilling has indicated ore to depths of 300 to 600 feet. Samples have been sent to the Department of Mines at Ottawa for testing. The studies are chiefly concerned with metallurgical problems posed by the low quality of the concentrates.

The Sterrett mine of Chromite, Ltd., at St. Cyr, Quebec, continued operating in 1942. The 50-ton mill began producing concentrates in December 1941. A description of the occurrence of chromite in the Eastern Townships, by Denis,[17] includes a discussion of the Sterrett mine. The Wartime Metals Corporation—a Canadian Government agency—had properties in this district examined, and one of them—the Bélanger deposit[18]—is being reopened. A new mill was scheduled to begin operation in April 1943 at a daily rate of 600 tons. Exploration was also undertaken in the Gaspé region along a serpentine belt described as more than a mile long and several hundred feet wide. The assays reported a content slightly exceeding 40 percent Cr_2O_3. Chromium Mining & Smelting Corporation, manufacturers of ferroalloys at Sault Ste. Marie, Ontario, was said to be interested in the Gaspé occurrences.

Cuba.—An extensive preliminary report on the chromite deposits of Cuba was published by the Geological Survey of the United States.[19] A few salient points are abstracted from this report. In 25 years from 1916 onward, 795,277 short tons of Cuban chromite were imported into the United States. About 85 percent of this amount consisted of refractory ore, and the remainder was metallurgical ore. The Cuban deposits are irregular masses of variable size occurring in serpentinized peridotite belts along most of the northern coast. Mining has been limited to the eastern half of the island. The chief sources of the Cuban ore have been the Camaguey district and eastern Oriente Province. The latter area includes the Mayari district, a source of metallurgical ore analyzing 55 to 58 percent Cr_2O_3 and with a Cr : Fe ratio of about 3.4 : 1. Refractory ore from the Camaguey district contains 30 to 32 percent Cr_2O_3, 28 to 32 percent Al_2O_3, and about 5 percent SiO_2. In most districts the grade of ore is fairly constant. The field work of the Geological Survey was expanded during 1942, especially in Oriente Province.

Greece.—The entire output of chromite in Greece is concentrated and shipped to the Krupp Works in Germany, according to a recent report. The operating properties are apparently the St. Athanasius mine at Xinia and the Apostolides mine at Tsagli in Thessaly, the Vrioni mine in Macedonia, and the Papostoriou mine near Kozani in Thessalonikē. The monthly rate of production from the mines was about 5,000 tons at the end of 1942.

[17] Denis, B. T., The Chromite Deposits of the Eastern Townships of the Province of Quebec: Quebec Bureau of Mines, Ann. Rept., part D, 1931, pp. 95-98.
[18] Denis, B. T., Work cited in footnote 17, pp. 83-87.
[19] Thayer, T. P., Chrome Resources of Cuba: Geol. Survey Bull. 935-A, 1942, pp. 1-74.

New Caledonia.—Although New Caledonia has not been the leading chromite producer since 1920, its output continues to be outstanding in quality. In 1942 the average grade of New Caledonia ore and concentrates imported into the United States was 53 percent Cr_2O_3. The annual rate of production is now estimated at over 75,000 short tons. Chromite has been produced in New Caledonia for 65 years, and the output has totaled approximately 2,000,000 tons. The principal deposits are in the Tiébaghi Dome in the northern part of the island and have yielded more than 75 percent of the total output but currently are producing about one-half the annual total. The Tiébaghi mine is one of the largest in the world, having produced roughly 1,500,000 tons of ore averaging 55 to 57 percent Cr_2O_3. Other properties in the Tiébaghi Dome are the Fantoche, Alpha, and Chagrin mines.

Turkey.—More space has been devoted to the subject of the disposition of Turkey's chromite after expiration of the Anglo-Turkish agreement on January 8, 1943, than to any other aspect of the world chromite industry. The German-Turkish agreements concluded in October 1941 and reported in the American and British press at that time were known to involve Turkey's chromite. The provisions apparently called for exchange of German war materials with a value of £T18,000,000, to be delivered during 1942, for 90,000 to 100,000 tons of chromite in both 1943 and 1944. The agreement was looked upon with misgiving, as it was stated that "The matter from the Allied viewpoint has been of importance, not so much from the angle of assuring supplies to Britain and her Allies, but of depriving the Germans of strategic material."[20] Subsequent statements on the provisions of the agreement varied somewhat, so that a complete version as of the beginning of 1943 is quoted here:[21]

> Between January 15 and March 31, 1943, Turkey and Germany will exchange goods to the value of £T55,000,000, including 45,000 tons of chrome on the Turkish side, and war material of the value of £T18,000,000 on the German side. It now seems to be established that the Germans will obtain supplies of chrome in proportion to the amount of war material and other goods delivered by them to Turkey by the end of March 1943. According to the same agreement Germany may obtain from Turkey an additional 45,000 tons of chrome during the rest of 1943, and another 90,000 tons in 1944, against delivery of war material to Turkey, but these further deliveries become operative only if Germany has delivered by March 1943 the entire quantity of war material provided for in the first paragraph of the agreement.

Considerable skepticism was displayed as to Germany's ability to deliver goods acceptable to Turkey, and it was also suggested that Turkey was dissatisfied with goods so far received. There is nothing to indicate whether an actual exchange has taken place. It is noteworthy that Great Britain is reported to have resumed conversations with Turkey with a view to renewing their agreement. Also, Germany was reported in April 1943 to have negotiated further exchange of goods, but whether chromite was included is not known.

Production of chromite in Turkey has apparently decreased since 1938. One estimate from a German publication [22] gives 80,000 metric tons for 1941; at the same time it is suggested that an increase will result from the German agreement. It is stated that the chrome-

[20] Metal Bulletin, Germany and Turkish Chrome: No. 2634, October 14, 1941, p. 7.
[21] Chemical Age, Turkish Chrome: Vol. 48, No. 1229, January 16, 1943, p. 98.
[22] Schuren, E., Die Metallwirtschaft in dem neuen Europa: Metallwirtschaft, vol. 21, No. 27/28, July 10, 1942, pp. 419–422.

mining areas in western Turkey are being exploited more fully again after a period of years during which the eastern deposits were most important.[23] The Eti Bank, state mining bank of Turkey, was said to have received over £T1,000,000 to expand chrome mines.[24]

U. S. S. R.—In 1942 the United States imported 30,061 short tons of chromite averaging 52 percent Cr_2O_3 from U. S. S. R. The principal deposits are in the Urals. Official information on production since 1936 has been entirely lacking. An unofficial British estimate[25] placed 1940 production at 400,000 tons of 48-percent ore. In 1940 a statement was made to the effect that production of 600,000 tons a year was planned by 1942.[26] Reserves of chromite in the U. S. S. R. were estimated[27] to be 15,194,000 metric tons at the beginning of 1934. Of this total, 13,748,000 tons were in Saranovo, Sverdlovsk Province.

United Kingdom.—Refractory-grade chrome ore occurs on the island of Unst, Shetland Islands. It was mined during the last century and again in small quantities during and since World War I. In a recent report, Wilson[28] states that between 1922 and 1927 about 3,000 tons were produced; 323 tons were shipped in 1936, 710 tons in 1938, and 1,100 tons in the year ended July 31, 1940. The ore now worked contains about 26 percent Cr_2O_3. Typically the ore analyzes 25 to 45 percent Cr_2O_3, 10 to 20 percent SiO_2, and 5 to 12 percent Al_2O_3.

Chrome-magnesite bricks produced from Shetland chromite have proved satisfactory in trials in open hearth and arc furnaces. The product compares favorably with brick made from Greek chrome ore.[29]

[23] Chemical Age, Work cited in footnote 21.
[24] Metall und Erz, vol. 39, No. 8, April 1942, p. 153.
[25] Foreign Commerce Weekly, Soviet Industries in the Urals: Vol. 7, No. 7, May 23, 1942, p. 9.
[26] Friedensburg, F., Bodenschätze und Bergbau der Sowjetunion: Glückauf, vol. 76, 1940, pp. 317–339.
[27] Volodomonov, N. V., Chromite: Min. Res. U. S. S. R., Cent. Geol. Prosp. Inst., Bull. 8, 1935.
[28] Wilson, G. V., Talc, Other Magnesium Minerals and Chromite, Associated with British Serpentines: Geol. Survey, Great Britain, Wartime Pamphlet 9, 2d ed., October 1941, 27 pp.
[29] Lynam, T. R., Chesters, J. H., Howie, T. W., and Jay, A. H., Shetland Chromite as a Refractory Material: Trans. British Ceram. Soc., vol. 41, pp. 27–44.

NICKEL

By H. W. Davis

SUMMARY OUTLINE

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SUMMARY

As a result of larger imports of nickel and the elimination of nonessential civilian and some military uses, conservation measures, and salvage of nickel-bearing scrap, the available supply was apparently adequate for vital war needs of the United States in 1942. So far as known, no shut-downs of essential war production due to lack of nickel supplies occurred during 1942. Nevertheless, so great was the demand that at no time during 1942 were domestic stocks of primary nickel more than a month's supply. An important conservation measure in the United States was the development of the National Emergency steels. These steels, some of which contain 0.2 to 0.7 percent nickel, were brought into being to spread the available alloys as widely as possible. No primary nickel is required for these steels. According to Butzner:[1]

NE steels, with their huge savings of nickel and vanadium, were first produced in May, but the first heavy production was in August, when they made up 30 percent of the alloy production. In August a new and still more economical series was announced. The monthly production has since reached as much as 50 percent and will of necessity go higher. The proportion will fluctuate quite considerably month to month, depending on fluctuating emphasis on gun steels, for example, which are still high-nickel.

Salient statistics for nickel, 1938–42

	1938	1939	1940	1941	1942
United States:					
Production:					
Primary ..... short tons	416	394	554	660	421
Secondary ..... do	2,300	2,920	4,152	5,315	(1)
Imports (gross weight)[2] ..... do	29,546	64,796	92,468	124,130	133,062
Exports (gross weight)[3] ..... do	6,581	10,167	11,994	7,125	7,068
Price per pound [4] ..... cents	35	35	35	35	35
Canada:					
Production ..... short tons	105,286	113,053	122,779	141,129	141,616
Imports ..... do	491	697	(1)	(1)	(1)
Exports ..... do	98,852	117,391	(1)	(1)	(1)
World production (approximate) ..... do	127,000	134,000	147,000	172,000	174,000

[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] Butzner, J. I., Nonferrous Metals: Iron Age, vol. 151, No. 1, January 7, 1943, p. 242.

Production of nickel in Canada in 1942 was about the same as in 1941, but in New Caledonia it declined slightly. The expansion program of the International Nickel Co. of Canada, Ltd. (announced in 1941), entailing an expenditure of $35,000,000, has progressed to a point where it now assures an increase in productive capacity of 50,000,000 pounds of nickel annually over the 1940 rate of production. The expansion program of Falconbridge Nickel Mines, Ltd., begun in 1941, was completed about the middle of 1942.

In 1942, as heretofore, the domestic output of primary nickel was insignificant. In addition to the nickel produced as a byproduct in the electrolytic refining of copper and as secondary nickel, a little was recovered as a byproduct of talc production in Vermont.

The St. Louis Smelting & Refining Co. did development work at its properties near Fredericktown, Madison County, Mo., where nickel and cobalt occur with lead, copper, and iron. The complexity of the ore presents a problem in metallurgy. However, the Bureau of Mines has studied the metallurgical problems involved, and the results of laboratory and pilot-plant tests at Rolla, Mo., indicate that fairly satisfactory recoveries can be made in cobalt-nickel and copper-lead concentrates by selective flotation. Exploratory drilling was done by the Freeport Sulphur Co. on a nickel deposit near Riddle, Douglas County, Oreg. Some prospecting was reported at the long-idle nickel property near Lancaster, Pa.[2]

Based upon the field work of the Bureau of Mines and upon data made available from other sources, a number of War Minerals Reports[3] on nickel deposits were prepared for the confidential use of Federal war agencies.

The Geological Survey published reports describing the nickel deposits of Yakobi Island, Alaska,[4] and near Gold Hill, Colo.[5]

The Dillon nickel prospect in Montana was described by Sinkler.[6]

PRODUCTION

Domestic production of nickel is small and comprises secondary metals recovered from scrap-nickel anodes, nickel silver, and copper-nickel alloys (including Monel metal), and primary metal recovered in copper refining and produced from ore and as a byproduct of talc production, as listed in the following table. Domestic primary nickel was recovered in 1942 as a byproduct in copper refining at Baltimore, Md., Laurel Hill, N. Y., Perth Amboy, N. J., and Tacoma, Wash. Concentrates containing 10 percent nickel and 0.78 percent cobalt were recovered as a byproduct of talc production in Vermont; however, none were shipped.

[2] Skillings' Mining Review, vol. 31, No. 42, February 6, 1943, p. 2.

[3] Bureau of Mines, Big Stake Nickel Property, Custer County, Colo.: War Minerals Rept. 1, 1942, 7 pp.
Bureau of Mines, St. Louis Smelting & Refining Co. Property, Fredericktown, Madison County, Mo. (Lead, Copper, Nickel, and Cobalt): War Minerals Rept. 3, 1942, 14 pp.
Bureau of Mines, Cle Elum Nickel-Iron Ore Deposit, Kittitas County, Wash.: War Minerals Rept. 27, 1942, 10 pp.
Bureau of Mines, Blewett Pass Nickel-Iron Ore Deposit, Chelan County, Wash.: War Minerals Rept. 28, 1942, 10 pp.

[4] Reed, J. C., and Dorr, J. V. N., Nickel Deposits of Bohemia Basin and Vicinity, Yakobi Island, Alaska: Geol. Survey Bull. 931-F, 1942, 34 pp.

[5] Goddard, E. N., and Lovering, T. S., Nickel Deposit near Gold Hill, Boulder County, Colorado: Geol. Survey Bull. 931-0, 1942, 14 pp.

[6] Sinkler, Helen, Geology and Ore Deposits of the Dillon Nickel Prospect, Southwestern Montana: Econ. Geol., vol. 37, No. 2, March–April 1942, pp. 136–152.

Nickel produced in the United States, 1938–42

Year	Primary (short tons) [1]		Secondary [2]	
	Byproduct in copper refining [3]	Other [4]	Short tons	Value
1938	416		2,300	$1,610,000
1939	394		2,920	2,044,000
1940	554		4,152	2,906,400
1941	619	41	5,315	3,720,500
1942	416	5	(5)	(5)

[1] Bureau of Mines not at liberty to publish value.
[2] Nickel recovered as metal and in alloys and salts.
[3] Nickel content of nickel salts and metallic nickel.
[4] Nickel content of matte produced from ore and of concentrates produced as byproduct of talc.
[5] Figures not yet available; they will be found in chapter on Secondary Metals—Nonferrous.

FOREIGN TRADE [7]

The nickel imported into the United States in 1942 comprised chiefly metallic nickel, matte, and oxide. As heretofore, Canada was the chief source of the imports; it supplied 61,003,121 pounds of matte, 161,151,775 pounds of metallic nickel, 23,837,605 pounds of oxide, and 1,990,000 pounds of residues. The matte from Canada, which contains approximately 55 percent nickel and 25 percent copper, is refined to Monel metal and other products at the plant of the International Nickel Co., Inc., Huntington, W. Va. New Caledonia supplied 19,472,399 pounds of matte; it contains about 78 percent nickel and is also refined at Huntington, where a new plant was completed in 1941 for refining matte from New Caledonia and elsewhere. About 7,200 short tons of nickel were produced at Huntington from New Caledonian matte in 1942. Cuba supplied 117,602 pounds of ore (presumably); the United Kingdom 117,304 pounds of oxide and 383,170 pounds of metallic nickel; and Mexico and Switzerland 40,007 and 178 pounds, respectively, of metallic nickel.

The nickel content of the unmanufactured nickel products imported into the United States is estimated at 228,550,000 pounds in 1942, as compared with 212,363,000 pounds in 1941. Imports of nickel in 1942 established a new peak.

Exports of nickel comprise largely products manufactured from imported raw materials. Exports of metallic nickel, Monel metal, alloys, and scrap increased 9 percent over 1941, whereas nickel-chrome electric resistance wire almost doubled. Exports of nickel silver, however, declined 91 percent. The United Kingdom (7,927,986 pounds), U. S. S. R. (3,076,692 pounds), and Canada (2,079,398 pounds) were the chief markets for nickel, Monel metal, alloys, and scrap in 1942.

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

Nickel (excluding residues) imported for consumption in the United States, 1940–42, by classes

Class	1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	34,889,970	$4,705,454	79,892,400	$11,267,845	80,593,122	$11,599,491
Nickel pigs, ingots, shot, etc	140,625,658	35,152,218	149,466,723	37,429,028	161,202,200	40,588,948
Nickel bars, rods, tubes, etc	434,139	193,284	520,199	227,319	372,930	174,511
Nickel oxide	8,986,834	1,692,961	18,377,937	3,039,026	23,954,909	3,982,877
Manufactured:						
Nickel silver or German silver in sheets, strips, rods, and wire	153	84	2,800	2,545	----------	----------
All other manufactures of nickel	(1)	1,787	(1)	1,785	(1)	57,478
	----------	41,745,788	----------	51,967,548	----------	56,403,305

[1] Quantity not recorded.

Nickel exported from the United States, 1940–42, by classes

Class	1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore, concentrates, and matte	21,845,989	$7,416,252	12,190,549	$4,608,139	104	$92
Alloys and scrap containing nickel (including Monel metal)					8,996,413	3,472,575
Metal in ingots, bars, sheets, etc					4,251,948	1,947,597
Manufactures	(1)	1,393,636	(1)	863,011	(1)	3,753,594
Nickel-chrome electric resistance wire	640,816	777,539	336,123	381,927	668,194	792,255
Nickel silver or German silver, crude, scrap, or bars, rods, etc	1,502,071	269,907	1,694,800	359,732	155,282	94,563
Nickel salts and compounds	(2)	(2)	[3] 28,363	[3] 10,104	64,981	23,909
	----------	9,857,334	----------	6,222,913	----------	10,084,585

[1] Quantity not recorded.
[2] Not separately classified.
[3] Figures cover September to December; not separately classified before September 1.

WORLD PRODUCTION

Because of restriction on the publication of statistics by many governments, few figures have become available since 1939.

World production of nickel (content of ore), 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Australia	----------	20	----------	(2)	(2)	(2)
Brazil	104	375	25	(2)	(2)	(2)
Burma	1,233	959	921	(2)	(2)	(2)
Canada	[3] 102,015	95,514	102,559	111,383	128,029	128,471
Egypt	14	33	(2)	(2)	(2)	(2)
Germany	890	550	(2)	(2)	(2)	(2)
Greece	957	1,207	1,336	(2)	(2)	(2)
Italy	68	[4] 150	(2)	(2)	(2)	(2)
Morocco, French	132	163	(2)	(2)	(2)	(2)
Netherlands Indies	----------	[4] 500	[4] 753	2,222	(2)	(2)
New Caledonia	11,600	11,700	10,625	10,535	10,395	9,415
Norway	877	1,245	1,106	(2)	(2)	(2)
Southern Rhodesia	4	76	[4] 490	(2)	(2)	(2)
Union of South Africa	----------	44	398	416	(2)	(2)
U. S. S. R.	2,000	2,500	(2)	(2)	(2)	(2)
United States [5]	199	377	357	503	599	382
	120,100	115,500	[4] 122,000	[4] 133,000	[4] 156,000	[4] 158,000

[1] In addition to countries listed, Finland and Japan produce nickel, but data of output are not available.
[2] Data not yet available; estimate included in total.
[3] Excludes small quantity produced in British Columbia.
[4] Estimate.
[5] Byproduct in electrolytic refining of copper. Includes also—1941: Small quantities produced from ore and as byproduct of talc; 1942: Small quantity as byproduct of talc.

Brazil.—The nickel deposits at São José do Tocantins, State of Goyaz, and at Livramento, State of Minas Gerais, have been described in considerable detail by Wright and Pardee.[8] A brief summary of the deposits will be found in Minerals Yearbook, 1941.

According to the American Smelting & Refining Co.: [9]

The company acquired a 50-percent interest, together with a term management contract, in a nickel property in the State of Goyaz, Brazil. This property was carefully examined by four of the company's senior engineers. Their reports indicate there is a very large tonnage of ore, containing a percent of nickel that should assure a profitable operation. The ore is refractory, but the company's research department succeeded in working out a process which will recover the nickel. The mine contains cobalt in commercial amounts, and extraction of this metal will probably begin in advance of the nickel operation. It is planned first to erect at Perth Amboy (N. J.) a small pilot plant, and with knowledge gained therefrom to design a commercial plant to be constructed at the property during 1944, although as regards completion much will depend on nonpredictable factors, such as ability to obtain the necessary material, equipment, and shipping facilities.

Canada.—Virtually all the Canadian output is derived from the copper-nickel ores of the Sudbury district, Ontario; and two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Production in Canada was 141,616 short tons in 1942, compared with 141,129 tons in 1941 and 122,779 tons in 1940.

The International Nickel Co. of Canada, Ltd.,[10] stated:

It is gratifying to report, as forecast a year ago, that the increase in production of nickel in all forms of 50,000,000 pounds over the 1940 output has been realized. Work on production expansion has progressed according to schedule and is largely completed. All of the company's works ran continuously throughout the year and, considering the shortage of labor and the difficulty in securing supplies, the operating results were satisfactory.

According to Falconbridge Nickel Mines, Ltd.: [11]

All treatment plants were operated at maximum capacity throughout the year, though with considerable difficulty at times due to the construction programs which were being carried out. On the whole the result achieved may be viewed with satisfaction, since a substantial increase both in tonnage treated and in production is again recorded. The program to expand capacity begun in 1941 was completed by the middle of the year. This project included additional crushing equipment at the shaft head; some increase in storage-bin capacity and handling equipment; grinding mills; flotation equipment and additions to thickening and filtering capacity in the mill; additional sintering capacity and changes in the smelting plant, together with the provision of added and improved change-house facilities both at mine and smelter.

The Alexo nickel property, which produced nickel during the First World War, is again to be a contributor, arrangements having been made for the sale of the ore.[12]

According to the Northern Miner: [13]

Nickel Offsets, Ltd., is proceeding with the deepening of the shaft at its property in Foy and Bowell Twps., Sudbury district. In previous work the shaft was sunk to 530 feet, with a large amount of development carried out at the 200, 350, and 500-foot levels. It is now proposed to go down to 1,250 feet and to cut stations at 150-foot intervals as sinking proceeds.

[8] Wright, C. W., and Pardee, F. G., The Nickel-Cobalt Deposit at São José do Tocantins, State of Goyaz, Brazil: Ms. Rept., June 4, 1941, 22 pp.; The Nickel Deposit at Livramento, Minas Gerais, Brazil: Ms. Rept., June 14, 1941, 10 pp.
[9] American Smelting & Refining Co., 44th Annual Report: 1942, p. 3.
[10] International Nickel Co. of Canada, Ltd., Annual Report: 1942, p. 4.
[11] Falconbridge Nickel Mines, Ltd., 14th Annual Report: 1942, pp. 1–10.
[12] Canadian Mining Journal, vol. 63, No. 12, December 1942, p. 818.
[13] Northern Miner, vol. 28, No. 39, December 17, 1942, p. 8.

A deposit of high-grade nickel ore has been developed at the Moose mine, near Sudbury, by the Ontario Nickel Corporation; equipment has been partly installed for a daily output of 300 tons.[14]

Cuba.—According to the Freeport Sulphur Co., which, through its subsidiary, Nicaro Nickel Co., is constructing a plant in Cuba for the production of nickel: [15]

> A great deal of time and thought of this organization has gone into pushing the construction of this plant during the past year. It is difficult to say when production will start, because the commencement of operations is dependent upon the priorities which we may receive for the equipment necessary for the completion of the plant.

Finland.—A Swedish engineering firm is erecting automatic heating apparatus for the mining town of Kilosjoki, where the mines of Petsamo Nikkeli O/Y are situated.[16] The town will shelter the 3,000 workers and officials of the nickel-mining company.

With the assistance of German materials and engineers, the mine (Petsamo), which was considerably damaged in the first Russo-Finnish conflict, has been restored and production resumed.[17] Another nickel deposit has been discovered in central Finland at Nivala; preparations for production are in progress.

A plant now under construction by the Outukumpu O/Y at Pori, the first of its kind in the country, will eventually supply 400 tons of nickel a year.[18] Meanwhile, the company is producing copper-nickel ore at the rate of 18,000 tons a year, most of which is probably being sent to German refineries.

New Caledonia.—New Caledonia ranks second in world production of nickel. The Société Le Nickel owns a number of properties in various parts of the island, but the most important are those around Thio on the east coast and around Voh and Koné on the west coast. The smelter, comprising four furnaces, is at Noumea and produces a matte containing 77.5 to 78 percent nickel for export. About 90 percent of the ore smelted comes from the mines of the company, and 10 percent is purchased from small miners. For several years previous to the war, shipments of ore were made to Germany and Japan by the small miners.

Nickel ore treated in and matte exported from New Caledonia, 1938–42

Year	Ore treated		Matte exported (long tons)				
	Long tons	Percent nickel (average)	Australia	Belgium	France	United States	Total
1938	241,131	4.5	----	4,194	3,710	----	7,904
1939	248,020	4.0	----	2,569	6,586	----	9,155
1940	296,246	3.5	[1] 3,143	----	[1] 4,724	----	7,867
1941	292,309	3.5	[2] 394	----	----	7,756	8,150
1942	264,752	3.5	738	----	----	6,417	7,155

[1] Of these quantities, 1,019 tons destined to Australia and 883 tons destined to France were reexported to the United States in 1941.
[2] Reexported to the United States in 1942.

[14] Engineering and Mining Journal, vol. 143, No. 5, May 1942, pp. 95–96.
[15] Freeport Sulphur Co., 30th Annual Report: 1942, p. 5.
[16] Metal Bulletin (London), No. 2671, February 24, 1942, pp. 9–10.
[17] Schuren, E., Metal Industry in New Europe: Metallwirtschaft, vol. 21, No. 27/28, July 10, 1942, pp. 419–422.
[18] Chemical Age (London), vol. 47, No. 1214, October 3, 1942, p. 306.

COBALT

By H. W. Davis

SUMMARY OUTLINE

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SUMMARY

Despite prohibitions and limitations on the use of cobalt for many purposes, total consumption in the United States was about 12 percent greater in 1942 than in 1941. There was a marked increase in consumption of cobalt in stellite and stellite-type alloys, magnets and magnet steels, and carbide-type alloys; but this gain was partly offset by a decline in the amount used in ground-coat frit, pigments, and driers. Although domestic production of cobalt made considerable gain in 1942, most of the demand, as heretofore, was supplied by imports, mainly in the form of alloy from Belgian Congo and ore from Canada. The domestic ore, which averages about 1.4 percent cobalt, is processed to metal, oxide, and hydrate at Wilmington, Del. The alloy from Belgian Congo contains about 40 percent cobalt and is converted to metal and oxide at Niagara Falls, N. Y., and to oxide, sulfate, catalytic salts, or driers at Chicago, Ill., Cincinnati and Cleveland, Ohio, Elizabeth, N. J., New Brighton, Pa., and Richmond, Calif. The Canadian ore, which averages about 11 percent cobalt, is processed to cobalt oxide and other products at Cincinnati, and to cobalt-nickel oxide at Canonsburg, Pa., and Cleveland, Ohio. A new cobalt-nickel plant was being built at Cleveland, Ohio, to treat Burmese speiss, which contains about 7 percent cobalt, 30 percent nickel, 40 percent arsenic, and 10 percent copper. The products contemplated are cobalt oxide, nickel oxide, copper oxide or hydroxide, and calcium arsenate. It is expected that the plant will be ready for operation about May 15, 1943. In the plant, room is provided for the addition at a later date of smelting equipment for treating Canadian concentrates containing about 10 percent cobalt, 3 percent nickel, and 25 percent arsenic.

Domestic quotations for metal in 100-pound lots and for black oxide in 350-pound lots remained unchanged throughout 1942 at $1.50 and $1.84 a pound, respectively. These prices have been in effect since the latter part of October 1939.

PRODUCTION

Though comparatively small, production of cobalt ore in the United States increased considerably in 1942; the Bethlehem Steel Co., Beth-

lehem, Pa., was again the chief producer and shipper. The cobalt (averaging about 1.4 percent) is contained in the sulfides that accompany the magnetite mined at Cornwall, Pa. The Eastern Magnesia Talc Co., Inc., Burlington, Vt., recovered 50 short tons of concentrates, containing 0.78 percent cobalt and 10 percent nickel, as a byproduct of froth flotation of talc. The Sullivan Mining Co., Kellogg, Idaho, recovered 64 short tons of residue, containing 5.66 percent cobalt, at its electrolytic zinc plant. At the Columbia mine near Goodsprings, Nev., Otto F. Schwartz did some development work and shipped 1 short ton of concentrates averaging 6.96 percent cobalt.

The St. Louis Smelting & Refining Co. did development work at its properties near Fredericktown, Madison County, Mo. By December 1942, a new shaft had been sunk to 400 feet; two additional shafts are contemplated in 1943. At these properties cobalt and nickel occur with lead, copper, and iron, but the complexity of the ore presents a problem in metallurgy. The property was visited by a Bureau of Mines engineer in August 1942, and a report [1] was prepared showing the production possibilities of the deposits and indicating the metallurgical testing undertaken by the Bureau to determine a suitable treatment method. Results of the Bureau's laboratory and pilot-plant tests at Rolla, Mo., indicate that fairly satisfactory recoveries can be made in copper-lead and cobalt-nickel concentrates by selective flotation.

After examinations in 1941 and June 1942, the Bureau of Mines in August 1942 undertook an exploration and ore-testing project on a group of claims of the Uncle Sam Mining & Milling Co., Inc., in the Blackbird district in east-central Idaho. By the end of 1942, sampling of underground workings had established a moderate tonnage of positive ore averaging 2.06 percent copper and 0.29 percent cobalt, with additional values in gold and silver. This sampling also provided a basis for estimating a considerable tonnage of geologically inferred ore. Further surface and underground exploration, including sampling, drifting, and crosscutting, are planned for 1943. Ore testing of samples at the Salt Lake City Experiment Station of the Bureau has shown that good recovery of cobalt, copper, and gold can be made by bulk flotation in a concentrate that is of low grade with respect to cobalt. Fair recovery of cobalt in a separate cobalt concentrate of better grade was obtained by selective flotation and tabling. Results of the preliminary examinations and plans for Bureau exploration are discussed in a recent report.[2]

Small amounts of cobalt are associated with many manganese ores, but the cobalt is not extracted in the usual metallurgical and chemical processing of these ores. The Bureau of Mines determined early in its development of the electrolytic manganese process that most of the cobalt goes into solution together with the manganese in the leaching step and is precipitated with other impurities upon purification of the leach solution. In view of this potentially large source of cobalt and the difference of opinion as to whether leach solutions containing cobalt can be purified sufficiently for satisfactory electrodeposition of manganese, tests were made at the Boulder City (Nev.) electrolytic manganese pilot plant of the Bureau on the separation and electrodeposition

[1] St. Louis Smelting & Refining Co. Property, Fredericktown, Madison County, Mo.: Bureau of Mines War Minerals Rept. 3, 1942, 14 pp.
[2] Blackbird District, Lemhi County, Idaho; Bureau of Mines War Minerals Rept. 78, 1943, 8 pp.

of manganese and cobalt from manganese electrolytes. These tests proved that appreciable concentrations of cobalt in manganese solutions can be eliminated sufficiently to allow satisfactory electrodeposition of manganese and that recovery of cobalt from the sludge residue of the manganese-electrolyte purification is feasible.

FOREIGN TRADE[3]

Imports.—Imports of cobalt into the United States in 1942 were 30 percent less than those in 1941, which, however, was a peak year. The chief source of imports in 1942 was Belgian Congo, which supplied 7,928,952 pounds in the form of an alloy containing 3,208,687 pounds of cobalt. Canada supplied 148,304 pounds of cobalt (metal) and 834,797 pounds of ore containing 91,597 pounds of cobalt, and the United Kingdom 200 pounds of salts and compounds of cobalt.

Cobalt ore, metal, oxide, and other compounds of cobalt imported for consumption in the United States, 1938–42

Year	Ore			Metal		Oxide		Sulfate		Other salts and compounds	
	Pounds		Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
	Gross weight	Cobalt content									
1938	449,984	(1)	$32,354	938,476	$1,146,559	373,215	$519,201	41,811	$18,277	56	$98
1939	611,083	(1)	54,446	2,130,296	2,711,677	680,644	944,836	75,290	34,343	1,374	3,405
1940	10,497,719	(1)	3,660,869	130,321	207,345	756,759	1,124,554	11,468	7,818	------	------
1941	12,414,314	4,326,929	4,587,787	554,030	842,288	38,002	55,120	4,480	3,779	500	885
1942	8,763,749	3,300,284	3,198,700	148,304	228,452	------	------	------	------	200	448

[1] Data not available.

Exports.—Exports of cobalt were 118,866 pounds valued at $162,039 in 1942. From July to December 1941 exports totaled 34,341 pounds valued at $37,670; exports of cobalt before July 1, 1941, are not separately recorded.

USES

The largest single use of cobalt is in stellite or stellite-type alloys, and such alloys absorbed about 39 percent of the total cobalt consumed in 1942. Other important uses of cobalt are in magnets and magnet steels, high-speed steels and other cutting-tool materials, valve steel, welding rod, and carbide-type alloys; these outlets comprised about 44 percent of the cobalt consumed in 1942. Smaller quantities of cobalt are employed in the ceramic industry, in the preparation of driers, in electroplating, as a catalyst, and for a variety of other uses. Of the total cobalt consumed in 1942, 10 percent was used in driers, 5 percent in ceramics, and 2 percent for electroplating, catalyst, and other applications.

WORLD PRODUCTION

As cobalt production data for many countries are lacking, it is impossible to prepare an accurate statement of world output. Never-

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

theless, world production for 1942 is estimated at 5,000 to 5,500 metric tons. With the occupation of French Morocco, the United Nations control about 85 percent of the world output. The following table shows world production by countries, 1937–42, insofar as statistics are available.

World production (partly estimated) of cobalt, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	Cobalt-bearing material	Cobalt content					
		1937	1938	1939	1940	1941	1942
Australia	Cobalt ore	(2)	(2)	(2)	(2)	(3)	5
Belgian Congo	Cobalt alloy	1,500	1,532	(2)	(2)	(2)	2,200
Bolivia (exports)	Cobalt ore	(3)			2	2	28
Burma	Cobaltiferous nickel speiss	[4] 298	[4] 238	[4] 229	218	73	(2)
Canada	Cobalt ores, oxide, and metal	230	208	332	360	119	39
Morocco, French	Cobalt ore	581	720	719	700	700	400
Northern Rhodesia	Cobalt alloy	[4] 578	[4] 1,073	[4] 1,598	(2)	(2)	(2)
United States	Cobalt ore				(5)	(5)	(5)

[1] In addition to the countries listed, Brazil, Chile, China, Finland, Germany, Italy, Japan, and Mexico produce cobalt, but production data are not available. The world total for 1942 is estimated at 5,000 to 5,500 tons.
[2] Data not available.
[3] Less than 1 ton.
[4] Year ended June 30 of year stated.
[5] Bureau of Mines not at liberty to publish figures.

Belgian Congo.—Belgian Congo is the world's chief source of cobalt. Cobalt is mined as such and as a high-grade copper-cobalt ore. Cobalt also occurs with sulfide and carbonate copper ores, from both of which partial recovery is made by concentration. Production data have not been published since 1938, when 1,532 metric tons were produced. Since then, however, it has been reported that further reserves of rich cobalt minerals have been discovered, the Kabolela cobalt mine has been developed, a concentrator has been installed, and a fourth electric furnace added. As a consequence, production undoubtedly has increased considerably and may have reached 2,200 tons in 1942. Two additional electric furnaces were under construction in 1942 which, when in operation, should increase production to above 3,000 tons.

Brazil.—Cobalt is associated with nickel at Jacuba, São José do Tocantins, State of Goyaz. The American Smelting & Refining Co. (New York, N. Y.) recently acquired a 50-percent interest in the Companhia Niquel Tocantins and will construct a pilot plant at Perth Amboy, N. J., to refine nickel from ore from the properties in the State of Goyaz. Extraction of cobalt probably will be begun in advance of the nickel operation.

French Morocco.—French Morocco ranks third as a world producer of cobalt. With the occupation of this country by the United Nations, the Axis-controlled countries lost access to its cobalt supplies, which have been allocated to the United States by the Combined Raw Materials Board.

Northern Rhodesia.—Northern Rhodesia is the second-largest producer of cobalt in the world. Cobalt in association with copper is produced at the Nkana mine of the Rhokana Corporation, Ltd. The

copper ore contains 0.02 to 0.5 percent cobalt in the form of sulfide, and by special processes, involving differential flotation of certain of the ores and treatment of the converter slags, a rich cobalt-iron-copper alloy is produced.[4] The alloy contains about 40 percent cobalt and at present is exported to Canada for refining. Recent production figures are not available, but in a statement circulated with the annual report of the Rhokana Corporation, Ltd., for the year ended June 30, 1942, it was reported that the largest possible amount of cobalt had been produced and was still being produced, in spite of the many difficulties that had to be overcome. During the year ended June 30, 1939, alloy containing 1,598 metric tons of cobalt was produced.

[4] Deans, T., The Mineral Resources of Northern Rhodesia: Min. Jour. (London), vol. 220, No. 5612, March 13, 1943, p. 130.

MOLYBDENUM

By Frederick Betz, Jr., and Alice P. van Siclen

SUMMARY OUTLINE

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SUMMARY

Molybdenum is produced in many parts of the world, but compared with the United States there is no producer of importance. The combined output of all other countries is less than 10 percent of the world total, and most of that comes from Western Hemisphere countries and Norway and French Morocco. Reliable estimates of output in European and Asiatic countries under the influence of the Axis are not available, but no established producer of any note, except Norway, would fall in that category.

In 1942 all earlier records for domestic production of molybdenum were exceeded. Output of molybdenum in ore and concentrates in the United States rose 42 percent to 57,077,000 pounds; the Climax Molybdenum Co. produced approximately 73 percent of the total, and all but about 3 percent of the remainder was byproduct recovery from three copper operations. Imports of molybdenum ordinarily are a negligible factor in the available supply; although still relatively very small, in 1942 they amounted to 755,950 pounds in ores and concentrates, the greater part of which came from Chile. Exports increased 52 percent in 1942 to 11,617,517 pounds.

Molybdenum has been used so extensively to replace less abundant steel-alloying metals that measures for its conservation have been adopted by placing it under complete allocation (WPB General Preference Orders M–110 and M–110–a) and by reducing the Mo content of alloy steels in the new NE (National Emergency) series.

Salient statistics of the molybdenum industry in the United States, 1940–42

	1940	1941	1942
Concentrates:			
Production—short tons	33,128	38,962	56,239
Molybdenum contained—pounds	34,313,000	40,162,000	57,077,000
Shipments (including exports)—short tons	24,300	36,894	65,329
Molybdenum contained:			
Average—percent	52.12	51.77	50.85
Total—pounds	25,329,000	38,200,000	66,437,000
Value [1]	$17,189,000	$25,883,000	$47,299,000
Exports—short tons	6,339	7,673	10,731
Molybdenum contained—pounds	6,584,714	7,640,330	11,617,517
Value	$4,904,000	$5,379,367	$7,958,662
Imports for consumption (molybdenum contained):			
Pounds		4,300	755,950
Value		$2,898	$554,232

[1] Estimate by Bureau of Mines.

WAR REGULATIONS

All forms of molybdenum, including scrap, were placed under complete allocation by War Production Board General Preference Order M–110, dated March 18, 1942 (effective May 1). On August 8 this order was amended to permit the melting of molybdenum only after approval of melting schedules, as provided in Order M–21–a, and to extend the effective time of the order until revoked. The original provision exempting users of less than 50 pounds monthly from reporting their requirements was modified on November 6 by an amendment (M–110–a) permitting, under certain conditions, deliveries up to 500 pounds of contained molybdenum in any one month without allocation. Melters whose requirements are not large may use up to 500 pounds monthly without submitting melting schedules to the War Production Board. On January 9, 1943, secondary molybdenum chemicals were removed from the M–orders on molybdenum.

An order of the Board of Economic Warfare provided that, as of July 9, 1942, molybdenum ore and concentrates, products, alloys, and scrap could be exported under general license only to Canada and Newfoundland. An individual license is required for clearance of exports of these molybdenum-bearing materials to all other foreign countries.

MARKET

The quoted price for molybdenum ore refers to molybdenum in concentrates containing 90 percent MoS_2. The price has held at 45 cents per pound (equivalent to 75 cents per pound of molybdenum contained) f. o. b. mines for several years. In practice, the price is said to vary with the grade. The molybdenite concentrates are shipped largely to processing plants for conversion to molybdenum oxide, calcium molybdate, ferromolybdenum, etc. The prices of the principal molybdenum products are based on a pound of contained molybdenum, f. o. b. producer's plant. Molybdenum oxide and calcium molybdate are priced at 80 cents and ferromolybdenum at 95 cents.

UNITED STATES

PRODUCERS IN 1942

Only seven ore deposits were exploited actively during 1942 for their molybdenum content. One of them, the Climax deposit, is the world's largest molybdenum producer. All but two are operated mainly for their yield of other metals. Among the group that produces molybdenum as a byproduct is the Bingham copper deposit, second-largest producer of molybdenum in the United States. The chief ore of molybdenum is molybdenite (MoS_2); wulfenite ($PbMoO_4$), once mined from several deposits in southwestern United States, is now extracted at a single mine.

Domestic shipments of molybdenum in ore and concentrates in 1942, amounting to 66,437,000 pounds, were 74 percent greater than

in 1941 and represent about 23 percent of the total shipments since 1918.

Molybdenum in ore and concentrates shipped from mines in the United States, 1914–42 [1]

Year	Pounds	Value [2]	Year	Pounds	Value [2]
1914–18	1,601,643	$2,070,213	1939	32,415,000	$22,157,000
1919–23 [3]	355,493	370,371	1940	25,329,000	17,189,000
1924–28	8,498,343	6,160,304	1941	38,200,000	25,883,000
1929–33	18,954,917	11,406,000	1942	66,437,000	47,299,000
1934–38	94,077,000	64,244,000			
			1914–42	285,868,396	196,778,888

[1] For shipments by years, 1914–38, see chapter of this series for 1941.
[2] Largely estimated by Bureau of Mines.
[3] No shipments in 1920 and 1921.

Climax and Questa are the only molybdenum deposits now operated solely for their content of this metal. In 1942 Climax produced 73 percent of the total United States output of molybdenum. Questa is a very much smaller operation but has been a consistent producer for 20 years and thereby has contributed substantially to the domestic production of molybdenum during that period.

The Climax deposit in Colorado has been discussed extensively in literature, as have the various aspects of the mining and milling operation. In 1942, Vanderwilt [1] summarized the ore occurrence, and a review of Climax is presented in the discussion of domestic deposits in the chapter of Minerals Yearbook, 1941, on Molybdenum and Vanadium.

Molybdenum contained in concentrates produced from Climax deposit in Colorado, 1918–42 [1]

Year	Pounds	Year	Pounds
1918–37 [1]	80,060,256	1941	27,751,273
1938	28,242,085	1942	41,852,136
1939	21,796,116		
1940	22,782,608	1918–42	222,484,474

[1] For production by years, 1918–37, see chapter of this series for 1941. No production from 1920 to 1923, inclusive.

Molybdenite near Questa, Taos County, N. Mex., was first recognized during World War I. The deposit was developed by the R & S Molybdenum Mines Co., and about 100,000 pounds of molybdenum in concentrates were produced in 1919 and 1920. The Molybdenum Corporation of America acquired ownership in 1920 and built a mill and camp in 1923. Since that time the property has been in regular operation.

The mine is in Sulphur Gulch, 7 miles east of Questa; the mill is on Red River, three-quarters of a mile from the mine. The deposit covers an area about half a mile square, on the western flank of the Sangre de Cristo Range, at an elevation of 8,000 to 9,000 feet. Accord-

[1] Vanderwilt, John W., The Occurrence and Production of Molybdenum: Colorado Sch. Mines Quarterly, vol. 37, No. 4, October 1942, p. 38. Structure of the Climax Molybdenite Deposit (in Ore Deposits as Related to Structural Features): Princeton Univ. Press, 1942, pp. 136–137.

ing to Vanderwilt,[2] mineralization is in fissure veins near the contact of a small granite mass with a series of sedimentary and volcanic rocks. Numerous iron-stained fractures mark the mineralized area at the surface. The deposit is unique in the production of large quantities of molybdenite from veins and is likewise outstanding in the richness of the ore (about 5 percent MoS_2).

Mining and milling methods employed by the Molybdenum Corporation of America at Questa have been described by Carman.[3]

Production of molybdenum in concentrates at Questa is summarized in the accompanying table.

Molybdenum contained in concentrates produced from Questa deposit in New Mexico, 1919–42

Year	Pounds	Year	Pounds	Year	Pounds	Year	Pounds
1919	65,492	1925	332,293	1931	469,800	1937	499,182
1920	34,900	1926	334,412	1932	515,588	1938	438,672
1921		1927	285,833	1933	571,500	1939	477,327
1922		1928	450,264	1934	571,956	1940	484,120
1923	22,667	1929	475,925	1935	342,000	1941	466,856
1924	140,239	1930	639,852	1936	405,000	1942	376,285

Molybdenite is present in all the important disseminated-copper deposits in southwestern United States and Mexico.[4] Its recovery as a byproduct in the concentration of copper ores was begun in the United States by the Utah Copper Co. in 1936 from the Bingham deposit; it had already been accomplished in Mexico at Cananea in 1933. The Nevada Consolidated Copper Corporation became a molybdenum producer in 1937 from the Chino (Santa Rita) property in New Mexico, and in 1938 the Miami Copper Co. at Miami, Ariz., entered the field. These three producers supplied 24 percent of the 1942 production of molybdenum. The Bingham deposit is second only to Climax as a producer of molybdenum.

The molybdenum content of the various porphyry-copper deposits is quite variable. At Miami, the content is reported as 0.009 percent MoS_2; at Bingham [5] it is 0.04 percent; and at Chino the grade falls between these two.

Molybdenum is an accessory value at the Pine Creek tungsten mine of the United States Vanadium Corporation near Bishop, Inyo County, Calif. Lemmon[6], discussing the deposit, states that the ores are mainly disseminated in contact-metamorphosed limestones. Molybdenite and powellite [$Ca(Mo,W)O_4$] are the molybdenum minerals. The crude ore averages 0.5 percent MoO_3 and has a maximum of 2 percent MoO_3. Burwell [7] has described the metallurgical

[2] Vanderwilt, John W., Geology of the "Questa" Molybdenite Deposit, Taos County, N. Mex.: Proc. Colorado Sci. Soc., vol. 13, No. 11, 1938, pp. 599-643; see also reference in footnote 4, pp. 39-44. Molybdenite Mineralization near Questa, Taos County, N. Mex. (in Ore Deposits as Related to Structural Features): Princeton Univ. Press, 1942, pp. 245-246.

[3] Carman, J. B., Mining Methods of the Molybdenum Corporation of America at Questa, N. Mex.: Bureau of Mines Inf. Circ. 6514, 1931, 15 pp. Milling Methods at the Questa Concentrator of the Molybdenum Corporation of America, Questa, N. Mex.: Bureau of Mines Inf. Circ. 6551, 1932, 14 pp.

[4] Vanderwilt, John W., The Occurrence and Production of Molybdenum: Colorado Sch. Mines Quarterly, vol. 37, No. 4, October 1942, pp. 48 and 60.

[5] Vanderwilt, John W., Work cited in footnote 4, p. 60.

[6] Lemmon, D. M., Tungsten Deposits in the Sierra Nevada near Bishop, Calif.—A Preliminary Report: Geol. Survey Bull. 931-E, 1941, pp. 89-91.

[7] Burwell, Blair, Milling Tungsten Ores at Pine Creek: Min. Cong. Jour., vol. 27, No. 10, October 1941, pp. 16-18.

problems in treating the ores, and Partridge [8] has given a brief history of the property.

At Tiger, Ariz., Mammoth-St. Anthony, Ltd., carries on a unique operation involving the only commercial production of molybdenum from wulfenite ($PbMoO_4$) in the United States. The molybdenum is in a complex ore which also carries values in gold, silver, lead, and vanadium. The recovery process employed is described as follows in a communication from J. L. Fozard, general manager, Mammoth-St. Anthony, Ltd. (slightly abridged):

> Smelting in a reverberatory furnace of oxide concentrates (which have been mixed with soda ash and coke) yields a lead bullion containing the bulk of the gold and silver; a small amount of matte carrying lead, copper, gold, and silver; and a molybdenum-vanadium rich slag, which is treated at the plant.
>
> The slag is hand-sledged, crushed, and ground wet in a rod mill. This solution contains the bulk of the vanadium and molybdenum that was in the slag. After suitable filtering, part of the solution is evaporated by smelter waste heat to the dry sodium molybdate-sodium vanadate salt; the remainder of the solution is used in the separation of the molybdenum from the vanadium.
>
> In the salt plant, the currently made salt, stored salt, and salt solution are mixed, the amount of stored salt to be used being determined from the specific gravity of the solution. This mixture is agitated for 8 hours. The molybdenum of the solid salt goes into solution, and the vanadium of the solution is precipitated. The product is filtered, the residue being the vanadium shipping product, which assays 20–25 percent V_2O_5 and less than 2 percent MoO_3. The filtrate is then agitated with lime and calcium chloride for 2 hours. This material is filtered. The residue is a low-grade molybdate-silicate precipitate, which is stored for future re-treatment. The filtrate is treated with calcium chloride, and a high-grade calcium molybdate is precipitated, filtered, dried, sacked, and shipped.

EXPLORATION AND DEVELOPMENT

In 1942 the Defense Plant Corporation purchased the Urad mine, 10 miles from Empire in Clear Creek County, Colo., from the Vanadium Corporation of America. The Government agency was reported to have expended $110,000 in the purchase and to have authorized the further expenditure of $250,000 for development of the property by the Molybdenum Corporation of America, designated as operators. Production is scheduled to begin sometime in 1943. The Urad mine was a producer during World War I, having shipped several hundred thousand pounds of molybdenite concentrates in 1918 and 1919. Operations were suspended in 1919, and the mill was dismantled by the Vanadium Corporation of America, which acquired the property from the Primos Chemical Co.

No molybdenum has been mined commercially in Alaska, according to P. S. Smith,[9] who summarized details on geology, mineralogy, and exploration of 41 occurrences of molybdenum minerals scattered through that Territory. Field work was performed on the Muir Inlet molybdenum deposit by the Geological Survey, and exploratory investigations were carried on by the Bureau of Mines; the latter agency also examined the Shakan deposit, Prince of Wales Island.

CONSUMPTION AND USES

Since July 1941 the Bureau of Mines has conducted for the War Production Board (and its predecessor, Office of Production Management) monthly studies of production and consumption of molybdenum

[8] Partridge, John F., Jr., Tungsten Resources of California: California Jour. Mines and Geol., vol. 37, No. 2, April 1941, pp. 295–296.

[9] Smith, P. S., Occurrences of Molybdenum Minerals in Alaska: Geol. Surv. Bull. 926–C 1942, pp. 161–207.

and molybdenum products. Responses from consumers of molybdenum products indicate that, of the total consumption (exclusive of scrap) of over 22,000 short tons of molybdenum in 1942, approximately 63 percent was consumed as molybdenum oxide (roasted molybdenite), 24 percent as ferromolybdenum, 12 percent as calcium molybdate, and the remaining 1 percent as metal or as one of the molybdenum chemicals. Monthly consumption of molybdenum in primary products increased from about 1,300 tons in January 1942 to 2,200 tons in December. Ninety-five percent of all the molybdenum (including scrap) was used in the production of steel ingots and castings, 3 percent in iron castings, and 2 percent in minor uses such as pigments and colors, welding rods, etc.

An important step toward stretching available supplies of molybdenum and other critical steel-alloying metals was taken through adoption of specifications for NE (National Emergency) steels to replace the standard (SAE) steels. These alternate steels effect savings of critical metals through employment of leaner mixtures. The first specifications announced by the War Production Board in March 1942 included the Mn–Mo, Ni–Cr–Mo, and C–Mo steels. Revisions were made subsequently to meet changing conditions in supply of the metals involved. All but two of the compositions employing more than a maximum of 0.25 percent Mo were deleted.[10] Special attention was devoted to combining recoverable Ni, Cr, and Mo from scrap with small quantities of virgin metals, which led to introduction of two series containing 0.08 to 0.15 and 0.15 to 0.25 percent Mo, respectively.[11]

IMPORTS AND EXPORTS [12]

Molybdenum ore and concentrates were imported during 1941 and 1942. Total imports in 1942 amounted to 755,950 pounds (molybdenum contained), valued at $554,232, compared with only 4,300 pounds in 1941 (value $2,898). Molybdenum in other forms has not been imported since 1939, when 26,347 pounds contained in ferromolybdenum were received in the United States.

Molybdenum ore and concentrates exported from the United States, 1941–42, by countries [1]

Country	1941			1942		
	Pounds		Value	Pounds		Value
	Gross weight	Molybdenum content		Gross weight	Molybdenum content	
Canada	974,321	500,402	$400,706	1,939,801	1,027,372	$816,280
Chile	30,255	15,000	12,000			
U. S. S. R.	4,715,284	2,367,492	1,777,185	10,339,064	6,107,213	3,960,079
United Kingdom	9,625,391	4,757,436	3,189,476	9,182,495	4,482,932	3,182,303
	15,345,251	7,640,330	5,379,367	21,461,360	11,617,517	7,958,662

[1] Information from exporters indicates that figures from Department of Commerce may include molybdenum oxide or other compounds.

[10] Roush, R. W., NE Alloy Steels: Steel, vol. 112, No. 9, March 1, 1943, pp. 94, 96, 98, 135–137.

[11] The development of NE steels and their properties are discussed in considerable detail in Steel, beginning with the issue of February 9, 1942.

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

WORLD PRODUCTION

Canada.—Most of the molybdenum produced in Canada during 1942 came from Quebec, but small amounts were also obtained from British Columbia and Ontario.

The Moss mine [13] of the Quyon Molybdenite Co. is in Onslow Township (Pontiac District), Que., about 33 miles west of Ottawa. The molybdenite is disseminated, generally as small flakes, through a granitic mass. From 1916 to early 1919, concentrates containing 765,091 pounds of MoS_2 were produced, and the property was the world's leading individual molybdenite producer. In 1938 development was revived. Ore reserves were estimated at 30,000 tons containing 0.53 percent MoS_2 in 1941. A 150-ton mill and smelter were built in that year, and roasted molybdenite (molybdenum oxide) briquets are the shipping product.

Siscoe Metals, Ltd., took over operation of a property in La Corne Township (Abitibi District), near Amos, Que., for the Wartime Metals Corporation, a Canadian Government agency. The mine was dewatered to the 250-foot level, and a 150-ton mill was started. The ore is reported to grade somewhat less than 0.5 percent MoS_2, and reserves were given as 40,000 tons in old reports.

In Preissac Township (Abitibi District), about 400 miles northwest of Quebec City, the Dome Exploration Co., located a molybdenite deposit in an area in which unsuccessful efforts were made during World War I to develop commercial ore bodies. Eardley-Wilmot,[14] describing the deposits in this area, states that they are mostly fissure-vein types. Drilling in 1942 indicated an ore zone at least 400 feet long and 200 feet wide, with an average width of 30 feet. The grade ranges from 0.245 to 1.188 percent Mo, and the average is approximately 0.92 percent. The company was awarded a substantial contract by the Canadian Government and at the end of 1942 was proceeding with construction of roads, camps, and a 500-ton mill. Production is considered a likelihood by the spring or summer of 1943.

The Phoenix property of the Zenith Molybdenite Corporation, Ltd., in Bagot Township, Renfrew County, Ont., is to be operated by the Wartime Metals Corporation. A small production was realized from this property during World War I. The mill will be rehabilitated and operated as a custom plant for the district.

Other molybdenum deposits, too numerous to mention, in Quebec, Ontario, and British Columbia were under investigation.

French Morocco.—The Azegour molybdenite deposit,[15] 50 miles southwest of Marrakech, in western Morocco, was first noted about 20 years ago. Small shipments were made in 1929, 1930, and 1932. A 100-ton mill was erected by the Société Le Molybdène in 1933. The mill heads were stated to average 1.08 percent MoS_2 and 0.05 percent Cu. In 1941, von der Weid [16] published a monograph on the deposit.

Azegour is unusual in being one of the few contact metamorphic

[13] Eardley-Wilmot, V. L., Molybdenum: Canada Mines Branch Rept. 592, 1925, pp. 150–155.
Chubb, W. F., Molybdenum Production in Canada: Metal Ind. (London), vol. 60, No. 14, April 3, 1942, pp. 236–237.
Wilson, M. E., Numerous Deposits of Molybdenite Known: Northern Miner, vol. 28, No. 14, June 25, 1942, pp. 32 and 39.
[14] Eardley-Wilmot, V. L., Work cited in footnote 13, pp. 125–131.
[15] Described in Bureau of Mines Minerals Yearbook, 1934, p. 433.
[16] von der Weid, F., Le gisement de molybdénite d'Azegour et la région des Guedmioua (Atlas de Marrakech, Maroc): Librairie de l'Université, Geneva, 1941, 88 pp.

molybdenite deposits in which there are commercial quantities of ore. The molybdenite occurs almost exclusively in garnetized limestones near the contact with granitic intrusions. The ore mineral is localized in interstices of the garnet rocks and in fractures.

According to statistics given by von der Weid the concentrates shipped from 1932 to 1938, inclusive, averaged 82.4 percent MoS_2, and the total content of molybdenum was 516.5 metric tons. It was reported in the press that in 1939 the output was about 250,000 pounds of molybdenum. "Small amounts" were said to have been exported in 1942.[17]

Manchuria.—Discovery of molybdenum at the Yangchiachantze properties of the Manchuria Lead Mining Co. in Chinchow Province was reported in 1939. The deposit was described as having a vein "several yards wide and about 100 yards long," with a metal content of 0.5 percent. In 1942 there appeared a news item [18] to the effect that as a result of intensified exploitation of the molybdenum deposits at Mienchiatzu and operation of a large "ore preparing and refining plant" the company was providing "equivalent to one-tenth the world's production" and hoped soon to be second to Climax.

Norway.—For some years before 1934, Norway was the second-largest molybdenum producer in the world. Since then, as far as available official statistics show, Mexico has occupied this rank. However, it was claimed recently that "Norway's production * * * in 1940 was 900 tons (fine)."[19] This figure indicates that in 1940 Norway again ranked second.

The Knaben deposits, 40 miles east of Stavanger, are the principal sources of production. Molybdenite occurs in veins and disseminated in granitic rocks in a zone several kilometers long and a few hundred meters wide. The ore mined in 1940 averaged 0.2 percent MoS_2, according to Quittkat,[20] who described the milling process.

Early in March 1943 it was reported than an R. A. F. attack on the Knaben mill had damaged, and probably destroyed, the whole plant.[21]

World production of molybdenum in ores and concentrates, 1938–42, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942
Australia [1]	32	39	20	10	8
Canada [1]	3	[3]	5	46	36
Chile		30	267	229	[5] 614
Mexico	483	523	310	522	855
Morocco, French (exports)	94	[4]	[4]	[4]	[4]
Norway	462	433	[4]	[4]	[4]
Peru	85	167	190	148	[5] 219
Turkey	41	[4]	[4]	[4]	[4]
United States	15,103	13,755	15,564	18,217	25,890
Other countries [6]	[6]	[6]	[6]	[6]	[6]
	[7] 16,310	[7] 15,100	[7] 17,100	[7] 19,800	[7] 28,200

[1] Gross weight of ore and concentrates reported; molybdenum content estimated by authors.
[2] Less than 1 ton.
[3] 10 months.
[4] Estimate included in total.
[5] Preliminary figure.
[6] Estimate for Greece, Italy, Rumania, and Yugoslavia included in total; in addition, molybdenum ore is produced in Burma, China, Chosen, Finland, Japan, Manchuria, and U. S. S. R., but data of production are not available.
[7] Partly estimated.

[17] Foreign Commerce Weekly, Mining in French Morocco: Vol. 10, No. 11, March 13, 1943, p. 29.
[18] Metal Bulletin (London), No. 2716, August 11, 1942, p. 12.
[19] Metal Bulletin (London), No. 2774, March 5, 1943, p. 16.
[20] Quittkat, G., Recovery and Dressing of Molybdenum Ores of the Knaben Mine, Norway: Metall u. Erz, vol. 38, 1941, pp. 261–264; Chem. Abs., vol. 36, 1942, p. 3758
[21] Mining Journal (London), vol. 220, No. 5611, March 6, 1943 p. 120.

VANADIUM

By Frederick Betz, Jr., and Alice P. van Siclen

SUMMARY OUTLINE

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SUMMARY

World production of vanadium ores is limited almost entirely to four countries—United States, Peru, Northern Rhodesia, and South-West Africa. The United States displaced Peru as the leading producer in 1941 and increased its lead in 1942 to supply over 50 percent of the total world output. All important sources of vanadium ore are controlled by the United Nations. However, vanadium is also recovered as a byproduct from other ores and raw materials. Significant among the other sources are certain iron ores and crude oils. The Axis countries apparently must rely on such sources, especially iron ores, and Germany is said to fulfill its requirements for vanadium in this manner. In the United States, vanadium ores have been supplemented with phosphate rock and imported vanadium-bearing flue dust to meet increased wartime needs. Titaniferous magnetite may yield future additions, and greatly increased exploitation of phosphate rock for its vanadium content is imminent.

Domestic shipments of vanadium ore in 1942 surpassed the record established in 1941 by 77 percent. More than 90 percent of the output comes from the Colorado-Utah region.

Salient statistics of the vanadium industry in the United States, 1940–42

	1940	1941	1942
Ores and concentrates (vanadium contained):			
Mine shipments—pounds	2,162,916	[1] 2,513,051	4,439,130
Value [2]	$1,044,100	[1] $1,179,500	$2,468,100
Mill products [3] (vanadium contained):			
Produced—pounds	1,548,133	1,853,655	2,655,784
Shipped—do	1,204,102	2,052,886	2,508,632
Value [2]	$2,350,500	$3,968,800	$4,890,800
Ore, concentrates, and vanadium oxide:			
Imports—short tons	22,551	12,323	18,246
Vanadium contained—pounds	2,574,951	2,138,608	2,422,376
Value	$1,216,705	$1,012,991	$1,274,483
Exports—short tons	[4]	28	37
Vanadium contained—pounds	[4]	25,462	22,140
Value	[4]	$63,213	$86,218
Vanadium-bearing flue dust:			
Imports—short tons	[5]	[5]	312
Vanadium contained—pounds	[5]	[5]	154,028
Value	[5]	[5]	$29,545

[1] Revised figure.
[2] Estimate by Bureau of Mines.
[3] Vanadium oxide (termed fused vanadium oxide, red cake, sodium vanadate) from domestic ores only.
[4] Data not available.
[5] Not recorded.

WAR REGULATIONS

The War Production Board placed vanadium deliveries under allocation on December 20, 1941 (Order M–23–a). Melting of vanadium was made subject to approval of the melter's schedule in an amendment to Order M–23–a on June 23, 1942. This amendment also lowered the limit of unrestricted deliveries of vanadium from 50 to 10 pounds per month. A further amendment, issued December 26, defined vanadium as including ores and concentrates, primary vanadium compounds, vanadium alloys, and waste products (such as flue dust); ferrovanadium producers are exempt from melting restrictions and may freely acquire vanadium-bearing raw material; no authorization is required for melting 10 pounds of vanadium or less per month.

MARKET AND USES

The nominal price of 27½ cents per pound of V_2O_5 contained has been quoted for vanadium ore since early in 1925, but there is a market by grades among mill operators. The average value of shipments, estimated from data collected by the Bureau of Mines, was 31 cents per pound in 1942, and prices as high as 50 cents were reported in sales to Metals Reserve Co. agencies. Vanadium pentoxide (technical grade) was priced at $1.10 per pound of V_2O_5 contained, and ferrovanadium was sold for $2.70 to $2.90 per pound of V contained.

Vanadium is generally extracted from ores and concentrates, the first stage of recovery being completed in the production of vanadium pentoxide (85 to 90 percent pure). This product is consumed largely as a raw material in the manufacture of ferrovanadium but also has a wide variety of applications, especially in chemical industries.[1] Ferrovanadium, containing 35 to 40 percent V in the normal domestic grades, is the principal means of introducing vanadium into tool steels and high-strength iron and steel forgings. The Bureau of Mines estimates that over 80 percent of the vanadium consumed is in the form of ferrovanadium. Figures of the War Production Board indicate that more than 60 percent of the total vanadium consumption is in tool steel, whereas nonmetallurgical uses absorb only 1 to 2 percent.

UNITED STATES

PRODUCTION IN 1942

The center of domestic vanadium-ore mining is in the Colorado-Utah region. A small output is realized in Arizona and Nevada, and vanadium-bearing phosphate rock is mined in Idaho. Production seems assured in the near future from the phosphate rock deposits in Wyoming, and recovery of vanadium from magnetite concentrates produced in New York is a possibility.

The Colorado-Utah vanadium-ore region is an area comprising southwestern Colorado, southeastern Utah, and extending into northern Arizona. In recent years production has been limited to only a small part of the vanadium-ore region. Burwell[2] states that

[1] Alexander, J., Vanadium and Some of Its Industrial Applications: Chem. and Ind., vol. 48, 1929, pp. 871–878; 895–901.

[2] Burwell, Blair, Vanadium Output Indicates Vigorous Progress: Min. Cong. Jour., vol. 29, No. 2, February 1943, pp. 27–29.

during 1942 the principal producers, in cooperation with Government agencies, prepared for the development of other areas by building roads (of which 300 miles were completed), by opening ore-purchasing depots to provide a market for small producers, and by establishing plants near the newly opened areas to treat ore from hitherto untouched and former marginal deposits. The principal problem in mining is the interpretation of ore structures and, corollary thereto, the following of the irregular course of the deposits.

The deposits occur principally in the Morrison formation, but those at Rifle and Placerville, Colo., are found in the Entrada sandstone. According to Fischer:[3]

> The deposits in the Entrada sandstone are commonly referred to as the "vanadiferous sandstone deposits," or "roscoelite deposits," as they contain only a trace of uranium. The deposits in the Morrison formation, on the other hand, are generally referred to as the "carnotite deposits," a term that has been carried over from the time of the earlier operations, when carnotite was the desired mineral because of the uranium and radium it contained. These deposits, however, contain several times as much vanadium as uranium, and the bulk of the vanadium is apparently in the same mineral form as in the deposits in the Entrada sandstone.
>
> The principal vanadium mineral is micaceous, and it has heretofore been thought to be roscoelite, the vanadium mica; but, as a result of recent X-ray studies * * * it is now thought to belong to the imperfectly understood hydrous mica group of clay minerals. * * * The vanadium-bearing hydrous mica forms an aggregate of minute flakes, coating the sand grains. * * * Where the sandstone was more strongly mineralized, the pore spaces are completely filled with the vanadium mineral. This mineral imparts to the sandstone a gray or greenish-gray color, which darkens as the vanadium content increases.

The "carnotite ores" were mined principally for their uranium and radium content from 1911 to 1923, but some vanadium was recovered as a byproduct from 1915 to 1923. With the advent of other sources of radium, mining of these ores was greatly curtailed. Since 1937 the production has been resumed on a larger scale, now primarily for the vanadium content. The "roscoelite ores" were mined from 1909 to 1923 and 1925 to 1932, and since 1941.

The principal producers in 1942 were the United States Vanadium Corporation, which operates mills at Uravan and Rifle, Colo., and is the operator for the Metals Reserve Co. of a mill at Durango, Colo., and the Vanadium Corporation of America, with a mill at Naturita, Colo., and one operated for the Metals Reserve Co. at Monticello, Utah. The Rifle, Durango, and Monticello mills began producing vanadium oxide during 1942. Ores were also milled by North Continent Mines, Inc., at Cedar, Colo.; the Nisley & Wilson Vanadium Mill at Gateway, Colo.; and the Blanding Mines Co., Blanding, Utah.

In Arizona vanadium is recovered as sodium vanadate from complex (gold-silver-lead-molybdenum-vanadium) ore by Mammoth-St. Anthony Ltd., at Tiger, Pinal County. The vanadium-ore minerals are vanadinite and descloizite. The process employed in recovering calcium molybdate and sodium vanadate is described in the chapter of this volume on Molybdenum.

Since 1923 the Anaconda Copper Mining Co. has mined phosphat rock at Conda, Caribou County, Idaho.[4] The rock, which is said to

[3] Fischer, R. P., Vanadium Deposits of Colorado and Utah—A Preliminary Report: Geol. Surv. Bull. 936-P, 1942, pp. 363-394.

[4] Mining World, Mining Phosphate in Idaho (Conda Operations of the ACM Company): Vol. 4, No. 10, October 1942, pp. 3-8.

contain 0.3 percent V_2O_5 (or about 0.16 percent V),[5] is treated at the Anaconda reduction works in Montana for the manufacture of superphosphate. It was not until 1941 that a byproduct recovery of the vanadium in the form of "red cake" (vanadium oxide containing approximately 90 percent V_2O_5) was effected. The fundamental recovery process was evolved by the A. R. Maas Chemical Co. and patented in 1935, according to F. C. Bowman of that company,[6] who states that "The Anaconda Copper Company adopted the process and after considerable developmental research put it into commercial operation in 1941." The process in use now is summarized briefly as follows:[7]

> The rock is treated with sulphuric acid, primarily for the purpose of leaching out the phosphoric acid. At the same time, approximately 65 percent of the vanadium contained in the rock goes into solution together with the phosphoric acid. This is precipitated as phospho-vanadic acid by treating the solution with sodium chlorate. The yellow crystalline precipitate is separated by settlement. It contains phosphorus, iron, alumina, lime, and other impurities. By treatment with milk of lime and soda ash under carefully controlled conditions, the vanadium is obtained in a substantially pure sodium vanadate solution, from which vanadium pentoxide, V_2O_5, is precipitated by the addition of sulphuric acid.

EXPLORATION AND DEVELOPMENT

The vanadium resources in phosphate rock are attaining greater potential significance. The Federal Geological Survey announced in February 1943 that, as a result of studies begun in 1939, millions of tons of ore containing small percentages of vanadium had been discovered in southeastern Idaho and southwestern Wyoming in the same phosphate rock formation now mined at Conda, Idaho. The particular achievement was the discovery of an extensive shale horizon in the Phosphoria formation carrying commercial quantities of vanadium in a very finely divided state. The Bureau of Mines participated in the exploratory work in the Sublette and Afton areas of Wyoming and the Paris-Bloomington area of Idaho during 1942 and is continuing its investigations in 1943. Research on the metallurgical treatment of the ore has also been carried on to determine the best method of extracting vanadium. The Metals Reserve Co. contracted with the Homestake Mining Co. to develop these vanadium deposits. The work is being done by the Wyodak Coal & Manufacturing Co., subsidiary of the Homestake company.

An interesting mining development during 1942, which may affect the vanadium supply of the United States, was the reopening of the Lake Sanford titaniferous magnetite deposits in the Adirondack region of New York by the National Lead Co. The project, known as the MacIntyre development, was undertaken to provide a new domestic source of titanium for the manufacture of pigments. The ores of this region have long been known to contain small percentages of vanadium,[8] but no commercial recovery has been made to date. Hagar [9] describes the ore body at Lake Sanford as consisting of "irregular fine-grained masses of mixed ilmenite and magnetite distributed in an anorthosite country rock." The vanadium is contained

[5] Engineering and Mining Journal, Vanadium from Phosphate Rock: Vol. 143, No. 10, October 1942, p. 61.
[6] Oil, Paint and Drug Reporter, Phosphate Vanadium: Vol. 142, No. 16, October 19, 1942, pp. 4 and 73.
[7] Work cited in footnote 5.
[8] Kemp, J. F., The Titaniferous Iron Ores of the Adirondacks: Geol. Surv. 19th Ann. Rept., part III, 1897–98, pp. 377–422.
Walz, I., On the General Occurrence of Vanadium in American Magnetites: Am. Chemist, vol. 6, No. 12, June 1876, pp. 453–456.
[9] Hagar, I. D., The MacIntyre Development—New Source of Titanium: Eng. and Min. Jour., vol. 143, No. 12, December 1942, pp. 47–49.

in the magnetite; the content is 0.35 percent.[10] The plans call for mining about 4,500 short tons of ore daily, with a production of 900 tons of ilmenite concentrate and 1,800 tons of magnetite concentrate. The magnetite and ilmenite are associated in a mechanical mixture, according to Hagar, permitting ready separation of the ore minerals.

The recovery of vanadium from the Lake Sanford magnetite was the subject of an investigation by the Bureau of Mines, the National Lead Co., and the University of Minnesota.[11] According to the report on the investigation:

(p. 2) It appears that most of the vanadium in this ore can be recovered in pig iron, which can be blown in a converter to produce a slag containing vanadium in amounts suitable for the production of ferrovanadium. * * *

(p. 23) A recovery in the metal of 87.3 percent of the vanadium was obtained during the operation of the experimental blast furnace on burdens composed of iron ore and titaniferous sinter containing 11.1 percent TiO_2 and 0.26 percent vanadium. Approximately 4 percent of the vanadium was lost in the slag. These results show that the oxides of vanadium are reduced readily under blast-furnace conditions.

The potential annual recovery of vanadium from the Lake Sanford ore has been estimated at about 3,000,000 pounds in the form of ferrovanadium.[12]

Wood, Joseph, and Cole [13] call attention to several recent foreign experiments on methods of recovering vanadium from iron ore and slags. A more extensive review of recent literature on vanadium recovery, emphasizing especially Russian and German metallurgical work on these sources of vanadium, was prepared during 1942 by Lathe [14] of the National Research Council of Canada.

IMPORTS AND EXPORTS [15]

In 1941 imports of vanadium ore and concentrates were obtained almost exclusively from Peru and totaled 24,645,686 pounds with a vanadium content of 2,138,608 pounds. Other sources, especially South-West Africa, augmented the supply of vanadium in 1942, as is shown in the following table.

Vanadium ore and concentrates and vanadium-bearing flue dust imported for consumption in the United States in 1942, by countries

Country	Ore and concentrates			Vanadium-bearing flue dust		
	Pounds		Value	Pounds		Value
	Gross weight	Vanadium content		Gross weight	Vanadium content	
Canada				370,217	73,074	$15,554
Curaçao (N. W. I.)				125,303	11,818	9,835
Peru	31,610,284	2,053,399	$979,037	128,903	69,136	4,156
South-West Africa [1]	4,881,984	368,977	295,446			
	36,492,268	2,422,376	1,274,483	624,423	154,028	29,545

[1] Reported by Department of Commerce as Union of South Africa.

[10] In 1922, F. L. Nason (The Importance of the Iron Ores of the Adirondack Region: Am. Iron and Steel Inst. Yearbook, 1922, New York, pp. 168–207) published a complete typical analysis of the Lake Sanford ore. The crude ore was reported to contain 0.35 percent V_2O_5 (or 0.196 percent V), and the concentrates gave 0.47 percent V_2O_5 (or 0.26 percent V).

[11] Wood, C. E., Joseph, T. L., and Cole, S. S., Smelting of Vanadium-Bearing Titaniferous Sinter in an Experimental Blast Furnace: Bureau of Mines Rept. of Investigations 3679, 1943, 24 pp.

[12] Mining and Contracting Review, MacIntyre Development—Historic Mine Reopened: Vol. 44, No. 13, July 15, 1942, pp. 7 and 17.

[13] Wood, C. E., Joseph, T. L., and Cole, S. S., Work cited in footnote 11, pp. 3–5.

[14] Lathe, F. E., Review of Recent Literature on Vanadium Recovery with Special Reference to Vanadium Iron Ore: Nat. Res. Council Canada, N. R. C. No. 1075, June 1942, 32 pp.

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

All exports of vanadium ore and concentrates in 1942 went to Canada. The total was 73,542 pounds (vanadium contained, 22,140 pounds), valued at $86,218.

WORLD PRODUCTION AND DEVELOPMENTS

Canada.—Canada does not produce any vanadium ores. According to Bateman,[16] small amounts of vanadium are recovered from soot and ashes collected from oil-burning vessels. The Metal Controller's Office presented a schedule of prices for vanadium-bearing petroleum soot. The schedule is quoted as this source of vanadium has gained some importance recently. The prices in Canadian currency, per pound of contained V_2O_5, f. o. b. Castleton, N. Y., by grades, follow: 5 to 7.9 percent V_2O_5, 43 cents; 8 to 10.9 percent, 46 cents; 11 to 13.9 percent, 49 cents; 17 percent and more, 54 cents.[17] Bateman stated that open-hearth slags of the Dominion Iron & Steel Co. at Sydney, Nova Scotia, contain enough vanadium (which he believes could be recovered) to meet Canadian needs, if necessary. The slags[18] are derived from Newfoundland (Wabana) iron ores used at Sydney. Vanadium was found in titaniferous magnetites examined by the Ontario Department of Mines in Papineau Township, Ont., during 1942. Grab samples assayed 0.63 to 0.99 percent V_2O_5.[19]

Germany.—Extensive research on recovery of vanadium from iron ores has been reported from Germany. It is generally assumed that the vanadium supply is derived from this source, but no positive knowledge of the output is indicated in published reports. Planner[20] states that German ores yield the greater part of that country's requirements of over 10,000 tons of vanadium annually, produced in the form of an iron-vanadium alloy by conversion of slag. The stated requirements are striking, as they exceed the entire world production of vanadium from ores and probably from all other raw materials; also, they represent a very marked increase over German consumption in earlier years. Zieler[21] reported that the consumption was estimated at about 150 metric tons of vanadium contained in ferrovanadium in 1934, and at 300 to 400 tons in 1937, and that a considerable increase was indicated in 1938.

Northern Rhodesia.—Vanadium is the principal product, in terms of value, now recovered from the Broken Hill lead-zinc-vanadium deposit.[22] The ores, occurring in a series of steeply dipping lenses replacing dolomite, are roughly zoned, the rich vanadium ores being developed largely in the broken ground between the massive oxidized ores and the dolomite, as well as in fissures. The vanadium-ore

[16] Bateman, G. C., Canadian War Metals Developments: Min. and Met. Soc. Bull. 267, vol. 36, No. 1, January 1943, pp. 3–15. Also published under title, The Canadian Mining Industry in Wartime: Trans. Canadian Inst. Min. and Met., vol. 46, March 1943, pp. 71–79.

[17] Northern Miner, Prices for War Metals Schedule Announced: Vol. 28, No. 49, February 25, 1943, pp. 1, 4, and 5.

[18] Northern Miner, Vanadium Sought: Vol. 28, No. 32, October 29, 1942, p. 6.

[19] Northern Miner, Titaniferous Iron Find Reported: Vol. 28, No. 36, November 26, 1942, p. 9.

[20] Planner, Bernard, P., Emergency Production Methods Used by the German Iron and Steel Industry: Min. and Met., vol. 23, No. 429, September 1942, p. 466.

[21] Zieler, Hans, Die Gewinnung von Vanadin aus deutschen Rohstoffen: Stahl u. Eisen, vol. 58, No. 28, July 14, 1938, pp. 749–756.

[22] Deans, T., The Mineral Resources of Northern Rhodesia: Bull. Imp. Inst., vol. 40, No. 4, October-December 1942, pp. 295–306.

minerals are descloizite and vanadinite. Vanadium-bearing laterite in many places containing 3 percent V, is also mined at the surface. The export of vanadium ore was begun in 1921. Facilities for producing fused vanadium oxide were put into operation in 1930. The ore treated in the vanadium plant averaged 1.41 percent V in 1939. Proved reserves in June 1940 at Broken Hill were 2,400,000 tons of oxidized ore containing 0.83 percent V_2O_5, or approximately 11,200 tons of vanadium. The Camarnor vanadium deposit, 20 miles northeast of Broken Hill, has been worked on a small scale only.

Peru.—Peru has been an important source of vanadium for many years. From 1938 to 1940, inclusive, and in several earlier years it was the largest producing country in the world. Principal source is the famed Mina Ragra of the Vanadium Corporation of America in the Andes near Ricran, Department of Junin. The vanadium ore occurs associated with asphalt and was first prospected as a source of fuel for the Huaraucaca smelter, but because of the sulfur content the mine was abandoned. In 1905, Rizo Patron, the smelter manager, discovered that this carbonaceous material was rich in vanadium, and steps were taken immediately to explore the property. Patronite, the vanadium sulfide (named after its discoverer), was abundant in the deposit but is now virtually mined out. The remaining ore is largely a red calcium vanadate which carries up to 50 percent V_2O_5, occurring in pockets and filling cracks or fissures in the shales. The ore is surface-mined from an open pit 650 meters long and 360 meters wide. Operations at the reduction plant include roasting, lixiviation, precipitation, filtering, and drying. In the past, concentrates averaging 15 percent V and ores including ashes averaging 4 to 5 percent V were exported, but it is planned to ship only higher-grade concentrate or precipitate with about 50 percent V content, to reduce the volume of shipping space required as well as freight charges. During 1942 a new treatment plant with a daily capacity of 200 tons of lower-grade ore was under construction, which, with the 80-ton plant already in operation, would permit doubling the output. Total ore reserves are estimated at somewhat less than 500,000 tons, consisting of 27 percent "veta madre" ore with 4 percent V, 40 percent "broza" ore with 0.9 percent V, and the remainder flotation and leached tailings and a small tonnage of oxide dumps averaging 0.7 percent V. The total vanadium content of this ore is said to exceed 6,000 tons.[23] A minor source of vanadium is the vanadiferous ashes derived from asphaltites; the largest deposits of this material are at Yauli, Department of Junin, where the asphaltite was used at one time as a coal substitute. The V_2O_5 content of the ash may be as high as 20 percent, but ordinarily it is much lower.[24]

South-West Africa.—Vanadium deposits of distinctive character are numerous in the Otavi Mountains of northern South-West Africa over a distance of some 60 miles between Uris and Berg Aukas.[25]

[23] Mineral Trade Notes, Bureau of Mines, Mineral Industries of Peru: Spec. Suppl., Confidential Series, No. 6, December 1942, pp. 12–13.

[24] *See also:*
Baragwanath, John G., The Vanadiferous Asphaltites of Central Peru: Eng. and Min. Jour., vol. 111, 1921, pp. 778–781.
Hess, Frank L., Vanadium: Bureau of Mines Inf. Circ. 6572, April 1932, pp. 4–5.
Hewett, D. F., Vanadium Deposits in Peru: Am. Inst. Min. and Met. Eng., vol. 40, 1910, pp. 274–288.

[25] Clark, A. W., The Ore Deposits of the Otavi Mountains, South-West Africa: Min. Mag., vol. 44, No. 5, May 1931, pp. 265–272.
Krusch, P., Die metallischen Rohstoffe, vol. 1, Vanadin, Uran, Radium: Verlag F. Enke, Berlin, 1937, pp. 41–44.
Stahl, A., Die Vanadinlagerstätten Afrikas, insbesondere S. W.-Afrikas: Metallwirtschaft, vol. 21, No. 19, May 15, 1942, pp. 297–299.

The first discovery was made at Tsumeb-West before World War I. After the war, search revealed many other occurrences, including that of Abenab in 1921, which proved to be one of the largest vanadium deposits in the world.

The copper-lead-zinc vanadates of the Otavi region occur in a thick, folded series of dolomites and limestones. Cavities ("sandsacks") in the country rock are filled with lumps of vanadates (mainly descloizite and cuprodescloizite), blocks of silicified dolomite, and red dune sand. The vanadates also encrust the dolomite blocks and walls of the cavities and penetrate as veinlets into the adjacent country rock. Some of the "sandsacks" are the weathered outcrops of ore-bearing pipes or sink holes, but others show no ore below the cavities. The ore bodies are highly variable in size. The Abenab pipe deposit is 200 by 120 feet at the surface, but the Uris is only 50 to 60 feet across and the majority are considerably smaller. The crude ore contains 2 to 3 percent V_2O_5.

Abenab and another deposit operated by the Southwest Africa Co. are now producing 300 tons of concentrates (averaging 18 percent V_2O_5) a month. In earlier years this company produced also at Baltika, but the deposit was exhausted in 1939. The depletion of present reserves may be counteracted by further development work or discoveries. The Otavi Minen- und Eisenbahn-Gesellschaft formerly operated the Tsumeb and Uris deposits. The company suspended operations in September 1940. Subsequently it was reported that the South African Government would assume operation of the company properties. Shipments were made in 1942, and the production rate is reported as 40 to 60 tons per month of 10.5-percent V_2O_5 concentrates. The Karavatu deposit is apparently the source of present output from the Otavi holdings.

The total output from South-West Africa since 1920 has been over 65,000 short tons of concentrates or more than 6,500 tons of contained vanadium.

Venezuela.—The soot of Venezuelan oils, especially from Maracaibo, contains as much as 34 percent V_2O_5.[26] During 1942 several thousand pounds of soot were shipped by oil companies, which obtain the product from smokestacks of their tankers and power plants.

World production of vanadium in ores and concentrates, 1938–42, in metric tons

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942
Argentina		15	1	6	(1)
Mexico	101	83	32	(2)	
Northern Rhodesia	374	384	(1)	(1)	(1)
Peru	826	996	1,214	1,017	[3] 1,008
South-West Africa	557	514	428	269	(1)
United States (shipments)	732	900	981	[4] 1,140	2,014
	2,590	[3] 2,890	[3] 3,060	[3] 2,800	[3] 3,800

[1] Data not available; estimate included in total.
[2] Less than 1 ton.
[3] Preliminary figure; subject to revision.
[4] Revised figure.

[26] Iron and Coal Trades Review, The Ferro-Mineral Resources of South America: Vol. 145, No. 3892, October 2, 1942, pp. 889–892.

TUNGSTEN

By H. W. Davis

SUMMARY OUTLINE

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SUMMARY

Stimulated by greatly increased needs for tungsten in the military program and by higher prices, production of tungsten concentrates and high-grade sorted ore in the United States, despite the shortage of labor at many mines, reached a new peak in 1942. The labor shortage was relieved somewhat when the Army released some soldiers for work in tungsten mines. Domestic production was 9,433 short tons (60 percent WO_3 basis) in 1942, or 40 percent more than in 1941, the previous record year. Virtually the entire gain was contributed by California, Idaho, and Nevada, as output in all other producing States (except Texas) declined. The combined production in California, Idaho, Nevada, and Texas increased 54 percent over 1941; that in the remaining producing States decreased 37 percent. Three operators—one each in California, Idaho, and Nevada—accounted for 70 percent of the total 1942 output. The Yellow Pine mine in Idaho, which made its initial production in 1941, rose to be the second-largest producer in the United States in 1942. Probably more prospecting and developing were done on domestic tungsten-ore deposits during 1942 than in any other single year. New mills were completed at several mines.

Salient statistics of tungsten ore and concentrates in the United States, 1941–42

	1941		1942	
	Short tons, 60 percent WO_3	Value	Short tons, 60 percent WO_3	Value
Domestic production	6,746	(1)	9,433	(1)
Shipments from domestic mines	6,567	$9,223,726	9,333	$13,508,266
Imports:				
General (receipts)	13,820	(1)	15,851	(1)
For consumption	12,107	11,231,313	14,715	(1)
Stocks at consumers' plants, Dec. 31	2,527	(1)	3,590	(1)

[1] Figures not available.

Notwithstanding shipping difficulties, receipts of imported ore and concentrates increased 15 percent over 1941 to an all-time high of 15,851 short tons (60 percent WO_3 basis) in 1942. Of the 1942 total, Argentina supplied 17 percent, Bolivia 43 percent, and China 30 percent.

Consumption of tungsten ore and concentrates also reached a new peak in 1942 and amounted to 18,300 short tons (60 percent WO_3 basis), a gain of 5 percent over 1941.

To aid further in stimulating the domestic production of tungsten, the Metals Reserve Co. announced on April 22, 1942, that its domestic price policy of $24 per dry short-ton unit of WO_3 would remain in effect until December 31, 1943. In November 1942 the price was increased to $30 a unit.

Figure 1 shows trends in domestic shipments, imports, and prices of tungsten ore and concentrates since 1915.

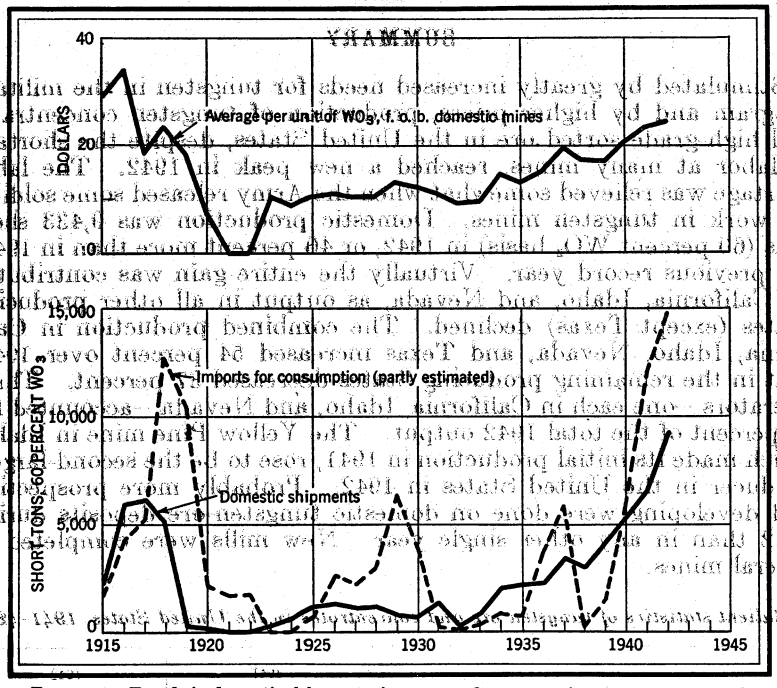

FIGURE 1.—Trends in domestic shipments, imports, and average price of tungsten ore and concentrates, 1915–42.

GOVERNMENT EXPLORATION

Continuing its search for strategic minerals, the Bureau of Mines investigated deposits of tungsten in Idaho, Colorado, Nevada, Wyoming, New Mexico, and Alaska during 1942. Exploration was continued at the Ima mine in Lemhi County, Idaho, in the Boulder County (Colo.) field, and at the Riverside mine at Hyder, Alaska. A substantial tonnage of low-grade ore was indicated by trenching and diamond drilling at the Tungstonia deposit in White Pine County, Nev. Surface trenching and diamond drilling on the properties of the North Tem Piute Mining & Development Co. and Tem Piute Mining Co. in Lincoln County, Nev., indicated a fairly large tonnage of low-

grade ore. At the property of the Tungsten Mining Co. at Cherry Creek, White Pine County, Nev., five scheelite lenses were explored by trenching and diamond drilling that indicated a substantial tonnage of low-grade ore. In New Mexico, exploration work was done on the Iron Mountain tungsten deposits in Sierra County. In the West Tintic district, Utah, diamond drilling and underground work indicated that a small production of tungsten ores will be available. The Romur tungsten property in Fremont County, Wyo., presents the possibility of opening up an entirely new tungsten-mining district. Exploration was begun on this property in November 1942. A limited program of trenching, sinking shallow shafts, and drifting underground by the Bureau has indicated that this district may contribute a large tonnage of tungsten.

The Geological Survey continued and expanded examination of domestic tungsten deposits as part of its program of investigations of strategic-mineral deposits. Altogether, over 100 separate areas, including more than twice that number of individual deposits, were examined, many of them at the request of various other Government agencies. This work was distributed over all of the Western States, Alaska, and, in the latter part of the year, northern Mexico. A number of the more promising deposits were studied in detail, and some other districts previously examined were reviewed. In several districts, Survey geologists collaborated with the Bureau of Mines on exploration projects; among these were Boulder County, Colo.; Seven Devils, Idaho; Cherry Creek, Tempiute, and Tungstonia, Nev.; Darwin, Calif.; and Hyder, Alaska. Reports on earlier work at Silver Hill, Wash., and in the Nightingale district, Nev., were published in 1942.

PRICES

Quotations on tungsten ore and concentrates were steady throughout 1942. According to the Engineering and Mining Journal, Chinese, Bolivian, and Portuguese ore was quoted at $24 a short-ton unit of WO_3, duty paid, and domestic scheelite, in carlots, delivered, at $26 a short-ton unit. The buying price of Metals Reserve Co. for domestic ore and concentrates from "eligible" producers was $24 a short-ton unit until November 19, 1942, when it was increased to $30. The average price for the domestic concentrates and high-grade sorted ore shipped in 1942, as reported to the Bureau of Mines, was $24.12 a short-ton unit of WO_3.

DOMESTIC PRODUCTION

Spurred by the need for tungsten to successfully prosecute the war, production of tungsten concentrates and high-grade sorted ore in the United States gained 40 percent over 1941 to reach an all-time high of 9,433 short tons (reduced to an equivalent of 60 percent WO_3) in 1942. The ore was obtained from a large number of widely scattered operations in Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, Texas, Utah, and Washington. However, California, Idaho, and Nevada supplied 93 percent of the total output, and three operators (one in each of these States) produced 70 percent of the United States total. California, which displaced Nevada as the principal producing State in 1940, maintained its rank in 1942.

In addition to the output of 9,433 tons of concentrates and high-grade sorted ore, a considerable tonnage of low-grade concentrates,

which require further milling, was produced in 1942; these concentrates have been or will be shipped to the re-treatment plant of Metals Reserve Co. at Salt Lake City, Utah, which was expected to begin operating in April 1943. The resultant high-grade concentrates recovered from this material will be included in later production and shipment figures.

Tungsten ore and concentrates produced and shipped in the United States, 1941–42, by States

State	Produced				Shipped from mines			
	1941		1942		1941		1942	
	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units
Alaska	26	1,590	(1)	(1)			(1)	(1)
Arizona	280	16,793	209	12,531	277	16,602	219	13,141
California	2,704	162,229	3,495	209,702	2,603	156,203	3,483	208,961
Colorado	646	38,740	380	22,810	631	37,839	376	22,574
Idaho	663	39,781	2,132	127,934	656	39,381	2,108	126,465
Missouri	3	164			3	164		
Montana	7	415	(1)	(1)	7	415	(1)	(1)
Nevada	2,316	138,983	3,135	188,071	2,289	137,321	3,052	183,126
New Mexico South Dakota	3	170			3	170		
Texas			(1)	(1)			(1)	(1)
Utah	30	1,802	30	1,786	30	1,806	29	1,717
Washington	68	4,103	45	2,695	68	4,103	43	2,590
Undistributed			7	428			23	1,403
	6,746	404,770	9,433	565,957	6,567	394,004	9,333	559,977

[1] Included under "Undistributed."

Tungsten ore and concentrates shipped from mines in the United States, 1938–42

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
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
1941	6,567	6,249,945	9,223,726	23.41	1.48
1942	9,333	8,882,403	13,508,266	24.12	1.52

Alaska.—At the Riverside mine near Hyder, virtually the entire 1942 operating season was devoted to treating slimes from previous operations, from which a small tonnage of concentrates was recovered and shipped. According to J. H. Scott, owner and operator of the mine, these slimes were difficult to treat, but toward the end of the season the metallurgical difficulties were solved. In the mill, 14 additional flotation cells and other equipment were installed. Some underground work was done in the mine, which brought about the discovery of good ore.

Arizona.—Production of tungsten concentrates in Arizona was 181 short tons averaging 69.23 percent WO_3 in 1942, compared with 251 tons averaging 66.90 percent WO_3 in 1941. Shipments were 192 tons averaging 68.44 percent in 1942 and 246 tons averaging 67.49

percent WO_3 in 1941. The output comprised scheelite, wolframite, huebnerite, and ferberite. By far the largest output came from the Boriana mine near Yucca, Mohave County, where wolframite and scheelite concentrates averaging 68.74 percent WO_3 were recovered from milling a 1.05-percent WO_3 ore in 1942. The mining and milling of tungsten ores at the Boriana mine were described recently by Munds.[1] The remainder of the output, which was produced at a number of widely scattered operations, came chiefly from the Tungsten Reef mines in Cochise County, Chloriding and Diff claims in Mohave County, and Morning Star claim in Pinal County.

California.—California maintained its rank as the principal tungsten-producing State in 1942. Shipments of tungsten concentrates (virtually all scheelite) from California totaled 3,334 short tons averaging 62.68 percent WO_3 in 1942, compared with 2,629 tons averaging 59.42 percent WO_3 in 1941. Although tungsten concentrates were shipped from a large number of widely scattered operations, six producers—the Atolia Mining Co. (in San Bernardino County), and the United States Vanadium Corporation, Tungstar Corporation, West Coast Tungsten Co., El Diablo Mining Co., and Bishop Tungsten Corporation (all in Inyo County)—accounted for 3,051 tons, or 92 percent of the State total. The bulk of the remainder was shipped from the Garnet Dike mine in Fresno County; Tungsten City and Victory mines in Inyo County; Stardust and Tungsten Chief mines in Kern County; Quigley mine in Madera County; and Big Jim, Dinuba, and Posey mines in Tulare County.

Production of tungsten concentrates in California was 3,324 short tons averaging 63 percent WO_3 in 1942, compared with 2,747 tons averaging 59 percent WO_3 in 1941. Of the 1942 total, Inyo County supplied 79.9 percent; San Bernardino 14.2 percent; Tulare 1.1 percent; Kern 1.0 percent; and Fresno, Mono, Madera, and Tuolumne Counties together 1.4 percent; the source of 2.4 percent was not reported. The largest producer in California, as well as in the United States, during 1942 was the United States Vanadium Corporation, which operated the Pine Creek mine near Bishop and, in addition, milled ore and tailings from other properties in California and in Nevada; the concentrates recovered from milling ore and tailings from Nevada have been credited in the statistics to that State. The new 1,300-ton concentrating and chemical plant of the company was put into operation the latter part of 1941, and as a consequence production of concentrates increased 77 percent in 1942 over 1941. The milling plant has been described by Burwell.[2] Development done in 1942 at the mine included 16,954 feet of diamond drilling, 2,677 feet of raises, 1,082 feet of crosscuts, and 2,926 feet of drifts. Mine development at the close of 1942 comprised adits and tunnels with sublevels and raises connecting approximately 12,000 feet in main levels and 8,000 feet in sublevels.

The Tungstar Corporation, operating the Tungstar mine near Bishop, completed at a cost of $135,000 a new aerial tramway, having an inclined length of 11,800 feet and a capacity of 100 tons in 8 hours, to transport ore from the mine to the mill. The tramway has been described by Engineering and Mining Journal.[3] The company also

[1] Munds, W. H., Mining and Milling Tungsten Ores at Boriana: Min. Cong. Jour., vol. 28, No. 9, September 1942, pp. 14–16.
[2] Burwell, Blair, Milling Tungsten Ores at Pine Creek: Min. Cong. Jour., vol. 27, No. 10, October 1941, pp. 16–18.
[3] Engineering and Mining Journal, vol. 143, No. 9, September 1942, pp. 64–65.

did 1,300 feet of tunneling and drifting into an ore body containing about 50,000 tons of ore averaging 0.75 to 1 percent WO_3. Work was carried on by sinking below tunnel level of the original ore body, where about 20,000 tons of 1.5- to 2-percent WO_3 ore were developed. The company operated its mill on a one-shift basis for 9 months but was idle 3 months because of its inability to transport ore from the mine. Consequently production of concentrates declined markedly in 1942.

The Adamson mine near Bishop was being developed by Panaminas (Inc.) in 1942. A plant was under construction, two adits were started at the 1,300-foot level, and a jib-back tram to the upper ore bodies was being installed.

During 1942 development was done at many other properties in California, and several new mills were completed, but lack of space precludes giving detailed information.

Colorado.—Production of tungsten concentrates in Colorado declined to 492 short tons averaging 46 percent WO_3 in 1942 from 810 tons averaging 48 percent WO_3 in 1941, and shipments dropped to 491 from 787 tons. Virtually the entire ouptut was ferberite from Boulder County, the greater part of which came from operations of the Wolf Tongue Mining Co. and the Vanadium Corporation of America. The bulk of the remainder came from operations of George H. Teal & Associates, S. W. Shattuck Chemical Co., W. L. & S. H. Tanner, Tom Walsh, and Boulder Tungsten Mills (Inc.). Most of the concentrates produced by George H. Teal & Associates and Boulder Tungsten Mills were shipped to the re-treatment plant at Salt Lake City, Utah, for further milling. A comparatively small quantity of huebnerite was produced in 1942 in San Juan County and a little ferberite in Summit County.

The Wolf Tongue Mining Co. did considerable core drilling (from surface and underground), surface trenching, drifting, and crosscutting but found no additional ore bodies. Core drilling was done at the Dorothy mine of George H. Teal & Associates, and two ore bodies were found to have commercial value. At the Pueblo Belle mine of the S. W. Shattuck Chemical Co. the shaft was sunk from 160 to 360 feet, but no ore was found below the 320-foot level; at the 200-foot level the drift was being extended eastward. Boulder Tungsten Mills (Inc.) completed a mill in mid-1942, which treated ore from its own mines and purchased ore; the company began unwatering and retimbering eight mines.

Idaho.—Production of tungsten concentrates in Idaho increased phenomenally to 2,389 short tons averaging 53.55 percent WO_3 in 1942 from 1,291 tons averaging 30.81 percent in 1941. Shipments of high-grade concentrates were 2,366 tons averaging 53.45 percent in 1942, compared with 1,269 tons averaging 31.03 percent WO_3 in 1941. In addition, 7,023 tons of low-grade flotation concentrates averaging 10.51 percent WO_3 were produced in 1942, of which 5,984 tons averaging 10.56 percent WO_3 were shipped to the re-treatment plant at Salt Lake City, Utah, for further milling. These low-grade concentrates have been omitted from the 1942 statistics, but the resultant high-grade concentrates recovered will be included in later figures.

The chief tungsten-producing mine in Idaho and second-largest in the United States was the Yellow Pine near Stibnite, in Valley County, where tungsten production was begun by the Bradley Mining Co. in August 1941. In 1942 this mine produced and treated 96,861

short tons of scheelite ore averaging 2.61 percent WO_3, which yielded 2,276 tons of high-grade concentrates (52.98 percent WO_3) and 6,905 tons of low-grade concentrates (10.48 percent WO_3). Most of the low-grade concentrates were shipped to the re-treatment plant at Salt Lake City for further milling. About four-fifths of the output in 1942 came from underground workings. During 1942 two Hardinge ball mills (making a total of 4), additional flotation cells (making a total of 12), and auxiliary equipment were installed; as a result, production in 1943 is expected to be double that in 1942, although the grade of ore will be lower. In 1943 at least three-fifths of the output will be from open-pit operations. The Yellow Pine mine has been described recently by Bradley, Mecia, and Baker.[4]

Production at the Ima mine in the Blue Wing district, Lemhi County, was 36 percent less than in 1941. Methods and costs of concentrating huebnerite ores at the Ima mine have been described by Dice.[5]

Tungsten became an important product of the Atlanta Group of claims near Atlanta, Elmore County, in 1942. These claims, operated by Talache Mines (Inc.), are Idaho's chief gold producers, and exploration has revealed tungsten ore in commercial quantities; however, the ore is of low grade in tungsten and could not be mined without its gold and silver content to supplement its tungsten value. One section of the company mill was converted to treat tungsten ore during 1942; 13,675 short tons of scheelite ore averaging 0.15 percent WO_3 were produced and treated, yielding 118 tons of concentrates averaging 12.26 percent WO_3, most of which were shipped to the re-treatment plant at Salt Lake City for further milling.

Montana.—Small quantities of scheelite were recovered from a waste dump in Park County and as a byproduct of placer mining in Powell County in 1942.

Nevada.—Nevada maintained its rank as the second largest tungsten-producing State in 1942. Production and shipments of concentrates (reduced to an equivalent of 60 percent WO_3) were 3,185 and 3,052 short tons, respectively, compared with 2,316 and 2,289 tons, respectively, in 1941. The greater part of the production was scheelite concentrates from operations of the Nevada-Massachusetts Co. and affiliated companies, which operate mills at Mill City, Golconda, and Totlon. Smaller but important producers of concentrates in 1942 were: Nevada Scheelite, Inc., operating the Leonard mine in Mineral County; Tungsten Metals Corporation, operating the Scheelite Chief, Oreble, Everitt, and Silver Bell mines in White Pine County; Lincoln Mines, Inc., operating the Tem-Piute mine in Lincoln County; M. G. L. Mining Corporation, operating the M. G. L. mine in Pershing County; and Getchell Mines, Inc., operating mines in Humboldt County. The concentrates produced by Getchell Mines, Inc., have not been included in the 1942 statistics because they require further milling at the Salt Lake City re-treatment plant. Of the other smaller mines producing concentrates in 1942, the largest were the Star in Elko County, Defense Tungsten in Humboldt County, Desert Scheelite and Gunmetal in Mineral County, and Black Mule and Tungsten Minerals in White Pine County.

During 1942 Nevada Scheelite, Inc., made about 1,000 feet of new

[4] Bradley, J. D., Mecia, J. A., and Baker, B. E., Yellow Pine Mine: Eng. and Min. Jour., vol. 144, No. 4, April 1943, pp. 60–66.

[5] Dice, C. M., Methods and Costs of Concentrating Huebnerite Ores at the Ima Tungsten Mine, Lemhi County, Idaho: Bureau of Mines Inf. Circ. 7230, 1943, 14 pp.

drifts, opened several large stopes from 40 to 80 feet wide, put finger raises through from the 100-foot level to the surface, and installed a new crushing plant.

A flotation plant was put into operation in August 1942 by Getchell Mines, Inc., and during the remainder of the year 21,675 short tons of scheelite ore averaging 0.394 percent WO_3 were treated, yielding 537 tons of concentrates averaging 12.69 percent WO_3. The ore treated came from the company mines in Humboldt County and from the Richmond mine, near Winnemucca, also in Humboldt County but operated by W. C. Rigg, who also has developed the Rose Creek mine in Pershing County to the productive stage. Development at the Getchell mines included 195 feet of drifts, 90 feet of crosscuts, and 97 feet of raises. Van Voorhis has described the mining and milling of tungsten ores by Getchell Mines, Inc.[6]

The M. G. L. mine, in Pershing County near Nixon, which has been under development for some time, made its initial output in August 1942 and during the remainder of the year produced and treated 10,233 short tons of scheelite ore, which yielded 73 tons of concentrates averaging 68 percent WO_3. The mine is provided with a modern concentrating plant.

Development was done at many other properties in Nevada in 1942, among which were the Cherry Creek and Canary Yellow in White Pine County, Star in Elko County, Silver Dyke in Mineral County, Defense Tungsten in Humboldt County, and Red Top and Red Ant in Churchill County, but lack of space precludes giving detailed information.

The tungsten deposits of the Nightingale district have been described by Smith and Guild.[7]

Texas.—A small quantity of scheelite was produced by the Moore Mining Co. in 1942 near Sierra Blanca in Hudspeth County, where a small mill was erected.

The scheelite occurrences in Gillespie County have been described recently.[8]

Utah.—Production of tungsten (all scheelite) in Utah was 33 short tons averaging 54 percent WO_3 in 1942, compared with 46 tons averaging 39 percent WO_3 in 1941. Shipments were 30 tons averaging 57 percent WO_3, compared with 44 tons averaging 41 percent WO_3 in 1941. Although production came from operations in Beaver, Box Elder, Juab, and Tooele Counties, two-thirds came from the Lone Pine mine in Box Elder County. Most of the remainder came from the Star Dust mine in Tooele County and the Massae mill in Box Elder County.

In addition to the 33 short tons of high-grade ore and concentrates produced in 1942, a small tonnage of ore was mined at several properties and shipped to the re-treatment plant of Metals Reserve Co. at Salt Lake City, which was expected to begin operating in April 1943.

Washington.—Shipments of tungsten concentrates from Washington were 73 short tons averaging 35.48 percent WO_3 in 1942, compared with 121 tons averaging 33.91 percent in 1941. Most of the pro-

[6] Van Voorhis, B. W., Jr., Mining Gold, Arsenic, and Tungsten Ores at the Getchell Mine: Mining World, vol. 4, No. 12, December 1942, pp. 5–8; How Getchell Treats Tungsten, Arsenic, and Gold Ores in Its Remodeled Mill: Mining World, vol. 5, No. 3, March 1943, pp. 9–13.

[7] Smith, W. C., and Guild, P. W., Tungsten Deposits of the Nightingale District, Pershing County, Nev.: Geol. Survey Bull. 936–B, 1942, pp. 39–58.

[8] Bureau of Economic Geology, Texas University, Scheelite in Gillespie County, Tex.: Mineral Resource Survey Circ. 55, 1942, 3 pp.

duction again came from the Germania mine near Fruitland, Stevens County, where the General Electric Co. worked over surface float and tailings to recover 19 tons of wolframite concentrates averaging 65 percent WO_3 and 45 tons of wolframite jig concentrates averaging 14 percent WO_3. Comparatively small quantities of wolframite concentrates were produced by James Keeth, Industrial Tungsten Corporation, Roy B. Greene, and W. H. West in Stevens County, and by the Zellweger Mining Co. in Okanogan County. W. H. West installed a jig mill at his mine in 1942, and the Zellweger Mining Co. had a small jig mill partly installed at the close of the year.

The tungsten deposits at Silver Hill, Spokane County, have been described by Page.[9]

FOREIGN TRADE [10]

Domestic production of tungsten is inadequate for requirements, and the United States imports both tungsten concentrates and products, chiefly the former. Receipts of imported ore and concentrates established a new high in 1942 and amounted to 15,085,793 pounds (tungsten content), equivalent to 15,851 short tons of 60 percent WO_3. Although ore and concentrates were received from 15 foreign countries in 1942, three—Bolivia (43 percent), China (30 percent), and Argentina (17 percent)—supplied 90 percent of the total.

Imports in 1942 for consumption amounted to 14,004,257 pounds (tungsten content), equivalent to 14,715 short tons of 60 percent WO_3; Bolivia, China, and Argentina supplied 47, 28, and 16 percent, respectively, of the total. In addition, 6,115 pounds of tungsten in concentrates were imported from Argentina (duty free) for smelting, refining, and export.

Tungsten ore and concentrates imported into the United States in 1942, by countries, in pounds

Country	General imports [1]		Imports for consumption [2]	
	Gross weight	Tungsten content	Gross weight	Tungsten content
Argentina	4,724,009	2,532,468	4,333,411	2,314,038
Australia	11,362	6,269	28,481	15,273
Belgian Congo	264,008	147,829	264,458	147,829
Bolivia	13,045,647	6,550,135	13,129,518	6,589,045
Brazil	85,134	44,130	85,134	44,130
Canada	32,417	7,272	32.417	7,272
China	8,602,346	4,487,399	7,506,059	3,888,498
Egypt			411,009	218,903
French Indochina	548,879	308,025	37,597	21,418
India, British	763	518	763	518
Mexico	159,113	79,104	152,813	76,106
Peru	433,433	222,272	511,932	264,586
Portugal	365,637	186,750	456,569	234,107
Southern Rhodesia	51,704	27,963	51,704	27,963
Thailand	358,310	204,420		
Union of South Africa	510,176	281,239	280,042	154,571
Total: 1942	29,192,938	15,085,793	[3] 27,281,907	[3] 14,004,257
1941	26,395,708	13,152,716	[3] 23,850,011	[3] 11,522,190

[1] Comprises ore and concentrates received in the United States; part went into consumption during year, and remainder entered bonded warehouses.

[2] Comprises ore and concentrates withdrawn from bonded warehouses during year (irrespective of time of importation) and receipts during year for consumption.

[3] In addition, following quantities were imported for smelting, refining, and export—1942: 12,000 pounds containing 6,115 pounds of tungsten; 1941: 48,196 pounds containing 27,558 pounds of tungsten.

[9] Page, L. R., Tin and Tungsten Deposits at Silver Hill, Spokane County, Wash.: Geol. Survey Bull. 931-H, 1942, pp. 177-203.

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

The duty on tungsten ore or concentrates is 50 cents per pound on the metallic tungsten contained therein. This is equivalent to $7.93 per short-ton unit.[11]

Exports of tungsten ore and concentrates from the United States are insignificant and amounted to only 15,714 pounds in 1942. From July to December 1941 exports were 2,616 pounds; exports of tungsten ore and concentrates before July 1, 1941, are not separately recorded.

Imports of tungsten metal were 4,435 pounds (tungsten content), compared with 36,793 pounds in 1941. No ferrotungsten, tungsten carbide, tungstic acid and other compounds of tungsten, or combination containing tungsten or tungsten carbide were imported in 1942.

Exports of metal, wire, shapes, and alloys other than ferrotungsten were 313,223 pounds in 1942, compared with 195,762 pounds in 1941. In 1942 exports of ferrotungsten were 297,108 pounds, and from July to December 1941 they were 5,180 pounds. Exports of sodium tungstate, tungstic acid, and tungstic oxide were 1,419, 39, and 11 pounds, respectively, in 1942; they were 58, 10, and none, respectively, from September to December 1941. Exports of ferrotungsten before July 1 and of sodium tungstate, tungstic acid, and tungstic oxide before September 1, 1941, were not separately recorded.

CONSUMPTION AND USES

Consumption of tungsten ore and concentrates in the United States was about 18,300 short tons (60 percent WO_3 basis) in 1942, compared with 17,500 tons in 1941. Of the total consumed in 1942, about 68 percent was converted to ferrotungsten, the form in which most of the tungsten is introduced into steel. However, high-purity tungsten concentrates are charged directly to the steel bath, and 17 percent of the total was so used in 1942. Metallic tungsten required about 10 percent of the total tungsten ore and concentrates consumed in 1942, and various tungsten chemicals absorbed the remainder (5 percent).

The chief use of tungsten, according to quantity, is in the manufacture of cutting tools, the majority of which are made of high-speed steel containing about 18 percent tungsten, 4 percent chromium, and 1 percent vanadium—commonly known as "18–4–1." Smaller quantities of tungsten are used in numerous other types of high-speed steels. Molybdenum-tungsten high-speed steels (which contain 1 to 2 percent tungsten and 5 to 10 percent molybdenum) are being used successfully for many applications of tungsten high-speed steels. Other important uses of tungsten are in armor-piercing projectiles, stellite and tungsten carbide cutting tools, magnet steels, austenitic valve steels and valve seats, and erosion-resisting gun liners. Minor amounts of tungsten are used in lamp and radio-tube filaments, X-ray targets, and electrical contact points. Tungsten salts are used in the chemical, pigment, and tanning industries.

WORLD PRODUCTION

Because of restrictions on the publication of statistics by many governments, a record of recent production in many countries is not available.

[11] A unit, as applied to tungsten ores, is 1 percent of a ton of tungsten trioxide (WO_3). Thus, a short-ton unit is 20 pounds of WO_3 or 15.86 pounds of tungsten (W).

World production of tungsten ores, 1937–42, by countries, in metric tons of concentrates containing 60 percent WO_3 [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
North America:						
Canada			4	6	32	204
Mexico	33	76	118	112	99	100
United States (shipments)	3,175	2,761	3,889	4,825	5,957	8,467
	3,208	2,837	4,011	4,943	6,088	8,771
South America:						
Argentina	866	1,195	1,309	1,417	1,720	2,209
Bolivia (exports)	1,802	2,530	3,337	4,183	4,353	5,606
Brazil (exports)	6	2	7	9	35	9
Chile	18	5	[2]	[2]	[2]	[2]
Peru	78	170	170	290	337	370
	2,770	3,902	[2]	[2]	[2]	[2]
Europe:						
France		22	[2]	[2]	[2]	[2]
Great Britain: Cornwall	148	258	[2]	[2]	[2]	[2]
Italy	3	4	[2]	[2]	[2]	[2]
Norway	3	19	31	[2]	[2]	[2]
Portugal	2,069	2,810	3,851	4,858	5,834	[2]
Spain	250	215	[2]	299	504	429
Sweden	127	180	200	[2]	[2]	[2]
	2,600	3,508	[2]	[2]	[2]	[2]
Asia:						
Burma	7,393	7,796	9,025	[2]	[2]	[2]
China (exports)	17,895	13,387	11,580	3,118	[2]	[2]
Chosen	2,058	[2]	[2]	[2]	[2]	[2]
India, British	15	12	[2]	[2]	[2]	[2]
Indochina: Tonkin	648	545	510	392	[2]	[3] 130
Malay States:						
Federated	1,077	749	246	108	[2]	[2]
Unfederated	279	333	362	427	[2]	[2]
Netherlands Indies	[4]	[4]	2	[4]	[2]	[2]
Thailand	221	251	378	400	[2]	[2]
	29,586	[2]	[2]	[2]	[2]	[2]
Africa:						
Belgian Congo				63	[2]	[2]
Egypt	193	[2]		15	43	[2]
Morocco, French		7	[2]	[2]	[2]	[2]
Nigeria	9	49	237	131	[2]	[2]
Southern Rhodesia	275	329	270	221	268	504
South-West Africa	41	48	50	24	[3] 62	[2]
Tanganyika Territory	2	5	[4]	2	[2]	[2]
Uganda	2	2	2	[2]	[2]	[2]
Union of South Africa	40	127	100	105	[5] 112	[5] 334
	562	[2]	[2]	[2]	[2]	[2]
Oceania:						
Australia:						
New South Wales	66	113	[2]	[2]	[2]	[2]
Northern Territory	345	515	354	320	[2]	[2]
Queensland	110	167	107	[2]	[2]	[2]
Tasmania	345	390	472	[2]	[2]	[2]
New Zealand	28	54	49	88	79	[2]
	894	1,239	[2]	[2]	[2]	[2]
	39,620	[6] 38,000	[6] 40,000	[2]	[2]	[2]

[1] In addition to countries listed, tungsten ore is produced in Cuba, Japan, U. S. S. R., and Western Australia, but data on production are not available.
[2] Data not available.
[3] January to June, inclusive.
[4] Less than 1 ton.
[5] January to October, inclusive.
[6] Estimated.

Argentina.—Argentina ranks second to Bolivia as a producer of tungsten in South America. Output comes principally from the Provinces of San Luis and Córdoba; much smaller amounts are produced in San Juan, Catamarca, Mendoza, and La Rioja. Production was 2,008 and 1,564 metric tons (66 percent WO_3), respectively, in 1942 and 1941. Exports were 1,636 metric tons averaging 66 percent WO_3 (all to the United States) in 1942.

Australia.—The principal sources of tungsten in Australia are mines at Grassy, King Island; Storey's Creek, Tasmania; Hatch's Creek and Wauchope, Northern Territory; Banks Island, Torres Strait; and Wolfram Camp, Queensland.

The King Island Scheelite Co. is the Commonwealth's largest producer. During the year ended October 31, 1942, it milled 32,200 long tons of ore, which yielded 242 tons of concentrates; in 1941 it milled 29,250 tons of ore and re-treated 18,870 tons of tailings, which yielded 204 and 17 tons, respectively, of concentrates. The company plans to erect a new concentrating mill to treat 20,000 tons of ore monthly.

Bolivia.—Bolivia is the largest tungsten producer in South America. Most of the deposits are in the Departments of La Paz, Oruro, Potosí, and Cochabama. The principal mineral is wolframite with some scheelite. Output (as indicated by exports) was 5,606 and 4,353 metric tons (60 percent WO_3 basis), respectively, in 1942 and 1941.

Canada.—An intensive search for tungsten ores was under way in Canada during 1942, and as a consequence many deposits were found. The distribution of the ores has been discussed by Eardley-Wilmot.[12] Output of tungsten concentrates was 218 short tons (62 percent WO_3) and 41 tons (51 percent WO_3), respectively, in 1942 and 1941. Output was from six provinces and the Northwest Territories in 1942, but most of it was from British Columbia, Northwest Territories, and Ontario.

Nigeria.—The tungsten deposits of Nigeria have been described in considerable detail by Haag.[13]

Peru.—Production of tungsten in Peru is relatively small, but since 1937 it has increased progressively and amounted to 370 metric tons (60 percent WO_3 basis) in 1942. Exports of ores and concentrates were 337 metric tons in 1942, compared with 322 tons in 1941; figures for WO_3 content of the exports are not available. The principal productive mines are in the Departments of La Libertad, Ancash, Puno, and Huancavelica. There was considerable activity in developing and expanding production in 1942. The Cia. Minera Tauca, after delays caused by poor mill construction, began producing concentrates in August 1942 at Ogapita, Department of Ancash. At Pasto Bueno, Department of La Libertad, the Banco Minero del Peru installed a tungsten concentrator of 30 to 40 tons daily capacity to handle custom ores from small mines in that region. A 150-ton gold-tungsten plant for treating oxidized gold ores containing tungsten was being constructed at the Tentadora mine near Lircay, Department of Huancavelica. In the Mundo Nuevo area, Department of Ancash, power plant and drilling equipment were being installed preliminary to erection of a small gravity tungsten concentrator.

[12] Eardley-Wilmot, V. L., Tungsten—Canadian and World Situation: Canadian Min. and Met. Bull. 367, November 1942, pp. 437–454.

[13] Haag, H. L., Wolfram in Nigeria, with Notes on Cassiterite, Wolfram, and Columbite Zones: Min. Jour. (London), vol. 220, No. 5609, February 20, 1943, pp. 94–95; No. 5610, February 27, 1943, pp. 107–108; No. 5611, March 6, 1943, pp. 118–119; No. 5612, March 13, 1943, pp. 131–132.

BAUXITE AND ALUMINUM

By JOHN H. WEITZ AND M. E. TROUGHT [1]

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SUMMARY

As the Nation fought through the first full year of its greatest war, aluminum became one of the most important metals in the war machine. Without the vast tonnages of the vital white metal, produced by a rapidly expanding domestic industry, the unprecedented number of bombing and fighting planes now giving air superiority to the United Nations over large areas of the earth's surface could not have been produced. Production (521,106 short tons) and consumption (588,522 tons) of primary aluminum in 1942 advanced 69 and 94 percent over 1941. The annual rate of production at the end of 1942 had risen to 720,000 tons, and the total output in 1943 should substantially exceed 900,000 tons. Imports from Canada are expected to aggregate about 225,000 tons in 1943, making the total available supply of primary aluminum more than 1,125,000 tons. Secondary production in 1943 is estimated at an additional 293,000 tons.

Highlights of the industry in 1942 included the following: Eight Government-owned, Aluminum Company-operated reduction plants were begun or completed; the Olin Corporation became the third domestic producer of aluminum; two large Government-owned alumina plants were built, and one of them began operations in the fall; and plans were made for constructing lime-soda-sinter units at the four large Bayer-process plants. In May 1943, construction of the new lime-soda-sinter units was well under way; production had begun at the new Government-owned alumina plant at Baton Rouge, La.; and operations were scheduled to start in the Government-owned alumina plant at Salt Lake City, Utah.

Recovery of secondary aluminum increased 86 percent in 1942. Imports and exports of crude and semicrude aluminum in 1942 increased 736 and 419 percent, respectively, compared with 1941.

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

Production (2,768,343 short tons) and consumption (2,820,525 tons) of bauxite in 1942 increased 176 and 46 percent, respectively, compared with 1941. As with aluminum production, the large output of bauxite in 1942 will be dwarfed by the 1943 production, estimated at nearly 7,000,000 short tons. Imports of bauxite, reduced by a shortage of ships and enemy submarine action, are estimated at about 1,000,000 short tons in 1943. Of the total estimated 1943 supply of nearly 8,000,000 tons, estimated requirements will take about 5,550,000 tons, and the remainder will be stocked by the Government and private industry. The allocation order, effective August 1, 1942, to conserve and direct the distribution of bauxite and alumina assures that the most essential uses are met by allocating the bulk of the high-grade bauxite to the alumina and abrasive industries.

In 1942 imports of bauxite (990,323 short tons, 76 percent of which came from Surinam) decreased 21 percent from 1941, while exports (dried equivalent) rose 35 percent. Of the domestic and foreign bauxite consumed, the alumina industry used 79 percent; chemical, 9 percent; abrasive and refractory, 11 percent; and other industries, 1 percent. Compared with 1941, the aluminum industry increased its consumption of bauxite approximately 67 percent; abrasive and refractory, 19 percent; and all other, 14 percent; whereas bauxite used in the chemical industry decreased 22 percent. Domestic ore was equivalent to 59 percent and imports to 41 percent of the total bauxite consumed. Shipments from Arkansas mines comprised 94 percent of the total domestic production, and output in Georgia, Alabama, and Virginia rose substantially above that in 1941. The average value actually received for all grades of ore shipped in 1942 dropped 9 percent from 1941.

World production of bauxite is believed to have increased 24 percent and of aluminum 35 percent in 1942. United Nations output of aluminum and bauxite in 1942 was estimated at 59 and 65 percent of the world totals and will be even larger in 1943.

Salient statistics of the bauxite and aluminum industries in the United States, 1940–42

	1940	1941	1942
Bauxite:			
Production (mine shipments)[1] ..... short tons	491, 583	1, 001, 475	2, 768, 343
Value [2]	$2, 578, 968	$5, 358, 976	$12, 934, 025
Imports [2] ..... short tons	705, 098	1, 250, 532	990, 323
Exports (including concentrates)[2] ..... do	91, 743	150, 916	291, 871
World production [3] ..... do	5, 222, 000	7, 338, 000	9, 123, 000
Aluminum:			
Primary production ..... do	206, 280	309, 067	521, 106
Value	$75, 292, 000	$100, 395, 000	[4] $150, 768, 000
Quoted price per pound [5] ..... cents	18. 7	16. 5	[6] 15. 0
Secondary production ..... short tons	80, 362	106, 857	198, 492
Imports	$5, 159, 924	$3, 827, 543	$37, 123, 657
Exports	$22, 437, 125	$6, 872, 522	$26, 865, 444
World production [3] ..... short tons	916, 000	1, 216, 000	1, 644, 000

[1] Dried bauxite equivalent. [2] As shipped. [3] Estimated. [4] Shipments.
[5] New York: 99 percent plus, pure virgin ingot, according to Metal Statistics, 1942, published by American Metal Market. [6] Ceiling price.

BAUXITE

PRODUCTION

A new all-time high was recorded in 1942 when bauxite production (mine shipments converted to a dried-equivalent basis) in the United States increased 176 percent in quantity and 141 percent in value over 1941. Production rose 187 percent in Arkansas, 46 percent in Alabama, 410 percent in Georgia, and 58 percent in Virginia. A small production was recorded from Mississippi; no bauxite was produced in that State during 1941.

Mines in Saline and Pulaski Counties, Ark., produced 94 percent of the total domestic output in 1942. American Cyanamid & Chemical Corporation operated the Rauch, Heckler, and England mines in Pulaski County and the Townsend, Ozark No. 24, Globe No. 28, Cargill, Fletcher, Quapaw, and Gates (Consolidated) mines in Saline County. Mining was done underground by the room-and-pillar method at the Rauch Lease, Heckler, Globe No. 28, and Gates properties; all other mining was open-pit. Large-scale stripping was carried on by dragline at the England, Cargill, and Fletcher properties, and mining began in September. The company's West Bauxite processing plant was idle in early 1942, but dried bauxite for the Republic Mining & Mfg. Co. during the latter part of the year. The Bierman property was developed by Consolidated Chemical Industries, Inc., and a shaft was sunk in 1942 preparatory to underground mining in 1943. Crouch Mining Co., Inc. (owned by General Abrasives Co.), mined and calcined ore from its Young mine, developed in 1941, solely for the abrasive industry. Dixie Bauxite Co., Inc., continued operations on its Dixie No. 2 underground mine and began underground mining at its Dixie No. 3 property. The calcining mill was dismantled and sold to Bauxite Co. of Alabama in the fall of 1942, and Dixie Bauxite Co. was engaged solely in producing high-grade bauxite for the aluminum industry. Dulin Bauxite Co., Inc., produced ore from its Reichardt mine throughout the year and stripped overburden from a large area. The Harley open-pit mine began operations late in May and closed temporarily during November and December 1942, and additional development was done on the Thorpe lease, which will be mined in 1943. The old Consolidated-Harris mine was reopened and some ore removed in December. A calcining kiln was installed by Dulin Bauxite Co., Inc., during 1942 to calcine high-grade ore for the abrasive industry. Hardin & Prewitt Bauxite Co. began mining in December from its open-pit property in Pulaski County for the Metals Reserve Co. The Porocel Corporation erected a new plant at Bergen, Pulaski County, to manufacture an isomerization catalyst made from low-iron activated bauxite impregnated with anhydrous aluminum chloride for use in the production of high-octane aviation gasoline.

Republic Mining & Mfg. Co. (subsidiary of Aluminum Co. of America), the principal domestic producer, extended its previous open-pit mining operations; open-pit mining was done in secs. 10, 14, 15, 16, 27, T. 2 S., R. 14 W., Saline County, and major overburden

stripping jobs were in progress during 1942 in other sections. A large new drying plant more than doubling Republic's drying capacity was constructed during 1942 at Bauxite and put into operation early in 1943; maximum production is expected by August 1943. Reynolds Mining Corporation operated its Covington and Hurricane underground mines near Brooks, Saline County, in 1942, after sinking shafts through difficult ground in early fall, and during the latter half of 1942 conducted extensive stripping operations at the Sherrill property in Pulaski County. Sweet Home Bauxite Co. began operations at its open-pit Sweet Home mine in Pulaski County in May and continued mining throughout the year. Sweet Home Mining Co. stripped its Hurricane Creek property in Saline County and began mining early in 1943. Victory Bauxite Co. opened its Weiss open-pit mine in Pulaski County in November and continued mining until April 1943; the company will open a new property in 1943 in Saline County. New Arkansas producers in 1943 will include the Bauxite Drilling & Testing Co., S. E. Evans Construction Co., and a new company to operate the Maner Graham and Billy Bridewell properties.

Bauxite shipped from mines in the United States, 1938–42, by States

State and year	Short tons					Value, f. o. b. mine, as shipped
	Crude	Dried	Calcined	Total		
				As shipped	Dried-bauxite equivalent	
Alabama and Georgia:						
1938	6,196	[1] 14,047		20,243	19,323	$132,882
1939	3,054	12,676		15,730	15,251	91,282
1940	[2] 2,646	10,463		[2] 13,109	[2] 12,747	[2] 77,575
1941	[2] 74,069	25,851		[2] 99,920	[2] 89,830	[2] 406,137
1942	[3] 112,397	60,751		[3] 173,148	[3] 155,922	[3] 904,619
Arkansas:						
1938	80,749	218,338	[1] 29,387	328,474	328,903	1,679,663
1939	111,121	252,398	[4] 41,088	404,607	405,093	2,074,954
1940	128,712	292,435	[4] 52,930	474,077	478,836	2,501,393
1941	247,898	596,708	[4] 66,564	911,170	911,645	4,952,839
1942	1,367,237	1,318,622	[4] 81,456	2,767,315	2,612,421	12,029,406
Total United States:						
1938	86,945	[1] 232,385	[1] 29,387	348,717	348,226	1,812,545
1939	114,175	265,074	[4] 41,088	420,337	420,344	2,166,236
1940	131,358	302,898	[4] 52,930	487,186	491,583	2,578,968
1941	321,967	622,559	[4] 66,564	1,011,090	1,001,475	5,358,976
1942	1,479,634	1,379,373	[4] 81,456	2,940,463	2,768,343	12,934,025

[1] Includes small quantity of activated.
[2] Includes Virginia.
[3] Includes Mississippi and Virginia.
[4] Includes sintered.

The production of bauxite in Alabama increased during 1942, but the percentage increase recorded was lower than in any other State. Bauxite Co. of Alabama, Barbour Bauxite Co., Republic Mining & Mfg. Co., Floridin Co., and D. M. Wilson Bauxite Co. were active in the Eufaula area in Barbour and Henry Counties. New driers were built in early 1943 by Bauxite Co. of Alabama and Barbour Bauxite Co. to dry ore for the chemical industry. J. C. Hebble ceased mining near Asheville, St. Clair County.

At Andersonville, Sumter County, Ga., American Cyanamid & Chemical Corporation increased production at its Thig Pen mine and operated an oil-fired drying kiln nearby, and Benjamin Easterlin shipped a small quantity of ore before abandoning his mine late in 1942. Republic Mining & Mfg. Co. opened a drying plant in Floyd

County and produced a small amount of ore from its Booger Hollow mine. H. G. Bradhaw and General Ore Co. also produced small quantities of ore from the Hermitage area in Floyd County. Bethlehem Co. mined for a short time at its Irwinton and Toomsboro mines and is planning to construct a small drier in Wilkinson County.

Republic Mining & Mfg. Co. continued to mine near Spottswood, Augusta County, Va., operating the Allen, Harris, and Lightner properties. J. W. Adams mined a small tonnage of ore from the Flora mine in Kemper County, Miss., in the fall of 1942.

A canvass of producers, conducted by the Bureau of Mines in November 1942, indicated that 1943 bauxite production will approach 7,000,000 short tons. It is estimated that known domestic reserves of what are at present considered commercial grades of bauxite will not last more than 3 years at the expected 1943 depletion rate. In realization of the precarious condition of bauxite reserves, the Bureau of Mines and the Federal Geological Survey in the fall of 1941 initiated an extensive drilling and exploration program in all States where bauxite deposits were known or thought to occur.

Stratigraphic studies in the Coastal Plain had shown that all known bauxite deposits in the province were associated with the Midway-Wilcox contact, and reconnaissance work was done along this horizon from Georgia to Texas by the Geological Survey in an effort to locate new areas in which bauxite deposits might be expected. Some areas that warranted further exploration were found, but the greatest value of the preliminary work was to eliminate large areas from further consideration. The largest Geological Survey party worked in Arkansas in cooperation with the Bureau of Mines drilling project and collected and assembled geologic information, made aerial and subsurface maps of selected districts, made drilling recommendations, and furnished other geological advice. In the eastern Gulf Coastal Plain drilling recommendations were made for three areas in Mississippi, two in Alabama, and two in Georgia. All the known deposits in the Appalachian Valley were examined and drilling recommendations were made for two districts in northwestern Georgia, two in northeastern Alabama, and one in Tennessee. Cooperation was also extended by the Survey in locating and logging drill holes and in furnishing information for the war minerals reports on bauxite prepared by the Bureau of Mines.

In Arkansas the Bureau of Mines covered 1,400 square miles in Pulaski and Saline Counties by geophysical surveys in 1942 and drilled 573 holes, with an average discovery of more than 10,000 long tons of bauxite per hole. The total footage drilled was 134,900, and 208 or 36 percent of the holes were in bauxite. Eight deposits were delimited by drilling and an estimated 3,650,000 long tons of marketable ore indicated. Reduced to a mined and dried basis, the total commercial ore discovered was approximately 1,912,500 long tons or 2,142,000 short tons.

At Eufaula, Ala., and Andersonville, Ga., Bureau drilling has disclosed considerable tonnages of marketable bauxite, and further exploration is being actively carried on in these areas. Initial prospecting disclosed 929,000 long tons of marketable ore, which on a mined and dried basis is approximately 670,000 long tons or 750,000 short tons. Drilling at Rock Run, Ala., and Chattanooga, Tenn., during 1942 gave disappointing results, disclosing only very small tonnages of marketable ore.

Stocks of bauxite on hand at mines and processing plants on December 31, 1942, totaled 294,337 short tons (dried bauxite equivalent) compared with 171,023 on December 31, 1941. Stocks at consumers' plants increased from 593,849 tons at the beginning of the year to 959,082 at the end. Metals Reserve Company stock piles contained 479,207 tons at the end of 1942.

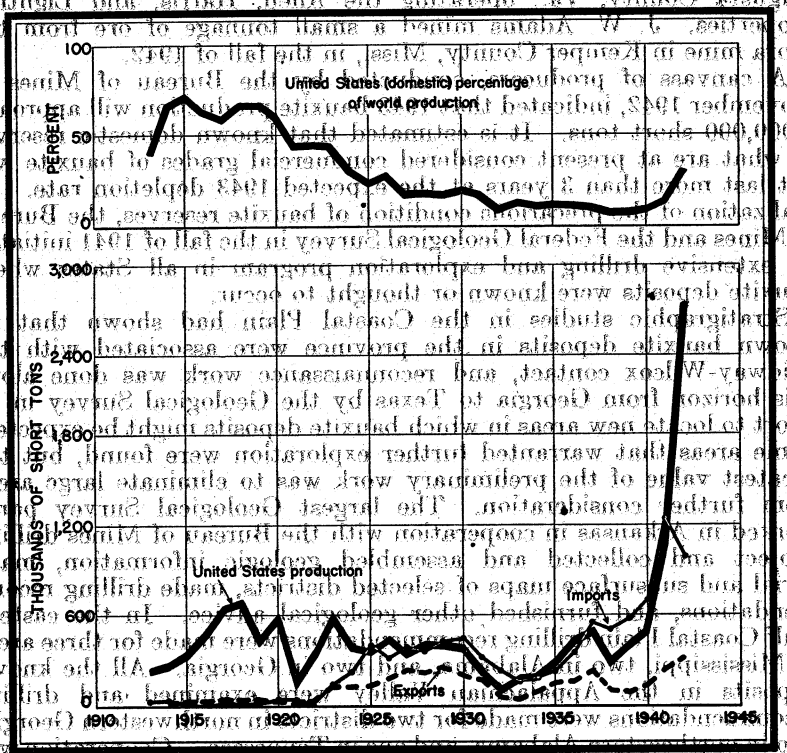

FIGURE 1.—Trends in production, imports, and exports of bauxite, 1913–42.

CONSUMPTION

Actual domestic consumption of bauxite (as determined by special monthly consumer surveys conducted by the Bureau of Mines for Federal war agencies) totaled 2,820,525 short tons (dried bauxite equivalent) in 1942 and compared with a consumption of 1,928,052 tons in 1941. The 1941 figure includes exports to Canada, as virtually all bauxite shipped there during that year was destined to American-owned abrasive plants for the manufacture of crude abrasives returned to the United States for final manufacture and consumption. The 1942 figure includes bauxite shipped to abrasive plants in Canada but does not include approximately 100,000 tons of dried ore shipped to the Canadian aluminum industry. Consumption of the 2,820,525 tons was as follows: Alumina industry, 2,229,157 tons; chemical, 256,479; abrasive (including refractories), 302,557; and cement, oil refining, steel, and ferro-alloy industries, 32,332 tons. Consumption

of bauxite "as shipped" totaled 2,742,573 tons and consisted of 430,486 tons of crude bauxite, 2,124,450 tons of dried, 180,337 tons of calcined and sintered, and 7,300 tons of activated ore. Of the bauxite consumed (dried equivalent basis), 41 percent was foreign and 59 percent domestic ore. The alumina industry used 94 percent and the chemical industry 4 percent of the foreign ore. About 2 percent of the foreign ore was employed in abrasives, cements, and other uses.

Apparent domestic consumption, shown in the table below, is presented from two different points of view; and apparent consumption within the United States does not correspond with the data above, inasmuch as the calculations are based upon "shipments" to domestic plants and do not consider fluctuations in consumers' stocks.

Shipments, imports, exports, and apparent consumption of bauxite in the United States, 1938–42, in short tons

[Dried-bauxite equivalent]

Year	Domestic shipments from mines and processing plants to industry			Imports	Exports	Apparent consumption within United States	Apparent consumption, including shipments to Canada for processing[1]
	Arkansas	Alabama and Georgia[2]	Total				
1938	308,088	19,323	327,411	510,376	101,182	736,605	819,800
1939	375,925	15,331	391,256	582,601	96,925	876,932	971,000
1940	490,107	[2] 12,995	503,102	705,098	134,462	1,073,738	1,200,600
1941	960,741	[2] 89,389	1,050,130	1,250,532	244,934	2,055,728	[3] 1,928,052
1942	2,588,637	[2] 153,663	2,742,300	990,323	329,477	3,403,146	[3] 2,820,525

[1] Includes exports to Canada, inasmuch as virtually all of this bauxite is shipped to American-owned plants in Canada for manufacture into crude abrasives reimported into the United States for final manufacture and consumption.
[2] Includes Virginia in 1940 and 1941 and Virginia and Mississippi in 1942.
[3] Actual consumption.

BY INDUSTRIES

The following table shows only shipments of domestic bauxite to consuming industries and excludes foreign ore.

Aluminum.—Actual consumption of bauxite by the aluminum industry increased approximately 67 percent over that in 1941 and comprised 79 percent of all the domestic and foreign ore used. The industry employed dried and undried ore from Alabama, Arkansas, Surinam, British Guiana, and Brazil. Estimated bauxite consumption in 1943 is expected to be about 118 percent above that in 1942.

Abrasive and refractory.—Manufacturers of crude aluminous abrasive pigs in Canada and the United States received approximately 19 percent more domestic bauxite in 1942 than in 1941, being consigned 6 percent of all the domestic ore shipped to industry. Except for a small quantity from British Guiana, all of the calcined and sintered ore employed came from Arkansas. The industry's 1943 ore requirements are expected to exceed those of 1942 by about 33 percent. The use of bauxite in refractories is combined with abrasives. In 1942 the consumption of special aluminous refractory products increased substantially over 1941 in the steel, glass, ship, and other industries.

Bauxite shipped from mines and processing plants in the United States, 1938–42, by consuming industries, in short tons

Industry	1938		1939		1940		1941		1942	
	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 [2]	161,513	161,513	180,329	180,329	240,947	239,897	618,763	597,607	[3] 2,445,365	[3] 2,266,839
Chemical	71,613	70,952	91,217	89,080	92,735	90,645	161,037	158,294	183,804	174,826
Abrasive [4]	54,879	83,568	61,987	92,205	90,522	144,276	148,562	237,980	170,060	251,497
Oil refining, refractory,[4] and other	11,572	11,378	15,947	29,642	14,254	28,284	51,370	56,249	47,366	49,138
Total quantity	299,577	327,411	349,480	391,256	438,458	503,102	979,732	1,050,130	2,846,595	2,742,300
Total value	$1,823,307		$2,448,038		$3,075,317		$6,155,714		$13,672,727	

[1] Includes crude, dried, calcined, and activated, 1938–42; and sintered, 1939–42.
[2] Includes some ore shipped to the abrasive and chemical industries.
[3] Includes 672,000 tons (584,640 dried equivalent) shipped to Metals Reserve Co. stock piles.
[4] Small quantity of bauxite shipped to makers of refractories probably included under "Abrasive."

Chemical.—The chemical industry consumed 22 percent less bauxite in 1942 than in 1941 and used 9 percent of all the domestic and foreign ore consumed. Shipments of domestic bauxite from mines and processing plants to the chemical industry increased 10 percent. Consumption by the industry in 1942 totaled 256,479 short tons of bauxite, but this includes ore used to make some aluminum chemicals other than those shown in the following table and does not include a large portion of the bauxite used in the manufacture of the alumina shown in the table. Ore used to make the aluminum salts and alumina shown in the table totaled approximately 306,880 tons. In addition to bauxite, producers of aluminum salts reported consuming 8,364 tons of alumina (calcined equivalent), 6,031 tons of primary and secondary aluminum, 19,637 tons of clay, and a relatively small quantity of beryl and chromite residue. Manufacturers estimated that their 1943 bauxite consumption will be 13 percent less than in 1942 (exclusive of a large part of the bauxite consumed in making alumina for the chemical and other industries).

Production and shipments of aluminum salts decreased 4 and 3 percent in 1942. Production of alumina increased 9 percent, but shipments decreased 7 percent. Of this alumina, only 14 percent was consumed by the producers of aluminum salts; the remainder was used in the manufacture of abrasives, refractories, petroleum products, spark plugs, glass, rubber, paints, and various other commodities.

Aluminum salts and alumina produced and shipped in the United States, 1941–42

	1941				1942			
	Production	Shipments			Production	Shipments		
	Short tons	Shippers	Short tons	Value	Short tons	Shippers	Short tons	Value
Aluminum salts:								
Alum:								
Ammonia	8,235	7	8,268	$511,414	7,698	7	7,265	$497,830
Potash	4,008	5	4,441	297,595	[1] 4,154	5	[2] 3,781	283,882
Aluminum chloride:								
Liquid	4,250	6	4,399	184,659	3,839	6	3,815	176,302
Crystal	16,583	4	16,180	2,545,373	16,717	3	16,578	2,714,682
Anhydrous		6				6		
Aluminum sulfate:								
Commercial:								
General	[3] 513,815	19	[3] 515,722	[3] 10,569,528	504,951	21	506,870	11,174,785
Municipal	11,670	9	11,768	188,980	12,940	9	12,925	204,872
Iron-free	[3] 35,401	[3] 9	[3] 34,632	[3] 1,106,024	22,210	9	23,331	833,378
Sodium-aluminum sulfate	32,078	2	30,974	1,979,102	28,404	2	29,993	1,850,200
Sodium aluminate		10				14		
Total aluminum salts	626,040	----	626,384	17,382,675	600,913	----	604,558	17,735,931
Alumina [4]	53,710	11	56,093	5,602,762	58,297	10	52,413	5,510,343

[1] Includes 73 tons made from iron-free aluminum sulfate.
[2] Includes 71 tons made from iron-free aluminum sulfate.
[3] Revised.
[4] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, light and heavy hydrate, converted to a calcined-alumina equivalent. Figures not comparable with those before 1939.

Aluminum salts shipped in, imported into, and exported from the United States, 1938–42

Year	Domestic shipments		Imports		Exports			
					Aluminum sulfate		Other aluminum compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1938	412,905	$10,197,354	1,871	$40,189	27,715	$578,330	1,770	$257,545
1939	494,032	11,813,299	823	22,835	34,734	744,755	1,792	208,455
1940	513,520	12,882,578	21	866	43,615	994,861	1,929	271,715
1941	626,334	17,382,475	(1)	281	51,261	1,184,160	2,815	349,951
1942	604,558	17,735,931	(1)	4	44,428	1,103,340	2,384	354,397

[1] 147 pounds in 1941 and 50 pounds in 1942.

Early in 1943 the Torrance Aluminum Products Co. began producing sodium aluminate at a plant in Torrance, Calif. The aluminous raw material being used is fine aluminum dross from West coast reduction plants. In late 1942 and early 1943 the General Chemical Co. was changing from bauxite to clay as an aluminous raw material at all of its aluminum chemicals plants, a change of major importance as the company has been a large consumer of bauxite in past years. A central calcining plant is being built at Owensville, Mo., which will calcine Missouri diaspore and ship the product to all General Chemical Co. widely scattered aluminum-salts plants.

Other.—The use of thermally activated bauxite as an adsorbent and catalyst in the petroleum industry maintained about the same rate as in 1941 but is expected to expand substantially in 1943, as production of high-octane aviation gasoline and synthetic rubber increase. More bauxite was used in fluxing ferro-alloys and in high-early-strength aluminous cement. Consumption in the cement, steel and ferro-alloy, and oil-refining industries rose 14 percent above the quantity used in 1941, and it is estimated that 1943 bauxite needs will exceed 1942 use by 90 percent.

PRICES

In 1942 the average selling price, f. o. b. mines and processing plants, was $3.84 a short ton for crude (undried) bauxite, $4.51 for crushed dried bauxite, $11.97 for calcined bauxite, and $46.68 for activated bauxite. Values per long ton were as follows: $4.30 for crude, $5.05 for dried, $13.41 for calcined, and $52.28 for activated bauxite. The average value for all grades of domestic ores as shipped was $4.80 a short ton ($5.30 in 1941) or $5.38 a long ton ($5.94 in 1941). Nominal market quotations on domestic, chemical, crushed and dried bauxite rose from $7 to $8.50 a long ton in 1941 to $7.50 to $8.50 in 1942. The Metals Reserve Co. began purchasing ore in May 1942, for stock piling and for consumption in the new Hurricane Creek (Ark.) and Baton Rouge (La.) alumina plants. The price schedule, set up by the Metals Reserve Co. for purchasing bauxite, provides a base price of $4 a long ton for ore containing 50 percent alumina and 13 percent silica, and a system of penalties and bonuses.

FOREIGN TRADE

Imports of bauxite in 1942 dropped 21 percent from the peak year of 1941, whereas exports (dried equivalent) increased 35 percent. Of the 1942 imports, 748,642 short tons came from Surinam, 238,426 from British Guiana, 3,252 from Brazil, and 3 from Canada. By customs districts, importations were as follows: 892,291 tons to Mobile, 69,427 to New Orleans, 19,451 to Philadelphia, 9,149 to Massachusetts, 3 to Vermont, and 2 to New York. Of the 1942 exports, 251,509 short tons were classified as bauxite and other aluminum ores, and 40,362 tons as alumina and other bauxite concentrates. More than 99 percent of the exports went to Canada; only small quantities were shipped to Argentina, United Kingdom, Iran, Trinidad and Tobago, Australia, Mexico, Curaçao, Venezuela, Cuba, and the Dominican Republic.

Bauxite imported into and exported from the United States, 1938–42

Year	Imports for consumption [1] [2]		Exports (including bauxite concentrates) [3]		Year	Imports for consumption [1] [2]		Exports (including bauxite concentrates) [3]	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1938	510,876	$3,521,325	64,653	$1,459,491	1941	1,250,532	$7,476,089	150,916	$2,773,877
1939	582,600	3,765,140	57,831	1,117,564	1942	990,323	5,939,486	291,871	5,086,695
1940	705,098	4,298,969	91,743	1,542,703					

[1] Also "alumina" as follows: 1938, 72 short tons valued at $5,484; 1939, 1 ton, $432; 1940, 12 tons, $1,743; 1941, 67 tons, $5,544; 1942, 24,316 tons, $1,571,877.
[2] Chiefly dried ore.
[3] As shipped.

ALUMINUM

PRODUCTION

Primary.—The production of 521,106 short tons of primary aluminum in 1942—69 percent more than the 309,067 tons produced in 1941—represented another all-time record for the aluminum industry. It was considerably more than the entire world production in 1937 but represented only about 50 percent of the ultimate annual production goal. The annual rate at the end of 1942 had risen to 720,000 tons, and the expected rate on December 31, 1943, (including all plants now operating, under construction, or approved), is estimated at approximately 1,147,000 tons. Actual domestic output in 1943 should total substantially more than 900,000 tons or more than the world production in 1940. The five aluminum-reduction plants of the Aluminum Co. of America and the five Defense Plant Corporation plants operated by the Aluminum Co. produced the larger part of the 1942 output. The Olin Corporation became the third producer of primary aluminum when it began operations at its plant in Tacoma, Wash., in 1942. Of the Aluminum Co. output from its privately owned plants, 39 percent was made at Alcoa, Tenn.; 23 percent at Vancouver, Wash.; 20 percent at Massena, N. Y.; 13 percent at Badin, N. C.; and 5 percent at Niagara Falls, N. Y. Of the output at Aluminum Co.-operated Defense Plant Corporation plants 31 percent

was produced at Massena, N. Y.; 25 percent at Mead, Wash.; 18 percent at Troutdale, Oreg.; 15 percent at Jones Mills, Ark.; and 11 percent at Los Angeles, Calif. The Listerhill (Ala.) plant of Reynolds Metals Co. supplied 55 percent of Reynolds' production, and the Longview (Wash.) plant the remaining 45 percent. The value of the aluminum shipped in 1942 averaged 14.62 cents a pound compared with 16.24 cents in 1941.

The second Government expansion program (of February 26, 1942) providing for an additional 320,000 tons of metal has not been increased since that date, although capacity estimates have been changed on the basis of performance so that the original privately owned capacity and the early expansion financed by private and Reconstruction Finance Corporation capital now totals about 474,000 tons; the first Government expansion, about 338,000 tons; and the second Government expansion, about 360,000 tons. On February 20, 1942, a contract was made between Defense Plant Corporation and the Aluminum Co. of America whereby the Aluminum Co. undertook to construct a 500,000-ton alumina plant at Baton Rouge, La., in addition to the 500,000-ton plant already approved at Hurricane Creek (Bauxite), Ark. A 150,000-ton addition to the Hurricane Creek plant was begun in February 1942; and recently, owing to the unexpectedly high production of metal per potline in the newer reduction plants, another expansion of 127,500 tons was announced for Hurricane Creek. The Kalunite, Inc., alumina plant at Salt Lake City, Utah, originally scheduled for 10,000 tons annual capacity, was expanded twice to 30,000 and finally to 36,000 tons.

All but one reduction plant in the first expansion program are essentially complete, and all plants in the second expansion program are partly constructed. Of a total of 36 potlines in the group owned by the Defense Plant Corporation and operated by the Aluminum Co. all but 14 were completed as of May 20, 1943. Two to four completed potlines in the new plants were idle during the latter part of 1942 and the early part of 1943 due to an acute alumina shortage. For this reason the alumina plants are being pushed toward completion under AA–1 priorities as rapidly as possible.

Bauxite importation problems became acute in the summer of 1942 owing to a shortage of cargo space and to an intensive submarine campaign in Caribbean waters. This situation caused a sharp drop in imports of high-grade South American ore, and more domestic ore of a considerably lower grade had to be used to keep the alumina plants going. Realizing this fact, and with shipping prospects growing steadily worse, the War Production Board, on advice from the National Research Council, approved lime-soda-sinter units at each of the four Aluminum Co.-operated alumina plants. Owing to delays, construction was not begun on these units until January and February 1943, but they are now proceeding under AA–1 priorities and will be in partial operation by September 1943.

In addition to the expansion of reduction and alumina plants there was a large increase, part in Government-owned and part in privately owned fabricating plants, of strong alloy-sheet capacity as well as forging, extrusion, rod and bar, and casting capacity. During early 1943 bottlenecks in the fabricating program in extrusions and rod and bar facilities constituted one of the main limiting factors in the ex-

Projected annual alumina- and aluminum-producing capacity of the United States in 1944, in thousands of short tons

Operating company and plant location	Alumina capacity		Aluminum capacity	
	Company-owned	Government-owned	Company-owned	Government-owned
Aluminum Co. of America:				
East St. Louis, Ill.	[1] 328			
Mobile, Ala.	650			
Hurricane Creek (Bauxite), Ark.		[2 3] 778		
Baton Rouge, La.		[3] 500		
Alcoa, Tenn.			180	
Massena, N. Y.			77	[2] 54
Niagara Falls, N. Y.			20	
Badin, N. C.			56	
Vancouver, Wash.			91	
Troutdale, Oreg.				[2 3] 72
Los Angeles, Calif.				[2 3] 90
Jones Mills, Ark.				[2] 72
Mead (near Spokane), Wash.				[2 3] 108
Maspeth, L. I., N. Y.				[3] 144
Burlington, N. J.				[3] 54
Modesto, Calif.				[3] 54
Reynolds Metals Co.:				
Listerhill, Ala.	100		[2] 50	
Longview, Wash.			30	
Kalunite, Inc.: Salt Lake City, Utah		[2 3] 36		
Olin Corporation, Tacoma, Wash.				[2] 20
Total capacity	1,078	1,314	504	668

[1] Includes only capacity for aluminum industry.
[2] First expansion program.
[3] Second expansion program.

pansion of aircraft production. This situation will be largely alleviated during the summer of 1943.

In 1942 the Aluminum Co. of America virtually completed its $250,000,000 privately financed expansion of alumina, aluminum-reduction, and fabricating capacity. In addition to company-owned expansion, the Aluminum Co. is building many plants for the Defense Plant Corporation which it will operate for the Government, among which are the following: Alumina plants at Baton Rouge, La. (500,000-ton annual capacity) and Hurricane Creek, Ark. (777,500 tons) aluminum-reduction plants at Massena, N. Y. (54,000 tons), Troutdale, Oreg. (72,000 tons), Los Angeles, Calif. (90,000 tons), Jones Mills, Ark. (72,000 tons), Mead (Spokane), Wash. (108,000 tons), Maspeth, L. I., N. Y. (144,000 tons), Burlington, N. J. (54,000 tons), and Modesto, Calif. (54,000 tons); sheet rolling mills at Spokane, Wash. (144,000 tons), and Chicago, Ill. (144,000 tons); extrusion and tubing plants at Cressona, Pa. (30,000 tons), and Phoenix, Ariz. (33,000 tons); forging plants at Cannonsburg, Pa. (38,700 tons), Newcastle, Pa. (10,600 tons), Vernon, Calif. (19,500 tons), and Monroe, Mich. (672,000 cylinder heads annually); plants for producing cast cylinder heads for air-cooled engines at Kansas City, Mo. (1,200,000 heads), and St. Paul, Minn. (600,000 heads); and a synthetic cryolite plant at Hurricane Creek, Ark. (9,000 tons).

After the refusal of the War Labor Board to allow a general wage increase in the plants of Aluminum Co. of America in the fall of 1942, the Aluminum Workers of America and the Aluminum Co. negotiated a wage adjustment applying to the plants at New Kensington, Detroit, Bridgeport, and Edgewater, which was subsequently allowed by the Board. During early December three wildcat strikes within a week interrupted production at the Detroit plant of Bohn Aluminum &

Brass Co. As the result of a week-long strike of the Mine, Mill, and Smelter Workers, Die Casting Division, Congress of Industrial Organizations, in die-casting plants of the Aluminum Co., the War Labor Board withheld the union's security clause for 60 days as a disciplinary measure. In January 1943 an unauthorized strike against rotating shifts took place in the New Kensington plant. Slowdowns and other labor difficulties that greatly curtailed production at the Cleveland plant of the Aluminum Co. were investigated in early February by a representative of the United States Army plant-protection service. The trouble continued, however, and developed into a walk-out, ending on February 26, 1943, after the War Labor Board ordered the discharge of 44 of the striking employees. Workers of the Republic Mining & Mfg. Co., the bauxite-mining subsidiary of Aluminum Co. of America, received a wage increase of 5 cents an hour retroactive to September 20, 1942, upon authorization by the War Labor Board in March. On April 21, 1943, a strike was called by local leaders of the Aluminum Workers of America at the Edgewater (N. J.) plant of the Aluminum Co. because of grievances arising from lay-offs. The strike was not sanctioned by the international president of the union.

After dismissal of the monopoly charges brought by the Government against the Aluminum Co. of America, the Department of Justice filed an appeal to the United States Supreme Court which was allowed in September 1942 and docketed for October 20. On November 23, the Clerk of the Supreme Court sent a letter to counsel for both sides stating that four justices had disqualified themselves from acting on the controversy and therefore the required quorum of six justices was not available. The Aluminum Co. immediately moved to dismiss the appeal. The Department of Justice asked the Court to deny the motion for dismissal, stating that "there is a possibility that, if the case is retained, legislation will be enacted empowering the Court to hear the appeal through those members of the Court qualified to participate."

On December 10, 1942, the New York State Court of Appeals upheld the Niagara Falls Power Co. and the Aluminum Co. of America against the State Waterpower and Control Commission in two decisions maintaining the status quo in regard to waterpower of the Niagara River.

During 1942 the Reynolds Metals Co., Federal Reserve Bank Building, Richmond, Va., completed an addition to its aluminum-reduction plant at Listerhill, Ala., bringing the annual capacity to 50,000 short tons, and this together with the 30,000-ton plant at Longview, Wash., brings the company total annual capacity to 80,000 tons. The year 1942 saw the completion of a sheet-rolling mill and rod mill at Listerhill, Ala., operated under the name of the Reynolds Alloys Co., and an extrusion plant at Louisville, Ky. At the instance of the Government, the sheet and rod facilities in Alabama are being increased in capacity by 12,000 tons, and negotiations have recently been concluded with the Defense Plant Corporation to further increase the company extrusion capacity.

The Olin Corporation (Western Cartridge Co.), East Alton, Ill., completed construction of its 20,000-ton aluminum-reduction plant

at Tacoma, Wash., during 1942 and began producing aluminum in September. Its subsidiary, Kalunite, Inc., constructed a 36,000-ton alumina plant at Salt Lake City, Utah, which will use alunite from Marysvale, Utah, as a raw material. The plant is expected to start operations before June 1, 1943. Both the alumina and aluminum plants were built with Defense Plant Corporation funds and are Government-owned.

Other companies that were enlarged or built new facilities in connection with the aluminum expansion program (chiefly with Defense Plant Corporation funds) were: Pennsylvania Salt Mfg. Co.—a 10,000-ton (annual) synthetic cryolite plant at Cornwells Heights, Pa.; Extruded Metals Defense Corporation—a 9,000-ton tubing and extrusion plant at Grand Rapids, Mich.; Bohn Aluminum & Brass Corporation—a 17,000-ton expansion to extrusion plant at Los Angeles, Calif.; Revere Copper & Brass Co.—extrusion plant at Baltimore, Md., and a 3,900-ton forging plant at Rome, N. Y.; Chevrolet Motor Division—a 59,040-ton forging plant at Saginaw, Mich., and a forged-cylinder-head plant at Anderson, Ind., with a capacity of 600,000 heads a year; Aluminum Forgings Co.—a 7,500-ton forging plant at Erie, Pa.; Chrysler Corporation—a 1,650-ton forging plant at Detroit, Mich.; Tube Turns, Inc.—a forged-cylinder-head plant with a 600,000-head annual capacity; Buick Motor Co., Flint, Mich., Wright Aeronautical Corporation, Lockland, Ohio, M. L. Oberdorfer Brass Co., Syracuse, N. Y., Servel, Inc., Evansville, Ind., Ford Motor Co., Detroit and Dearborn, Mich., National Bronze & Aluminum Foundry Co., Cleveland, Ohio, Dodge Motor Co., Chicago, Ill., Caterpillar Tractor Co., Peoria, Ill., and Nash-Kelvinator Corporation, Kenosha, Wis.—cast-cylinder-head foundries; and Great Lakes Carbon Corporation—a 90,000-ton calcined-petroleum-coke plant.

Secondary.—Recovery of secondary aluminum in 1942 totaled 198,492 short tons compared with 106,857 tons in 1941 and 80,362 tons in 1940. The 198,492 tons recovered from secondary sources included 14,104 tons of pure metal (98.5+ percent), 180,979 tons of aluminum alloys, 1,268 tons of aluminum in brass and bronze, 473 tons in zinc base alloys, and 1,668 tons of aluminum in chemical products (1,648 in aluminum chloride and 20 in sodium aluminate). Production in the form of secondary aluminum ingot totaled 144,694 tons (83,933 in 1941). The secondary aluminum recovered in 1942 required the consumption of 217,611 tons of aluminum scrap, 43,248 tons or 20 percent of which was old scrap (45,329 tons or 36 percent in 1941), and 174,363 tons or 80 percent new scrap (81,118, or 64 percent in 1941). Remelters, smelters, and refineries used 73 percent of this scrap; aluminum rolling mills, 26 percent; and foundries and other manufacturers, 1 percent. Additional information on secondary aluminum is given in the chapter on Secondary Metals—Nonferrous.

CONSUMPTION

Apparent domestic consumption of primary aluminum in 1942 increased 94 percent over 1941. Consumption of secondary aluminum increased at approximately the same rate.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1938–42

Year	Primary aluminum					Secondary aluminum	
	Production		Imports (short tons)	Exports (short tons)	Apparent consumption [1] (short tons)	Short tons	Value [2]
	Short tons	Value					
1938	143,441	$56,659,000	[3] 8,870	6,309	89,523	38,800	$15,326,000
1939	163,545	64,600,000	9,290	36,632	167,646	53,947	21,309,065
1940	206,280	75,292,000	17,435	26,886	227,017	80,362	29,332,130
1941	309,067	100,395,000	13,358	7,405	302,788	106,857	34,707,153
1942	521,106	[4] 150,768,000	111,650	38,732	588,522	198,492	58,039,061

[1] Data not available on fluctuations in consumers' stocks. Withdrawals from producers' stocks totaled 31,443 short tons in 1939, and 30,188 in 1940; additions to producers' stocks totaled 56,479 tons in 1938, 12,232 in 1941, and 5,502 in 1942.
[2] Based upon average price of primary aluminum as reported to Bureau of Mines.
[3] Crude and semicrude, some of which may be secondary aluminum.
[4] Shipments.

Of the primary and secondary aluminum consumed in the form of fabricated products, about 60 percent went into airplane construction in airframes, landing gear, engines, propellers, and fittings. The greater part of the remainder was used in ship construction, tank engines, ordnance, and other military uses. Only a minimum of civilian needs, such as tools, some chemical equipment, and deoxidation in steel manufacture, were filled. Prewar uses of the metal, such as automobiles, trains, electrical conductors, furniture, household utensils, decorations, packaging, and bridge and building construction, have been virtually eliminated for the duration of the war.

Consumption of aluminum in 1943 will follow a pattern similar to that in 1942, but over-all consumption is expected to be nearly twice as large. Aircraft construction, which may reach 100,000 planes in 1943, will continue to demand the largest share of the available supply; Army, Navy, and Lend-Lease requirements will take most of the remainder; and indirect military and essential civilian consumption is expected to be allotted only about 8 percent of the total.

PRICES

Throughout 1942 the New York open-market base price of primary aluminum remained at 15 cents a pound for lots of 10,000 pounds or more, 99 percent plus pure ingot aluminum, delivered. Deductions allowed for transportation charges on orders of 500 pounds or more cannot exceed the lowest carload rate of rail freight. On December 5, 1942, the Aluminum Co. of America for the first time in recent years included pig aluminum in its price schedule. The price was set at 14 cents a pound for guaranteed 99 percent average minimum purity and is subject to the same transportation deductions as primary ingot.

Prices of fabricated and semifabricated products have been reduced substantially since the beginning of 1942. These reductions are attributed to mass production, manufacturing improvements, lowered operating costs, and continued research.

Price schedule No. 2, Aluminum Scrap and Secondary Ingot, was originally issued and effective March 24, 1941. During 1942 a total of 12 price actions was taken with respect to this schedule,

which was reissued effective February 17, 1942, embodying all previous amendments. Since that date, sales of idle inventories to Metals Reserve Co. at the order of the War Production Board have been exempt from the order; prices have been set on additional grades of scrap; all grades of obsolete scrap except pure cable have been reduced in price; payment for contaminated aluminum-containing

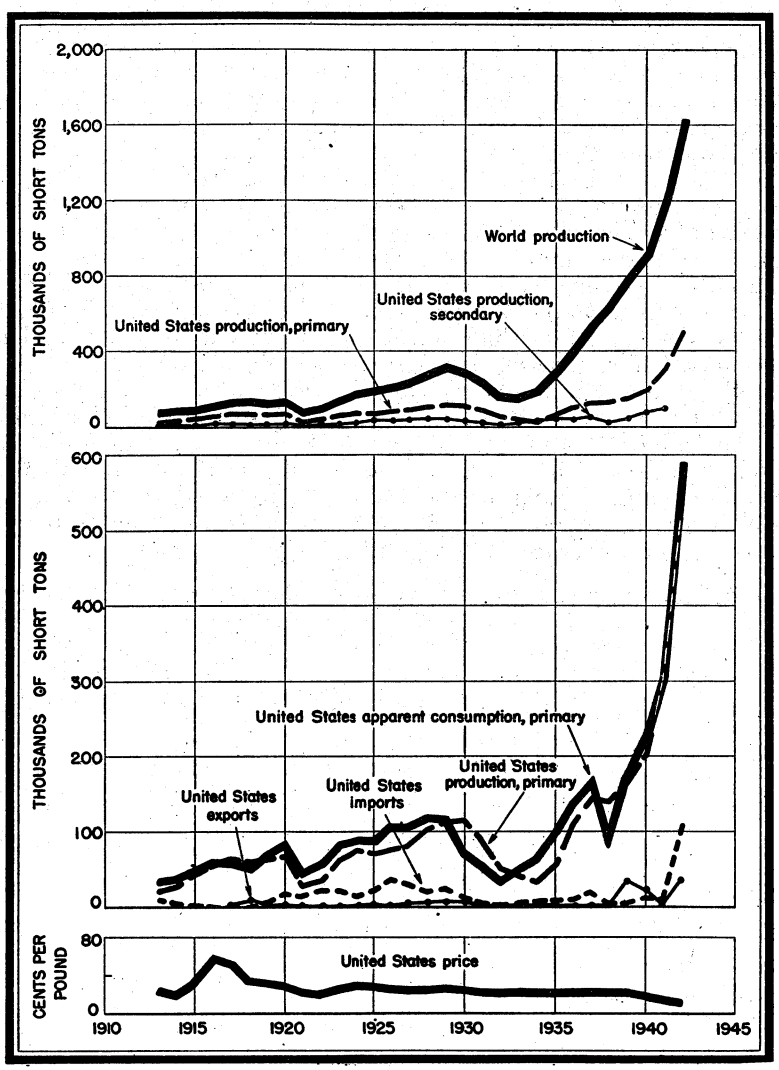

FIGURE 2.—Trends in production, imports and exports, apparent consumption, and average quoted prices of aluminum, 1913–42. Price is for No. 1 virgin 98–99 percent at New York through 1929, thereafter for 99-percent-plus virgin ingot, as reported by American Metal Market.

material has been limited to the actual metal contained; and a maximum price has been set for aluminum-bearing materials. On November 11, 1942, the Office of Price Administration announced that a premium of one-half cent a pound would be allowed in baled or packaged scrap sales to primary producers and 1 cent a pound for

briquetted scrap. On January 5, 1943, the Office of Price Administration announced the establishment of a maximum base price of 15 cents a pound for secondary ingot, and lower prices were set for low-grade alloys. The effect of this amendment was to rearrange and simplify the former classification of secondary ingot, and it had only a slight effect on prices.

FOREIGN TRADE

Imports and exports of crude and semicrude aluminum in 1942 were 736 and 419 percent more, respectively, than in 1941. The value of imports and exports of manufactured aluminum products increased 870 and 291 percent, respectively. Imports, exclusive of scrap, constituted 19 percent of the apparent consumption of primary aluminum in 1942. Of the imports of crude (105,795 short tons), less than 1 ton came from Curaçao and the remainder from Canada; of semicrude (5,855 tons), 5,799 tons came from Canada, 56 tons from Mexico, and less than 1 ton from other countries; and of scrap (487 tons), 464 tons came from Canada, 3 from Iceland, 2 from Panama, 8 from Canal Zone, 2 from Peru, 3 from New Zealand, 5 from Mexico, and less than 1 ton each from Curaçao, Cuba, Haiti, Venezuela, Chile, British East Africa, and the Bahamas.

Of the crude aluminum exported in 1942 (17,834 short tons), 439 tons went to Canada, 2 to Argentina, 1,704 to the United Kingdom, 4 to Australia, 111 to Brazil, 15,566 to U. S. S. R., 2 to India, 5 to China, 1 each to Chile and Surinam, and less than 1 ton to Canal Zone, Peru, and Egypt; of semicrude (20,898 tons), 3,715 tons went to the United Kingdom, 12,162 to U. S. S. R., and 5,021 to other countries; and of scrap (32 tons), all went to Canada.

Aluminum imported for consumption in the United States, 1940–42, by classes

Class	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Metal and alloys, crude	17,435	$4,628,601	12,830	$3,333,642	105,795	$33,148,393
Scrap	648	108,035	55	13,440	487	131,142
Plates, sheets, bars, etc	1	592	528	271,675	5,855	2,204,331
	18,084	4,737,228	13,413	3,618,757	112,137	35,483,866
Manufactures:						
Leaf (5½ by 5½ inches)	(1)	12,138	(1)	14,825	----------	----------
Powder in leaf (5½ by 5½ inches)	----------	----------	(2)	74	----------	----------
Bronze powder and powdered foil	----------	----------	22	28,044	(3)	4
Foil less than 0.006 inch thick	471	389,868	117	110,166	(3)	37
Table, kitchen, hospital utensils, etc	4	5,149	2	3,620	(3)	91
Other manufactures	(4)	15,541	(4)	52,057	(4)	1,639,659
	(4)	422,696	(4)	208,786	(4)	1,639,791
Grand total	(4)	5,159,924	(4)	3,827,543	(4)	37,123,657

[1] 1940: 10,244,034 leaves; 1941: 11,113,500 leaves; equivalent in pounds not recorded.
[2] 1941: 50,000 leaves; equivalent in pounds not recorded.
[3] Less than 1 ton.
[4] Quantity not recorded.

Aluminum exported from the United States, 1940–42, by classes

Class	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Ingots, slabs, and crude	12,227	$5,352,151	750	$325,218	17,834	$5,514,562
Scrap	955	331,757	57	22,352	32	1,157
Plates, sheets, bars, etc.	14,659	12,235,124	6,655	4,445,018	20,898	14,024,022
	27,841	17,919,032	7,462	4,792,588	38,764	19,539,741
Manufactures:						
Tubes, moldings, or other shapes	1,233	1,273,793	367	550,606	3,392	5,390,267
Table, kitchen, and hospital utensils	421	482,869	298	281,851	138	161,806
Foil	1,404	1,221,590	274	246,259	129	121,800
Powders and pastes (aluminum and aluminum bronze)	440	370,061	[1] 239	206,776	[1] 1,313	651,802
Other manufactures	[2]	1,169,780	[2]	794,442	[2]	1,000,028
	[2]	4,518,093	[2]	2,079,934	[2]	7,325,703
Grand total	[2]	22,437,125	[2]	6,872,522	[2]	26,865,444

[1] Aluminum content.
[2] Quantity not recorded.

TECHNOLOGIC DEVELOPMENTS

One of the most important technologic advances of 1942 was the development of the lime-soda-sinter method for treating red mud tailings from the Bayer process. Lime-soda-sinter units are being constructed at the four Aluminum Co. of America alumina plants at Mobile, Ala., Baton Rouge, La., Hurricane Creek, Ark., and East St. Louis, Ill., and will operate in conjunction with the Bayer plants by a combination process developed in pilot-plant experimentation at East St. Louis. High-silica bauxite will be treated directly by the Bayer process, and the red mud tailings will be sintered with lime and soda ash in rotary kilns. The sintered material will be leached, and the sodium aluminate liquor thus obtained will be added to the Bayer liquors. No increase in alumina capacity is to be expected from this process; it is solely a means of extracting a larger percentage of alumina from high-silica bauxites than is possible by the Bayer method.

Much research was carried out in 1942 and early 1943 on the problem of obtaining alumina from clay and other materials. Kalunite, Inc., in its pilot plant at Salt Lake City has further developed and perfected its process for the production of alumina from Marysvale (Utah) alunite. By this process the alunite is crushed, roasted, and dissolved in sulfuric acid, after which the basic alum, formed by decomposition of crystallized potash alum, is sintered. The sintered product is leached, leaving the insoluble alumina behind.

Investigations and research on the extraction of alumina from clay, low-grade bauxite, and alunite, and on the beneficiation of aluminous ores are being carried out by the Bureau of Mines in its laboratories and pilot plants at Tuscaloosa, Ala.; Rolla, Mo.; Salt Lake City, Utah; Boulder City, Nev.; College Park, Md.; Norris, Tenn.; and Seattle, Wash.

The presence of minor alloying elements commonly found as impurities in aluminum was studied with respect to the allowable limits of impurities and their effect on the physical properties of aluminum casting alloys.[2] Continued expansion in capacity and number of sand casting foundries resulted in improved foundry techniques and greater output.[3] Advancement in plating on aluminum as the base material was marked in 1942,[4] and studies were made on the electrodeposition of aluminum on other metals.[5] The cleaning and finishing of aluminum used on warplanes received much attention.[6] Improved alloying technique and numerous patents for new alloys accompanied the expansion of fabricating facilities.[7] The Aircraft Parts Division of the Reynolds Metals Co. is producing finished aircraft parts at its Louisville, Ky., plant and shipping them direct to aircraft manufacturers, thereby greatly reducing the usual 3- to 6-month delay in scrap return when sheet instead of finished parts is shipped.[8]

Anhydrous aluminum sulfate can be produced from commercial aluminum sulfate by a process that avoids the mechanical difficulties caused by transformation of the salt through a fluid, sticky stage previously considered unavoidable (U. S. Patent 2,304,519). A new process has been developed for the production of an aluminum chloride catalyst by soaking pieces of a suitable carrier material in a bath of molten anhydrous aluminum chloride (U. S. Patent 2,295,977).

WAR MEASURES

Mandatory priorities restricting delivery, processing, use, and inventories, which had been placed on aluminum by the Office of Production Management on March 22, 1941, were kept in force throughout 1941 and 1942. The original order, M–1, was changed and revised by the War Production Board. The order in force on April 1, 1943, was M–1–i, effective August 18, 1942, and last amended November 20, 1942; it provides for complete allocation control of virgin and secondary metal.

Order M–1–d, covering aluminum scrap containing more than 15 percent aluminum, became effective January 7, 1942, and prohibits the use of scrap, except home scrap, without the authority of the Director of Industry Operations. The order does not apply to virgin-aluminum producers or approved smelters. Each plant generating 1,000 pounds or more of scrap must segregate scrap at the machine and all 17S, 24S, and 52S alloy scrap in solid form must be sold to Aluminum Co. of America or Reynolds Metals Co. Other segregated scrap must be sold to these companies or approved dealers and smelters and the identity of segregated scrap must be certified to by the seller.

Manufacture and sale of aluminum pigments and paints was prohibited by order M–1–g effective March 10, 1942.

[2] Bonsack, Walter, Effects of Minor Alloying Elements in Aluminum Casting Alloys: Iron Age, vol. 150, No. 7, August 13, 1942, pp. 68–74.
[3] Allen, Arthur H., Buick Speeds Production of Aluminum Alloy: Foundry, vol. 70, No. 12, December 1942, pp. 66–71, 150–153.
[4] Yates, Raymond F., Plating on Aluminum: Metals and Alloys, vol. 16, No. 6, December 1942, pp. 1084–1088.
[5] Ostrow, B. D., A Résumé on the Electrodeposition of Aluminum: Metal Finishing, February 1943, pp. 70–72.
[6] Faulhaber, Frank V., Finishing Warplanes: Metal Finishing, vol. 41, No. 2, February 1943, pp. 113–119.
[7] Robinson, J. Towns, Development of Aluminum Alloys: Metallurgia, vol. 27, No. 158, December 1942, pp. 41–44.
[8] Froelich, M. H., Producing Aircraft Parts at the Aluminum Mill: Aero Digest, vol. 42, No. 1, January 1943, pp. 104, 109–110, 113–114.

On August 1, 1942, order M–1–h, fully allocating bauxite and alumina, became effective. For the purpose of this order bauxite was defined as "restricted" and "nonrestricted." Restricted bauxite (containing less than 15 percent silica) was further subdivided into high-silica restricted (8 to 15 percent silica) and low-silica restricted (less than 8 percent silica). The purpose of the order is to make certain that the higher grades of ore are allocated to the most essential needs and that no user who can use nonrestricted ore receives any of the high-grade material. Alumina and primary alumina products are stringently controlled by the order in an effort to divert all possible calcined alumina to the aluminum industry and essential abrasive uses, and small quantities of primary alumina products are manufactured and allocated to essential uses, largely refractories, catalysts, and the production of certain chemical products.

On November 2, 1942, the War Production Board announced a new long-range plan for controlling the flow of critical materials into war uses—the widely heralded Controlled Materials Plan. Under it, requirements for critical materials will be adjusted to the available supply, and the quantity and type of materials required will be available at the time and place necessary to meet approved programs. The plan, in effect a vertical allotment system, was applied to the three most basic and critical materials—aluminum, copper, and steel—and became effective in its transitory stages in the second quarter of 1943. The former horizontal allotment system—the Production Requirements Plan—will be completely replaced by the Controlled Materials Plan by July 1, 1943, for the above-mentioned critical materials.

WORLD BAUXITE AND ALUMINUM INDUSTRIES

Production and consumption of aluminum reached an unprecedented record in 1942, and this high mark will be considerably exceeded in 1943; most of the increase will be from expanded facilities in North America.

World production of bauxite, 1938–42, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942
Australia:					
New South Wales	442	[1]	[1]	[1]	[2] 4,000
Victoria	1,341	820	[2] 1,000	[2] 1,000	
Brazil (exports)	12,928	18,279	82	14,365	12,397
Czechoslovakia	[1]	[1]	[1]	[1]	[1]
France	682,440	[2] 800,000	[2] 700,000	[2] 700,000	[2] 650,000
Germany	19,703	[2] 20,000	[2] 20,000	[2] 25,000	[2] 25,000
Gold Coast			[1]	[2] 15,000	[2] 45,000
Greece	179,886	186,906	[2] 50,000	[2] 50,000	[2] 50,000
Guiana:					
British	382,409	483,653	[2] 700,000	1,089,833	[2] 1,175,000
Netherlands (Surinam)	377,213	511,619	615,434	1,198,900	[2] 1,245,000
Hungary	540,718	485,000	[2] 647,000	[2] 1,000,000	[2] 1,200,000
India, British	15,005	9,121	[2] 15,000	[2] 25,000	[2] 30,000
Indochina	160	330	118	[2] 1,000	[2] 1,000
Ireland			[1]	[2] 40,000	[2] 100,000
Italy	360,837	483,965	[2] 530,000	[2] 600,000	[2] 400,000
Japan	[2] 20,000	[2] 39,000	[2] 43,000	[2] 50,000	[2] 75,000
Netherlands Indies	245,354	230,668	274,345	171,821	[2] 160,000
Portuguese East Africa		180	1,030	[2] 1,000	[2] 1,000
Rumania	11,807	10,460	[2] 40,000	[2] 40,000	[2] 40,000
Southern Rhodesia				[2] 1,000	[2] 1,000
Spain			271	[1]	[1]
Unfederated Malay States: Johore	55,965	93,737	63,787	[2] 75,000	[2] 75,000
U. S. S. R.	[2] 250,000	[2] 270,000	[2] 300,000	[2] 250,000	[2] 275,000
United States (dried-bauxite equivalent)	315,906	381,331	445,958	908,525	2,511,385
Yugoslavia	396,368	318,840	[2] 290,000	[2] 400,000	[2] 200,000
	3,869,000	4,344,000	4,737,000	6,657,000	8,276,000

[1] Data not available.
[2] Estimated production. Estimates for 1939, 1940, 1941, and 1942, by the authors.

World production of aluminum, 1938–42, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942
Canada	66,000	75,000	[1] 100,000	[1] 200,000	[1] 300,000
France	45,300	50,000	[1] 59,000	[1] 62,200	[1] 70,000
Germany	161,100	[1] 210,000	[1] 240,000	[1] 300,000	[1] 350,000
Austria	4,500				
Hungary	1,500	1,500	[1] 2,800	[1] 5,000	[1] 5,000
India					[1] 500
Italy	25,800	34,200	[1] 40,000	[1] 50,000	[1] 45,000
Japan	17,000	23,000	[1] 35,000	[1] 65,000	[1] 90,000
Norway	29,000	31,000	[1] 28,000	[1] 18,000	[1] 22,000
Spain	651	[1] 800	271	[1] 700	[1] 800
Sweden	2,400	2,700	[1] 2,000	[1] 2,500	[1] 2,000
Switzerland	27,000	28,000	[1] 31,000	[1] 25,000	[1] 25,000
U. S. S. R.	43,800	[1] 73,000	[1] 75,000	[1] 55,000	[1] 55,000
United Kingdom	23,300	25,000	[1] 28,000	[1] 35,000	[1] 50,000
United States	130,100	148,400	187,100	280,383	472,737
Yugoslavia	1,200	2,400	[1] 2,800	[1] 3,000	[1] 3,000
	578,700	705,000	831,000	1,101,800	1,491,000

[1] Estimated production. Estimates for 1939, 1940, 1941, and 1942 by the authors.

World production of bauxite is estimated to have reached approximately 8,276,000 metric tons in 1942, 24 percent more than in 1941 and 114 percent more than in the pre-war year 1938. Of the world output in 1942, it is thought that the production in Axis dominated or controlled territories was 2,876,000 tons or 35 percent and that 5,400,000 tons or 65 percent was under United Nations control.

The aluminum produced in 1942 is estimated to have totaled 1,491,000 metric tons, 35 percent more than in 1941 and 158 percent more than in 1938. Of the world output in 1942, it is thought that production under the control or domination of the Axis in Europe and the Far East was 612,800 tons, or 41 percent, and under total United Nations control 878,200 tons, or 59 percent.

REVIEW BY COUNTRIES

Australia.—Bauxite is mined at Bundanoon, New South Wales, for use as a flux in steel manufacturing by Broken Hills Proprietary, Ltd., and at Nahoo and Boolara, Victoria, for chemical purposes and alumina production by Sulphates, Ltd., at Melbourne. According to present plans the production of bauxite will not exceed 5,000 tons in 1943. Sulphates, Ltd., the only producer of alumina in the Commonwealth, has a plant of 1,000 tons annual capacity and successfully uses a sodium bisulfate process developed by Michael Martin as an improvement on the Penniakoff process. It is reported that an acid process using ammonium sulfate is under consideration in plans for a possible expansion of alumina capacity. Proposals to erect a reduction plant at Sydney apparently have not yet materialized and may have to wait until after the war. Fabricating facilities have been greatly expanded, and it is reported that consumption of ingot has nearly doubled.

Brazil.—Construction has been nearly completed on the 10,000-ton alumina plant and 2,000-ton reduction plant of the Companhia Electro-Chimica Brasileira at Saramenha, near Ouro Preto, Minas Gerais. These plants will be able to fill present Brazilian domestic needs for alumina and aluminum. The Gambe deposit near Ouro Preto with a 2,000,000-metric ton reserve will supply the alumina

plant with ample high-grade material. Negotiations have been continuing between Brazil and the United States to obtain equipment for mining the Pocos de Caldas deposits and for the construction of a 40,000-ton alumina plant and a 20,000-ton reduction plant near São Paulo. The bauxite deposits on the Pocos de Caldas Plateau are said to contain 7,000,000 tons of proved reserves. Estimates by the Brazilian Government indicate 120,000,000 tons of possible ore. Analyses of the bauxite range from 57 to 61 percent Al_2O_3, according to a reliable source. Power for the reduction plant would be obtained from standby power from the São Paulo Tramway Light & Power Co. at Serra Cubatao and from two additional units to be constructed. Exports of bauxite from Brazil in 1942 totaled 12,397 metric tons compared with 14,365 tons in 1941.

British Guiana.—Exports of bauxite by the Demerara Bauxite Co., Ltd., and the Berbice Co., Ltd., totaled 1,116,463 long tons in 1942, of which 872,138 tons went to Canada, 204,750 to the United States, 39,574 to the United Kingdom, and 1 to Trinidad. The Berbice Co., Ltd., began sending dried bauxite by barge from its property 130 miles up the Berbice River to the loading point of Everton in the early spring of 1942 for shipment to Canada. This company has been shipping bauxite solely to Canada. The Demerara Bauxite Co., Ltd., is reported to have opened up a new deposit of bauxite 40 miles up river from the port of MacKenzie. The Demerara River was being dredged in late 1942 to facilitate transport of ore by allowing deeper draught vessels to load farther upstream.

Canada.—Compared with 1942, Canadian aluminum production is expected to increase more than 50 percent in 1943. The estimated rate of production to be attained in 1943 is 508,000 tons. The gigantic facilities of the Aluminum Co. of Canada for alumina and aluminum at Arvida, Quebec (1,050,000-ton alumina plant and 360,000-ton reduction plant) are by far the largest in the world and at capacity will supply nearly one-fourth of the metal to be produced annually in the Western Hemisphere. Other Canadian reduction plants, all owned by the Aluminum Co. of Canada, are at Shawinigan Falls (75,000 tons capacity), Beauharnois (25,000 tons capacity), Le Touque (25,000 tons capacity), and Isle Maligne (15,000 tons capacity). With the exception of one potline at Isle Maligne all the above plants were in full operation on May 1, 1943. A lime-soda-sinter plant will be completed in the third quarter of 1943 at Arvida for use in conjunction with the present Bayer facilities if the shipping situation should deteriorate further and necessitate the importation of relatively high-silica Arkansas bauxite from the United States. Since 1939 aluminum-fabricating facilities have been greatly expanded, principally at Kingston, Ontario, where strong-alloy sheet, extrusions, and forgings are made, partly for United States consumption. Rolled screw machine and rivet stock is produced at Shawinigan Falls, Quebec, and sheet and castings at Toronto, Ontario. At Toronto a new sand-casting foundry is producing 200,000 pounds of castings a month. The Kingston forging plant is turning out 10,000 propeller blades a month, most of which are for the United States.

To save shipping space bauxite cargoes from British Guiana and Surinam were unloaded largely at eastern United States ports, principally New York, and then shipped by rail or rail and barge to the alumina plant at Arvida.

Central America.—Bauxite deposits have been reported from Nicaragua, Honduras, and El Salvador. No definite information is available on grade or reserves, but exploration is being pressed.

China.—Large deposits of aluminous material have been discovered in western China in the Provinces of Yunnan and Szechwan. It is reported that exploitation will be undertaken by the Chinese Economic Ministry.

Colombia.—A deposit of bauxite has been reported in the region of San Martin, Intendencia del Meta.

France.—French aluminum production in 1941 was only 62,200 tons, falling short of its objective of 70,000 tons by about 10 percent. Fuel, power, and rail shortages probably were the primary causes, aided by labor shortages and labor troubles. Production in the first quarter of 1942 is reported to have been at a rate slightly exceeding 70,000 tons. The well-known French firm of Alais, Froges & Camargue (Pechiney) is understood to have expanded its capacity by constructing two new plants at the suggestion of the Germans. The company capital was doubled to more than 800,000,000 French francs to make the expansion possible. During 1942 alumina was exported to Germany, and there is reason to believe that a substantial share of this was reshipped to Norway. According to Vichy several hundred French prisoners of war were sent back from Germany to work in the bauxite mines in the Brignoles area.

Germany.—German and Austrian aluminum production in 1942 has been estimated at 350,000 tons. Larger production, desperately needed to supply the Luftwaffe with planes, is thought to have been retarded by shortages of power, labor, and transportation. The power stations supplying electric energy for the aluminum plants are mostly based on lignite; labor for lignite mining and transport for bauxite seem to be the principal limiting factors in the German aluminum industry. Reports indicate that most German bauxite imports are from Hungary and southern France since transportation from these sources is easier than from the more remote bauxite districts of Croatia, Italy, and Greece. Intense effort is being put forth to recover all possible light-metal scrap, and remelters have been instructed to concentrate on 14 grades of remelted aluminum. Most of these grades are blended with virgin ingot for use, but some are sold direct to foundries by the Association of German Aluminum Smelting Works.

Gold Coast.—Deposits in the Gold Coast became one of the major sources of bauxite for the United Kingdom aluminum industry in 1942. Development is progressing rapidly, and it is hoped that 120,000 tons of ore will be produced in 1943. Plans are to increase annual production to 240,000 tons by the end of 1945. All bauxite being produced at present is from the Sefwi Bekwai area in the western province of the Colony. Britain wishes to obtain rolling stock and mining equipment from the United States to facilitate shipping and increase the capacity of the mines.

Major deposits of bauxite in the Gold Coast are the following: Yenahia group, Ashanti, where reserves, including highly ferruginous bauxite, are estimated at 168,000,000 tons, some of which analyzes 1 percent SiO_2 and 63 percent Al_2O_3 and is 20 feet thick; Affoh group, Sefwi Bekwai, with estimated usable reserves of 32,130,000 tons; Asafo, N. W. Sefwi, 5 miles north of Asempanaiye, where 15,000,000 tons average more than 55 percent Al_2O_3; and Mount Ejuanema,

Kwaho, 2 miles from the railhead at Nkawkaw and 112 rail miles from the port of Accra, with estimated reserves of 4,000,000 tons of massive and rubbly bauxite. Numerous other minor deposits are scattered throughout the country and occur mainly as cappings of aluminous laterite on flat-topped hills. High-grade chemical ore exists in the Gold Coast to some small extent, but on the average the bauxite found here is comparatively low in silica and high in iron. Tremendous tonnages of metallurgical ore are available.

Hungary.—According to recent reports the world's richest bauxite deposits have been discovered in the mountain region of Borzoeny, Hungary. No statement of the size of this deposit has been made, but before its announcement bauxite reserves in Hungary had been estimated at 250,000,000 tons. The deposits of the Vertesgebirge alone contain 120,000,000 tons and are mined by open-cut methods. Operating companies in this area are members of Bauxit Trust A. G., Zurich, and export most of the production to Germany. The small quantity used domestically is consumed by the alumina plant of the Bauxite Industry Co., a subsidiary of Bauxit Trust A. G., which supplies the 3,000-ton reduction plant at Csepel and the 2,000-ton reduction plant of the Hungarian General Coal Mining Co. at Tatabanya. Bauxit Trust A. G., in 1942 established a Hungarian subsidiary, Donautaler Tonerdeindustrie A. G., to produce alumina near one of the existing reduction plants. The capital of the new company, 35,000,000 pengo, is divided between the Hungarian state, Bauxit Trust A. G., and Aluminium Werke A. G., Berlin. Ungarische Bauxitgruben A. G. has started to construct its 20,000-ton alumina and 10,000-ton reduction plant at Ajka near Veszprem. To ensure sufficient power for these plants a power unit producing 250,000,000 kw.-hr. a year was erected. This expansion will cover domestic requirements of the metal and will leave a balance for export to other European countries without greatly affecting bauxite exports. The extent to which the Hungarian aluminum industry can be expanded depends on power sources. Since the return of northern Transylvania to Hungary, plans are said to be proceeding for generating more hydroelectric power in the Carpathians.

India.—Titaniferous bauxite has been located in Jashpur State, Chota Nagpur, India. The deposits, however, are far from rail facilities, and the nearest important town—Ranchi—is 100 miles eastward. Exploration has continued on the bauxite deposits in the Shevaroy Hills in Madras. The Aluminium Corporation of India, Ltd., an Indian-owned company, has a 6,000-ton alumina plant at Anupuagar near Asansol; bauxite deposits are nearby. A reduction plant was also started there several years ago, but owing to shortages of material it probably cannot be completed until after the war. Alumina production ceased after the production of 60 tons, and there appears to be no present prospect of its being resumed. The Aluminium Production Co. of India, Ltd., part British- and part Canadian-owned, has constructed a reduction plant at Alwaye, Travancore, which is reportedly producing at the rate of 1,500 tons annually. Capacity will be nearly doubled when additional power facilities have been installed. Alumina for the plant is being supplied from a pre-war stock pile which appears to be running low. Efforts to bring the alumina plant at Anupuagar back into production have been unsuccessful. The Aluminium Production Co. of India, Ltd., also owns and operates a fabricating plant at Calcutta which, with small additions,

can turn out 2 million pounds of strong alloy sheet a year. The necessary equipment will be installed by October 1943.

Ireland.—It is estimated that 100,000 tons of bauxite were shipped to Britain from Ireland in 1942. Bauxite occurs in commercial quantities in County Antrim in northeastern Ireland, where it is found in lenticles and irregular masses between two basaltic flows. The individual deposits appear to have no great extent or thickness.

Italy.—The alumina and aluminum facilities of Italy are extremely vulnerable to Allied air attacks since the last Axis forces have been swept from Tunisia. It is not unlikely that the Italian light-metal industries will be greatly impaired by Allied air activities, if indeed they have not already been seriously disrupted. The following list gives the location of the alumina and aluminum plants:

Company:	Alumina	Aluminum
Ind. Nazionale Alluminio	Porto Marghera	Bolzano.
	Bolzano	
Societa Italiano Allumina	Porto Marghera	
Societa Ind. Min. El. Chim. (S. I. M. E.)	Bussi	
Societa Alluminio Veneto Anonima (S. A. V. A.).	Porto Marghera	Porto Marghera.
Societa Nazionale Alluminio		Mori.
Societa Alluminio Italiano		Borgofranco.

Two more reduction works have been proposed—at Ferrara and Manteca.

Jamaica.—Extensive deposits of low-silica, high-iron bauxite were discovered in Jamaica in the latter half of 1942. Preliminary estimates indicate that over 10,000,000 tons of ore are available in small deposits of 30,000 to 60,000 tons each. The deposits occur as parts of an unconsolidated mantle overlying Tertiary limestone of probable Oligocene age and are found in two general areas—the first 15 miles northwest of Old Harbor and the second 20 miles north of Kingston. Overburden is said to be light or absent over much of the ore. Analyses indicate the following composition of the bauxite: 46 to 49 percent Al_2O_3, 1 to 3 percent SiO_2, and 15 to 20 percent Fe_2O_3. The deposits are said to be accessible by rail and motor road to deep water harbors. The Government has decreed under the Defense Regulations that any bauxite or other minerals worked on the island shall become the property of the King and disposed of in accordance with Government regulations. Canada is reported to be planning to import 500,000 tons from this source in 1943 if the deposits can be put into operation soon enough and if certain technical difficulties involving the high iron content can be solved.

Japan.—No official information is available on activity in the alumina and aluminum industries during 1942. Japan's goal in her Four-Year Plan for light-metal production was reported to have been 140,000 to 150,000 metric tons. Present information indicates that this goal was revised downward considerably, and 1942 production is estimated at 90,000 metric tons. Japan has ample reserves of bauxite at her command in the Netherlands East Indies on Bintan Island, Johore, and the Japanese-mandated Caroline Islands. Plans were to import 50,000 tons of high-grade bauxite from the Caroline Islands in 1941 and to step up the import rate from Johore, Unfederated Malay States (75,000 tons estimated for 1941). According to German reports deposits of aluminous material in Korea, Formosa, and Manchuria will be developed by the Japanese light-metal industry.

Deposits estimated at 10,000,000 tons in the Japanese-mandated Caroline Islands (Palao, Panope, Yap, Marakaro, and Garasumao)

have been developed by the Nanyo Aluminium Industry Co., a subsidiary of the Japanese South Seas Development Co. The ore averages 55 percent Al_2O_3, 1 percent SiO_2, and 11 percent Fe_2O_3.

Liberia.—The chief deposits of bauxite noted are in the Bulcama and Gisima Sections of the Lorma or Buzi country, at Massao, between Kpaia and Zorzor and between Zorzor and Pisabu.

Netherlands East Indies.—Bauxite produced on the island of Bintan opposite Singapore and the neighboring islands of Angkoet and Kojang has been under the control of the Japanese since early 1942. Deposits estimated at 10,000,000 to 20,000,000 tons had been developed by the Nederlandische Indische Bauxiet Exploitatie Maatschappij on these islands, averaging about 54 percent Al_2O_3, 2 to 3 percent SiO_2, and 13 percent Fe_2O_3. The principal workings are at Soengi Kolak on the Kidjang Strait. Before Japanese occupation, the bulk of the production since 1939 had been exported to Japan. It is estimated that, when fully exploited, the deposits of the Netherlands East Indies can supply the Japanese aluminum industry with 400,000 tons of bauxite annually.

Norway.—Before the German occupation of Norway, six plants with a total capacity of 22,000 tons of alumina and 36,000 tons of aluminum were in operation. Rated annual capacities of the reduction plants were as follows: Stangfjord (owned by British Aluminium Co.), 800 tons; Vigolands Brug (owned by British Aluminium Co.), 3,500; Eydehavn (owned by Det. Norske Nitrid A. S.), 9,500; Hoyanger (owned by Norske Aluminium Co.), 8,000; Haugvik (Glomfjord) (owned by International Aluminium Co.), 9,000. Alumina capacity was concentrated at the Hoyanger plant which had a 22,000-ton rated annual capacity. Norwegian aluminum production was to have been raised to approximately 130,000 tons through German controlled and financed expansions, but latest indications are that numerous difficulties have appeared to greatly impede this plan. Not the least of the troubles experienced by the Germans has been the vexing problem of supplying Norway with bauxite and alumina from France, Hungary, and Germany. Swedish information indicates that some of the aluminum works have been closed by the Germans because of the raw material situation. Reports of sabotage of German equipment for the reduction plants and alumina plants are numerous and suggest another reason for German retrenchment in the expansion program.

Spain.—A new aluminum plant with an annual capacity of 8,000 tons will be built by Empresa Electro-Mecanica de Cordoba, in Spain. At present Aluminio Español at Sabinania with an annual peak capacity of 1,100 metric tons is the only light metal producer in this country. Production at Aluminio Español remained at only about 70 percent of capacity during 1942 owing to a power shortage.

Surinam.—Virtually all of the 1,150,000 long tons of bauxite exported from Surinam (Netherlands Guiana) in 1942 by the Surinamsche Bauxite Maatschappij (subsidiary of Aluminum Co. of America) and the N. V. Billiton Maatschappij went to the United States and Canada.

Sweden.—The A. B. Svenska Aluminium Kompaniet, which raised its capital in 1941 to 2,000,000 Swedish kronor, has been granted a Government credit of 1,000,000 kronor to finance expansions of its works. Importation of alumina from Norway to the Månsbo reduction works near Avesta was stopped in 1941; to meet the alumina

shortage a subsidiary, A. B. Svenska Aloxidverken, was formed and has constructed a plant at Kubikenborg near Sundsvall for the manufacture of alumina from andalusite. This plant began operation in the spring of 1942; the capacity, estimated at 6,000 tons a year, can be increased if necessary.

Switzerland.—Owing to an acute shortage of copper Switzerland has had to rely more and more on aluminum as a substitute, particularly for electrical purposes. This has resulted in a 50-percent cut in the exports of aluminum and a drastic series of regulations on the domestic use of the metal, especially in containers, furniture, cooking utensils, and luxury items.

Unfederated Malay States: Johore.—The principal bauxite deposits in Malaya now under Japanese domination are in South and West Johore. Deposits have been developed at Bukit Pasir and Sri Medan, near Batu Pahat, by the Japanese Ishihare Sangyo K. K. and at Perigi Achih, 12 miles east of Johore Bahru, by Chinese enterprise. The ore is said to average 52 to 61 percent Al_2O_3, 5 to 15 percent Fe_2O_3, and 2 to 7 percent SiO_2. Ports of shipment for the bauxite are at Batu Pahat and Penggarand. Virtually the entire output has been shipped to Japan since the opening of the mines in 1936.

United Kingdom.—It is estimated that British aluminum production in 1942 increased about 40 percent over that in 1941. The bulk of British requirements, however, continue to be filled largely from Canada. The Open General License permitting the importation of bauxite and cryolite into the United Kingdom has been revoked by the Board of Trade; separate licenses were required for goods dispatched to the United Kingdom after November 9, 1942, and imported into the United Kingdom after January 9, 1943. Prices of 99 percent ingot remained pegged at £110 a ton delivered.

Yugoslavia.—Bauxite production in Dalmatia and Hercegovina is reported to have declined from 270,000 tons in the first 6 months of 1941 to 106,000 tons in the same period of 1942. The Croatian Aluminum Co. has been formed in Agram with a capital of 20,000,000 kroner to erect an alumina plant with an annual capacity of 100,000 tons and a reduction plant with a 50,000-ton annual capacity near Hum, Hercegovina. Domestic bauxite will be furnished from large deposits in the Karst region of Dalmatia and Hercegovina where bauxite containing 54 to 60 percent Al_2O_3 and 1 to 2 percent SiO_2 is reported to occur in large quantities.

MERCURY

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

SUMMARY OUTLINE

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SUMMARY

The year 1942 marked continuation of the forward movement of mercury production in the Western Hemisphere. The output of 50,846 flasks in the United States is the highest since 1882 and has been surpassed in only eight previous years. Mexico and Canada established new peak rates by substantial margins, Chile and Peru likewise contributed to the total, and development was under way in other areas. Mexico's output was 32,443 flasks compared with the previous record of 23,137 flasks in 1941, and Canada's totals were 13,470 and 7,057 flasks, respectively. As pointed out in previous issues of Minerals Yearbook, developments in Western Hemisphere sources since the war began have exceeded expectations and, coupled with restrictive consumption measures, have solved United Nations problems with regard to this strategic metal.

Reports emanating from Italy and Spain, normally the principal mercury-producing nations, indicate that those countries also attained record output. These claims cannot be verified, and it does not seem entirely reasonable to suppose that they are true in view of the curtailed world markets available to the two countries. On the other hand, stocks in Spain are reported to have gained sharply; if this report is reliable, it would tend to confirm the claim of high production rates. If actually establishing production records, Spain and Italy together could readily be recovering over 140,000 flasks of mercury annually.

Despite conservation measures, consumption in the United States was again higher than in any other year, surpassing the previous record (that in 1941) by 11 percent. Domestic production for the year could slightly more than take care of domestic needs, but requirements in the second half of the year exceeded production by 7 percent.

Under arrangements made by the Metals Reserve Co., imports of metal attained new heights in 1942—a total of 38,911 flasks. It is expected that imports of metal will gain notably in 1943 because of anticipated receipts of constant amounts from Mexico, of substan-

tially more than double the quantity obtained from Canada in 1942, and of 2,000 flasks from Chile.

As exports of mercury were under strict control, the happy balance between production and consumption in the United States in 1942 would have permitted a stock-pile accumulation of virtually all the metal imported had not a large demand for metal developed in the U. S. S. R. and an urgent order been placed in the United States. The demand was due in large part to occupation of the principal Russian source of mercury, the Donets Basin, by the German Army. From October 1942 through February 1943 exports to the U. S. S. R. were officially reported to have totaled nearly 21,000 flasks.

Salient statistics of the mercury industry in the United States, 1938–42

[Flasks of 76 pounds]

	1938	1939	1940	1941	1942
Production.....flasks	17,991	18,633	37,777	44,921	50,846
Number of producing mines	91	107	159	197	184
Average price per flask:					
New York	$75.47	$103.94	$176.87	$185.02	$196.35
London	$66.92	$88.26	$201.10	$194.20	$227.87
Imports for consumption:					
Pounds	179,522	265,944	12,971	588,228	2,957,264
Equivalent flasks	2,362	3,499	171	7,740	38,911
Exports:					
Pounds	54,161	91,789	730,877	196,837	593,311
Equivalent flasks	713	1,208	9,617	2,590	7,807
Consumption.....flasks	[1] 19,600	[1] 20,900	26,800	44,800	49,700

[1] Apparent consumption.

Office of Price Administration.—Price-ceiling action taken by the Office of Price Administration in February 1942 was described in the Mercury chapter for 1941.

Metals Reserve Co.—In April, when permitted consumption lagged behind supplies available from domestic mines, the Metals Reserve Co. arranged to purchase surplus spot mercury from current domestic production at $192 a flask, f. o. b., New York. The program was enlarged in July to make it possible to dispose of metal at purchase depots established at many points throughout the country, and at that time it was extended conditionally through December 31, 1943. On March 30, 1943, the program was extended to December 31, 1944, with certain modifications regarding termination of purchases before that date. In projecting purchase agreements into the future, the Metals Reserve Co. recognized the premise that a sustained price, if at satisfactory levels, will insure greater production than will a rising price that may reverse itself at any moment.

Consumption restrictions.—Conservation Order M–78, issued January 23, 1942, restricted the use of mercury for certain purposes and discontinued its use for certain others; it was described in the Mercury chapter for 1941. In August 1942 the order was amended to add fireworks and preparations for film developing to the list of discontinued uses. The use of mercury for cosmetics or any preparation designed for bleaching the skin or removing freckles was cut to 30 percent.

Bureau of Mines and Geological Survey activities.—In continuing its search for strategic minerals, the Bureau of Mines investigated deposits of mercury in Idaho, Oregon, Nevada, California, and Alaska during the year.

An extensive area of mercury mineralization near the head of Cinnabar Creek in Valley County, Idaho, has been known since 1917. During 1941 and 1942 the Bureau of Mines completed 9,118 feet of diamond drilling on the Hermes, Annie Sell, and Pretty Maid claims, which resulted in the discovery of a large tonnage of commercial ore. It is estimated with reasonable assurance that underground operations upon a commercial basis may be continued for 3 to 5 years at a rate of about 300 flasks of mercury per month.

Early in 1942 the Bureau of Mines and the Geological Survey made preliminary examination of the Black Butte mine, south Lane County, Oreg. As a result of systematic sampling, which consisted of diamond drilling and extensive channel sampling on the 400-, 900-, and 1,100-foot mine levels, a large tonnage of low-grade ore was indicated.

Under a project called the Silver Spots Program, preliminary sampling was done on the following properties in Nevada: Reward Quicksilver mine, Mineral County; F and L Quicksilver mine, Esmeralda County; Mercury Mining Co., Nye County; Washington Hill property, Storey County; Thompson Quicksilver property, Nye County; B and B mine, Esmeralda County; Nevada Cinnabar mine, Nye County; Last Chance mine, Bottle Creek district; Rand mine, Ivanhoe district; Buckskin Peak, National district; and the Pershing Quicksilver mine, northeast of Lovelock. In Oregon the Bureau of Mines is conducting further exploration by churn drilling on the Bretz property in Malheur County.

The Guadalupe mine, 10 miles south of San Jose, Calif., is in one of the most productive mercury areas of the State. The Bureau of Mines has continued exploration in this area. The work has comprised trenching and test pitting of old dumps, as well as trenching and drilling of promising areas in search of new ore bodies; a substantial tonnage of low-grade ore is indicated.

Investigation and exploration continue on the mercury deposits in the Sleitmut area along the Kuskokwim River, Alaska. The Red Devil mine was explored during the summer and autumn of 1942, and a large tonnage of high-grade ore has been indicated. Other proved claims in the area include the Willis and Barometer and a number of small prospects where a potential reserve of 5- to 15-pound ore is available.

During 1942 the Geological Survey published reports on the mercury deposits of the Stayton [1] and Parkfield [2] districts, Calif.; Pike County, Ark.[3]; Wildhorse district, Nev.[4]; and Opalite district, Oreg. and Nev.[5] The Survey also issued general papers on the status of the industry[6] and concepts on the geology of mercury deposits in the United States.[7]

In California, field work was completed in the Guerneville district, Sonoma County, and the New Idria district, San Benito County.

[1] Bailey, E. H., and Myers, W. B., Quicksilver and Antimony Deposits of the Stayton District, Calif.: Geol. Survey Bull. 931-Q, 1942, pp. 405-434.
[2] Bailey, E. H., Quicksilver Deposits of the Parkfield District, Monterey and Kings Counties, Calif.: Geol. Survey Bull. 936-F, 1942, pp. 143-169.
[3] Gallagher, D., Quicksilver Deposits near the Little Missouri River, Pike County, Ark.: Geol. Survey Bull. 936-H, 1942, pp. 189-219.
[4] Dane, C. H., and Ross, C. P., The Wildhorse Quicksilver District, Lander County, Nev.: Geol. Survey Bull. 931-K, 1942, pp. 259-278.
[5] Yates, R. G., Quicksilver Deposits of the Opalite District, Malheur County, Oreg., and Humboldt County, Nev.: Geol. Survey Bull. 931-N, 1942, pp. 319-348.
[6] Ross, C. P., Mercury Mining Today in the United States: Eng. and Min. Jour., vol. 143, No. 9, September 1942, pp. 55-58.
[7] Ross, C. P., Some Concepts on the Geology of Quicksilver Deposits in the United States: Econ. Geol., September-October 1942, pp. 439-465.

A drilling project by the Bureau of Mines at New Idria, begun late in 1941, was completed. Geologic facts disclosed by drilling and by the Survey's detailed geologic mapping and interpretations are credited by the management as having led to the discovery of important new ore bodies. At the end of the year field work was in progress in the New Almaden district, Santa Clara County; Wilbur Springs district, Lake and Yolo Counties; Sulphur Bank district, Lake County; and the northwest and southeast parts of the Mayacmas district, Lake, Napa, and Sonoma Counties. A cooperative drilling and dump-sampling program was begun at the Guadalupe mine, New Almaden district, by the Geological Survey and Bureau of Mines. In Texas an exhaustive geologic study of all the mines in the Terlingua district was begun early in 1942 and was still in progress at the year end. In Oregon field work was completed on the Bonanza-Nonpareil and Horse Heaven districts, in Douglas and Jefferson Counties, respectively. Work was also in progress in the Meadows, Ochoco, and Blackbutte districts in Jackson, Crook, and Lane Counties. In Nevada, detailed geologic studies of the Pilot Mountains, Ivanhoe, and Relief (Antelope Springs) districts in Mineral, Elko, and Pershing Counties were completed. In addition to these larger districts, the Bureau of Mines and Geological Survey concluded a comprehensive sampling and mapping program that included nearly all the districts and isolated mines in the State and yielded concrete data on the reserves of commercial and marginal ores in Nevada. Supplementary reports were prepared on the only mercury-producing district in Washington and on the several mines in Arkansas. A detailed geologic study was made of the highly productive Hermes mine, Valley County, Idaho.

Preliminary investigations in Alaska were conducted at Decoursey Mountain, about 50 miles northwest of the Sleitmut area. In the Aleknagik area, Tikchik district, Southwestern Alaska, one promising prospect was investigated, and detailed but unsuccessful search was made for the bedrock sources of placer cinnabar in the Seventymile area in the Yukon region. In the Sleitmut area, Georgetown district, Southwestern Alaska, the Geological Survey continued investigations on five properties that were trenched and sampled by the Bureau of Mines. This work resulted in much more adequate determination of the surface outlines of several large ore bodies.

In Latin America detailed studies of the three most important mercury districts in Mexico—Nuevo Mercurio, Sain Alto, and Huahuaxtla—were made by the Geological Survey in the course of cooperative work with the Department of State. The work has been followed by significant increases in production. Study of an important prospect in Colombia was undertaken in cooperation with the Board of Economic Warfare.

Tests for mercury.—Since the outbreak of the present World War there have been many requests for information regarding specifications for mercury, tests to ascertain its purity, and other data along these lines. An article by Wichers [8] should be of interest in this connection.

[8] Wichers, Edw., Pure Mercury: Chem. and Eng. News, vol. 20, No. 17, September 10, 1942, pp. 1111-1112.

Wichers states—

> Virgin mercury, that is, mercury as produced at the mines, usually has a bright, mirrorlike surface and is clean except for traces of scum or perhaps particles of rust or other foreign matter from dirty containers. If such mercury is filtered through a pinhole in a paper cone, a glass filtering crucible, or several thicknesses of finely woven cloth into a clean, dry glass vessel and thereupon retains a bright and clean appearance, one can be sure that it does not contain so much as one part per million of any base metal. Metals more noble than mercury, that is, silver, gold, and platinum group elements, are not disclosed, but virgin mercury is not likely to contain them in amounts as great as a few parts in a million. Reclaimed mercury is generally as clean as the virgin metal, but may contain more of the noble metals because it is not always subjected to distillation in the reclaiming process.
>
> The statement that mercury which looks clean and does not show the behavior known as tailing is at least 99.9999 percent pure with respect to base metals may be challenged by many readers. It is indeed hard to believe that any commercial substance possesses such an exceptional degree of purity. But it can be demonstrated quite readily. To do so, drop about 0.5 mg. of tin foil into 100 grams of clean mercury in a small beaker or Erlenmeyer flask. Swirl the mercury around for a minute or so and observe the skin or crust that forms almost immediately. I think the observer will agree that the visible effect can be safely extrapolated to less than one part of tin in a million of mercury. Similar trials can be made with other base metals. The visible effects will not be exactly alike or appear equally rapidly, but they will be equally unmistakable.

PRICES

Monthly prices for mercury rose steadily throughout 1941 and into January 1942. Ceiling prices were established by the Office of Price Administration in February 1942; the details of the order (Price Schedule 93) were outlined in the Mercury chapter for 1941. Broadly, the prices ranged from $191 to $193 a flask, depending on the point of shipment. All other kinds and grades were to be sold at their normal differentials from the maximum prices established. Amendment 1 to Price Schedule 93 provided that, effective February 10 and until March 2, 1942, the schedule was not applicable to dealers who had mercury on hand or in transit on February 4 to meet contracts made before February 4. Press Release PM 2731, issued March 19, 1942, explained that the 2-percent premium allowed to dealers under the regulation could be split with another dealer or a broker but not with a producer if this would result in the producer obtaining more than the applicable maximum price. Amendment 1 to Revised Price Schedule 93 defined "mercury" as prime virgin mercury, redistilled mercury, reclaimed mercury, and all other kinds and grades of mercury. The amended schedule provided that, effective July 7, all kinds and grades of mercury sold in containers of 25 pounds or less should be sold and bought for not more than the normal differentials prevailing between October 1 and 15, 1941.

Under maximum price limitations the monthly quoted prices fell from $202.52 in January to $194.28 in June, remained at $194.43 for 3 months, and then advanced to $196 in November and December.

There is no evidence that any change has occurred in the average price for Spanish and Italian metal in what, for convenience, may be called the international market. As Germany was probably the principal consumer of mercury from these sources in 1942 and inasmuch as German methods of payment probably do not lend themselves to the restrictions of fixed prices, there is little question that the price indicated for Spanish and Italian metal was purely nominal.

The Control maximum prices for mercury in London were £48 15s. a bottle for over 1 bottle and less than 11 bottles and £48 for larger quantities, ex-sellers' premises in both cases. The prices were raised to £69 15s. and £69 in August, and they remained at these levels beyond the end of the year. Higher prices prevailed for lots under 1 bottle and for redistilled grades. There was speculation as to whether or not the advance in prices coincided with British purchased of Spanish metal.

Average monthly prices per flask (76 pounds) of mercury at New York and London and excess of London price over New York price, 1940–42

Month	1940			1941			1942		
	New York [1]	London [2]	Excess of London over New York	New York [1]	London [2]	Excess of London over New York	New York [1]	London [2]	Excess of London over New York
January	$156.96	$169.50	$12.54	$165.85	$193.64	$27.79	$202.52	$194.69	[3] $7.83
February	178.00	207.00	29.00	170.18	193.43	23.25	197.27	194.69	[3] 2.58
March	180.92	207.00	26.08	177.69	193.53	15.84	197.05	194.68	[3] 2.37
April	173.54	181.32	7.78	180.08	193.19	13.11	197.10	194.69	[3] 2.41
May	181.54	168.34	[3] 13.20	180.00	194.50	14.50	197.30	194.69	[3] 2.61
June	197.36	189.44	[3] 7.92	183.92	194.52	10.60	194.28	194.69	.41
July	194.42	207.36	12.94	188.58	194.56	5.98	194.43	194.69	.26
August	184.11	216.84	32.73	192.00	194.53	2.53	194.43	257.56	63.13
September	173.33	219.86	46.53	192.44	194.58	2.14	194.43	278.52	84.09
October	168.85	219.78	50.93	193.62	194.59	.97	195.35	278.52	83.17
November	168.39	219.94	51.55	196.27	194.65	[3] 1.62	196.00	278.52	82.52
December	164.96	206.79	41.83	199.65	194.69	[3] 4.96	196.00	278.52	82.52
Average	176.87	201.10	24.23	185.02	194.20	9.18	196.35	227.87	31.52

[1] Engineering and Mining Journal, New York.
[2] Mining Journal (London) prices in terms of American money through March 1940. Thereafter prices in terms of pounds sterling are converted to American money by using average rates of exchange recorded by Federal Reserve Board. Official prices, established early in May 1941, were £47 15s. to £48 15s. per flask until August 1942, when they were raised to £68 10s. to £69 15s.
[3] New York excess.

CONSUMPTION

Requirements for mercury gained in 1942 despite the restrictions placed on certain uses by the War Production Board, and a new high record rate of consumption was attained. Consumption was relatively stable in the first 3 quarters of the year, amounting to 10,300, 11,500, and 11,000 flasks. A 55-percent rise took place in the fourth quarter owing to some special orders for military purposes. Consumption in the 5-year period 1938–42 is shown in the following table, figures for 1938 and 1939 having been computed by the conventional method of adding production to imports and deducting exports, because of the absence of more precise information.

Data showing consumption of mercury by uses are shown in the second table following.

Supply of mercury in the United States, 1938–42, in flasks of 76 pounds

Year	Production	Imports for consumption	Exports	Consumption
1938	17,991	2,362	713	[1] 19,600
1939	18,633	3,499	1,208	[1] 20,900
1940	37,777	171	9,617	26,800
1941	44,921	7,740	2,590	44,800
1942	50,846	38,911	7,807	49,700

[1] Apparent consumption.

Mercury consumed in the United States in 1942, in flasks of 76 pounds

Use	Flasks [1]	Use	Flasks [1]
Pharmaceuticals	8,088	Electrical apparatus	4,550
Dental preparations	1,198	Industrial and control instruments	[2] 3,529
Fulminate:		Amalgamation	180
Munitions	4,146	General laboratory use	294
Blasting caps		Vermilion	215
Munitions other than fulminate	3,684	Felt manufacture	20
Agriculture	1,533	Redistilled	[2] 6,175
Antifouling paint	1,220	Other	[3] 9,103
As a catalyst or in the electrolytic preparation of—			[1] 49,700
Chlorine	549		
Caustic soda			
Acetic acid	1,410		
Other	1,843		

[1] The items are on a partial-coverage basis and do not add to the total, which has been increased to cover approximate total consumption.
[2] About half of the quantity shown under "Redistilled" was for use in industrial and control instruments.
[3] Of this total, 1,028 flasks were for a new chlorine-plant installation and to replace mercury-boiler leakages. It is deemed inadvisable at this time (May 1943) to divulge details covering 4,700 flasks.

Inasmuch as figures for 1941 were not obtained for the entire year upon the same basis, possibly the best means of comparing 1941 and 1942 data is to examine the total for 1942 in comparison with double the quantities reported for the latter half of 1941. Upon this basis the 1942 totals compare with 1941 as follows: Pharmaceuticals +51 percent, dental −2, fulminate +29, agriculture −61, vermilion −79, antifouling paint −10, felt manufacture −98, chlorine and caustic soda +77, acetic acid −15, other catalytic use −23, and amalgamation −44 percent. Production of redistilled mercury from virgin metal used 43 percent more metal in 1942 than twice the amount used in the latter half of 1941, and "other" uses were up well over 600 percent. Supplemental canvasses in 1941 and 1942 show that 50 percent or more of the metal redistilled is used to make industrial and control instruments, 16 percent for electrical apparatus, and 14 percent for dental purposes. A break-down of the quantities shown as "redistilled" in the table, therefore, would add substantially to the amounts used for these purposes. "Other" in 1942 includes mercury amounting to 4,700 flasks, the uses of which it is inexpedient to reveal at this time. Also reported under the "Other" class in 1942 are 1,028 flasks used in a new electrolytic chlorine-plant installation and in replacing metal leakages in mercury power boilers.

STOCKS

Inventories of mercury in the hands of consumers and dealers amounted to about 10,700 flasks at the end of 1942 compared with 12,400 at the end of 1941 and 14,100 at the end of 1940. On January 3, 1942, Metals Reserve Co. stocks totaled 5,408 flasks, and the Procurement Division of the Treasury Department held 2,050 flasks. On December 31, 1942, the Metals Reserve Co. had 17,416 flasks and the Procurement Division 9,994. Companies that use redistilled metal only held 2,400 flasks at the end of 1942 compared with 1,600 at the end of 1941. Stocks held by companies that report mine production monthly to the Bureau of Mines—about 95 percent of the total—were 1,377 flasks on December 31, 1942, compared with 439 flasks at the end of 1941.

REVIEW BY STATES

Under the stimulus of the highest annual price ever obtained and the assurance of a stable price, domestic producers gave a very good account of themselves in 1942; output was the highest since 1882. It is significant that the satisfactory quantity recovered was, for the most part, from mines whose names have been famous in mercury history for many years. The most important newcomer in 1942 was the Hermes mine (Idaho) of Bonanza Mines, Inc., just as the chief one in the recent past was the Bonanza mine (Oregon), operated by the same company.

The number of producing mines dropped from 197 in 1941 to 184 in 1942. The number in both years is very impressive in view of the fact that only about 20 mines [9] were active during the boom mercury period in the seventies.

Despite their excellent production record, producers were hampered by the same problems that beset other mining industries in 1942, particularly labor difficulties. Not only was the supply of labor insufficient, but available new workers were claimed to be very inferior. The inadequate labor supply impeded development work, and operators claimed this condition would doubtless have an early adverse effect on the rate of output.

Mercury produced in the United States, 1939–42, by States

Year and State	Producing mines	Flasks of 76 pounds	Value [1]
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
1941:			
Arizona	5	873	$161,522
Arkansas	19	2,012	372,260
California	87	25,714	4,757,604
Nevada	54	4,238	784,115
Oregon	21	9,032	1,671,101
Utah	1	19	3,515
Alaska, Idaho, Texas, and Washington	10	3,033	561,166
	197	44,921	8,311,283
1942:			
Arizona	7	701	137,641
Arkansas	16	2,392	469,669
California	85	29,906	5,872,043
Nevada	40	5,201	1,021,217
Oregon	23	6,935	1,361,687
Alaska, Idaho, Texas, Utah, and Washington	13	5,711	1,121,355
	184	50,846	9,983,612

[1] Value calculated at average price at New York.

The principal producing mines in 1942 were as follows:

Arizona—Maricopa County, Pine Mountain mine.

Arkansas—Clark County, Humphreys mine; Pike County, Arkansas Quicksilver group (Parker Hill and Gap Ridge).

California—Contra Costa County, Mount Diablo mine; Lake County, Great Western, Sulphur Bank, Abbott and Mirabel mines; Napa County, Knoxville and Oat Hill mines; San Benito County, Lea-Grant and New Idria mines; San Luis Obispo County, Oceanic and Klau mines; Santa Barbara County, Santa Ynez (Falcon) and Red Canyon (Red Rock) mines; Santa Clara County, New Almaden mine and Almaden dumps; Sonoma County, Socrates, Great Eastern, and Mount Jackson mines; Yolo County, Reed mine.

[9] Ross, C. P., Mercury Mining Today in the United States: Eng. and Min. Jour., vol. 143, No. 9, September 1942, p. 55.

Idaho—Valley County, Hermes mine; Washington County, Idaho Almaden mine.
Nevada—Humboldt County, Cordero and White Peak mines; Pershing County, Red Bird and Pershing mines.
Oregon—Douglas County, Bonanza mine; Jefferson County, Horse Heaven mine; Malheur County, Bretz mine.
Texas—Brewster County, Chisos and Big Bend and Texas Almaden mines; Presidio County, Fresno mine.

These 34 mines produced 89 percent of the United States total. The 33 most important mines produced 85 percent of the total in 1941, 29 produced 86 percent in 1940, and 16 produced 88 percent in 1939.

Several of the mines that were included in the group of 33 principal mines in 1941 were closed or virtually closed at the end of 1942. These were the Caddo, Contact, Idaho-Almaden, McAdoo group, Mount Tobin, Opalite, and Chisos. The Caddo and Opalite resumed production early in 1943. The Chisos has gone into bankruptcy, and no plans to reopen this famous old mine have been announced.

Before World War I the tenor of mercury ores treated in the United States averaged more than 10 pounds per ton or over 0.50 percent. The inclusion in the 1918 figures of a large quantity of low-grade material that was rejected before concentration at Sulphur Bank was partly responsible for the reduction in average grade to 6 pounds or 0.30 percent in 1918. In consideration of the sharply increased price paid for mercury in World War II, it is somewhat remarkable that the grade of ore treated has not fallen more rapidly. Dump material has been excluded insofar as possible from the grades shown for recent years, but separation of newly mined ore and dump material for many large mines (the New Idria is one of them) is not possible. The average grade indicated for 1942 was 0.25 percent (5-pound ore), compared with 0.26 percent (5.2-pound ore) in 1941, 0.31 percent (6.2-pound ore) in 1940, and 0.37 percent (7.4-pound ore) in 1939.

Alaska.—Output from Alaska came from Decoursey Mountain and Sleitmut areas, where geologic studies and drilling campaigns were carried on by the Geological Survey and the Bureau of Mines.

Arizona.—Production in Arizona declined from 873 flasks in 1941 to 701 flasks in 1942. The Pine Mountain, Ord, and Rattlesnake mines were the principal producing properties, and four others contributed to the total. Production was confined to Gila and Maricopa Counties.

Arkansas.—Fewer mines contributed to production in Arkansas in 1942 than in 1941, but a new record (by 19 percent) was established nonetheless. By far the largest producer was the Humphreys Gold Corporation property in Clark County. The Arkansas Quicksilver Mines, Inc., stood out in Pike County, and other large contributors in the State included the Caddo, Big Six, Superior, and U. S. Mercury.

The Humphreys Gold Corporation began development work in the summer of 1941 and in 1942 treated 18,758 tons of ore and recovered 1,176 flasks of mercury. In the final quarter of 1942 the production rate approximated 145 flasks a month.

California.—California increased its predominant position in mercury production in 1942, with an output of 29,906 flasks or 59 percent of the total, compared with 25,714 flasks or 57 percent of the total in 1941. All the California mines that ranked among the principal producers in 1941, except the Contact, were again prominent

in 1942, and the Abbott, Lea-Grant, Red Canyon (Red Rock), and Socrates joined the leaders. The Socrates mine was operated by the company that ran the Contact in 1941. An outstanding reason for the favorable California showing was the performance of the New Idria mine, whose output was more than double that of the next most important producer in the country in 1942 and was substantially more than equal to the combined total for the next three most important producers. The Sulphur Bank, New Idria, Klau, Mount Jackson, and Reed mines each produced nearly or more than 2,000 flasks in 1942.

Sixteen counties in California supplied some production in 1942, as follows: Colusa, Contra Costa, Fresno, Inyo, Kings, Lake, Napa, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Sonoma, Stanislaus, Trinity, and Yolo.

At the Abbott mine, Lake County, the shaft was deepened 100 feet. The Mirabel mine, also in Lake County, produced 720 flasks of mercury from 7,317 tons of ore. Some production was reported for the Helen mine, which has since been taken over by the Anglo-American Mining Corporation, Ltd. Altogether, 10 mines in Lake County reported mercury production in 1942.

Production of the Twin Peaks Mining Co. was shifted from the Twin Peaks in 1941 to the Corona mine, Napa County, in 1942. A total of 4,915 tons of ore from the Corona mine was treated in the new plant at the adjacent Twin Peaks mine, and 203 flasks of mercury were produced. Zack Anderson (operating the Oat Hill Extension mine in the same county) reported the construction of a 40-ton mill which in May 1943 he anticipated would soon be in operation. Nine other properties in Napa County reported some production.

At the Lea-Grant mine, Panoche district, San Benito County, about 10,000 tons of ore were treated to recover 291 flasks of mercury. This mercury property is one of those in which the Marsman Co. of California became interested before the end of the year, the others being the Altoona in Trinity County, Calif., and the Reward in Mineral County, Nev. Greatly expanded operations were carried on by the New Idria Quicksilver Mining Co. at the New Idria mine in 1942, and production was materially higher. This mine sharply increased its lead over all others in the country, and further gains are anticipated in 1943. At the Panoche mine 11,303 tons of ore were treated and 197 flasks of mercury produced in a 4- by 64-foot rotary furnace. Fourteen other mines in the county were productive.

A new bank of steel condenser pipes was installed at the Oceanic mine, San Luis Obispo County. Ore from the Echo Butte (Little Bonanza group) was furnaced at the Oceanic plant. The shaft at the Klau mine in being deepened by 100 feet from the present 450-foot level, and a new level will be developed. At the Polar Star mine 90 tons of ore were treated in a retort and 63 flasks of mercury produced. This mine was under option to Lawrence Requa at the end of the year. Production came also from 6 other mines in the county.

The Red Canyon Mining Co. was superseded by the Cachuma Mining Co. in operation of the Red Rock mine, Santa Barbara County. Together they treated 10,450 tons of ore, which yielded 613 flasks of mercury. The Santa Ynez mine was again operated by Geo. H. Hall, who made an important output, and one other property in the county made a small contribution to the total.

In the early part of 1942 Aalders and Prather operated the Amenden dumps, Santa Clara County, which subsequently were operated by Sam Cohen. Cohen left the property before the end of the year owing to "litigation over alleged pollution of creek." The New Almaden mine has been opened to the 800-foot level through the Day tunnel. The Santa Rita shaft was reopened, and a 150-ton pocket was built on the 800-foot level. An important production, roughly three-fourths of which came from dumps, was made by this mine in 1942. The Guadalupe and seven other mines in Santa Clara County were also productive.

The Mount Jackson was the principal producing mine in Sonoma County in 1942. At the Great Eastern mine 605 flasks of mercury were recovered from 21,966 tons of ore. Sinking the shaft to the 500-foot level and crosscutting 320 feet northwest were hoped to develop considerable additional ore. The Culver-Baer produced 112 flasks from 263 tons of ore. Development work at the Socrates mine is reported to have promised additional ore reserves. The Contact mine was flooded in January 1942; its future is undetermined. Seven other mines in the county produced in 1942.

The Reed mine in Yolo County was one of the outstanding producers in the country as well as in the State.

Idaho.—The promise of another important producer in Idaho was brought to fruition in February 1942 when the Hermes mine became a substantial contributor. Monthly successive gains were made at this mine throughout the year, and for December 1942 it ranked as the second-largest producer in the country. This property is more than offsetting the loss of production from the Idaho-Almaden mine, which closed in December owing (according to the operator) to exhaustion of commercial ore.

Nevada.—Production in Nevada gained 23 percent, rising from 4,238 flasks in 1941 to 5,201 flasks in 1942, although it came from only 40 mines compared with 54. The noteworthy increase was due largely to expansion in production at the Cordero mine, principal producer in the State by a substantial margin in 1942 and one of the outstanding producing properties in the country. Productive operations were carried on in Elko, Esmeralda, Humboldt, Mineral, Nye, Pershing, and Storey Counties.

The Mount Tobin mine, Pershing County, an important producer in 1941, made an output during January and February only in 1942. The principal producing mine in the county was the Pershing, which had been inactive since 1930. A total of 18,041 tons of ore was treated and 855 flasks of mercury produced. The next largest was the Red Bird, where a Gould furnace was completed early in 1943. Williamson & Garteiz produced 127 flasks at the Roman mine, a newly developed property. Eight other mines produced in 1942.

Operations at the Cordero mine, Humboldt County, were described by Williston.[10] Greenan produced 343 flasks of mercury from 2,500 tons of ore at the White Peak mine and 4 flasks from 30 tons at the Red Ore. The McAdoo properties contributed little to the State total after January 1942, following the substantial amounts produced in 1941. Altogether nine mines in Humboldt County reported production.

[10] Williston, S. H., Mining Quicksilver in Nevada: Min. Cong. Jour., vol. 28, No. 11, November 1942, pp. 24–28.

Seven mines in Mineral County reported some output in 1942; the chief was the Reward mine.

Four mines in Nye County were productive in 1942. The Horse Canyon mine produced 6 flasks from 58 tons of ore and was abandoned.

Oregon.—Oregon experienced a sharp set-back in production in 1942, although maintaining its position as second-largest mercury-producing State. The 1942 total was 6,935 flasks compared with 9,032 in 1941, a drop of 23 percent, and Oregon's share of the United States total was 14 compared with 20 percent in 1941. An outstanding reason for the drop was the decline in output from the Bonanza, which, however, maintained its noteworthy lead in Oregon and held second place among the mines of the country. Other important producers were the Horse Heaven in Jefferson County and the Bretz in Malheur County. Clackamas, Crook, Harney, Jackson, Lake, and Lane Counties also reported some production.

Texas.—Production in Texas rose in 1942, but the year witnessed the passing into bankruptcy of the famous old Chisos mine, which was idle during the last several months. This mine had been in virtually continuous operation for 40 years. It is in the Terlingua region, which according to Ross [11] has had a total production exceeding 150,000 flasks and perhaps comprising nearly 200,000 flasks. The Chisos has contributed by far the greatest part of this total. Its output from 1902 or 1903 to the present ranks it historically as the fourth-largest producing mercury mine in the United States.

FOREIGN TRADE [12]

Under the stimulus of Metals Reserve Co. purchase agreements, imports of mercury in 1942 were the highest on record by a wide margin. Imports for consumption amounted to 38,911 flasks, considerably more than had been received in the 5-year period, 1937–41. The preponderant part—29,918 flasks—came from Mexico, 7,564 from Canada, and 1,409 from Chile; 20 flasks were credited to Nicaragua. The movement of mercury to the United States from normal sources was cut off in 1940. Mercury began to arrive from other sources in August 1941. In November and December 1941, 6,861 flasks were received out of the total imports for the year of 7,740 flasks. There was wide variation in the amounts of mercury received in 1942, by months, from a low of 1,791 flasks in August to a peak of 6,374 flasks in December. There was a difference of only 10 flasks between imports for consumption and general imports in 1942.

In addition to the mercury received from Mexico in the form of metal during 1942, antimony-mercury concentrates imported from that country yielded 1,050 flasks during the year compared with 1,300 each in 1941 and 1940. This latter class of imports is not shown separately in foreign trade statistics.

[11] Ross, Clyde P., The Quicksilver Deposits of the Terlingua Region, Texas: Econ. Geol., vol. 36, No. 2, March-April 1941, pp. 115–142.

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

Mercury imported into the United States, 1938–42, by countries

Country	1938		1939		1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Canada	------	------	------	------	------	------	59,633	$130,468	574,888	$1,365,690
Chile	------	------	------	------	------	------	------	------	107,091	266,920
Germany	------	------	------	------	------	------	------	------	1	2
Hong Kong	------	------	------	------	3	$6	------	------	------	------
Italy	84,454	$50,434	25,528	$29,818	228	316	------	------	------	------
Mexico	------	------	42,745	61,313	9,698	13,681	520,692	1,171,752	2,273,739	5,088,709
Nicaragua	------	------	------	------	------	------	------	------	1,545	3,395
Spain	95,068	82,176	197,671	245,613	3,042	3,958	7,903	6,373	------	------
	179,522	132,610	265,944	336,744	12,971	17,961	588,228	1,308,593	2,957,264	6,724,716

Imports of mercury compounds were virtually nonexistent during 1941 and 1942, as is shown by the table that follows. Early in 1940 the increased receipts of mercury compounds from Italy had been a minor threat, at least, to the domestic industry; all imports from Italy, both as metal and as compounds, ceased officially in 1940. A large shipment of metal and compounds in 1941, however, credited to Portugal and subsequently exported, has presented some food for speculation.

Mercury compounds imported for consumption in the United States, 1941–42

Compound	1941		1942	
	Pounds	Value	Pounds	Value
Chloride (mercurous) (calomel)	25	$83	1	$4
Mercury preparations (not specifically provided for)	24	140	12	132
Vermilion reds (containing quicksilver)	25	9	25	10
	------	232	------	146

Exports of mercury, under Government control since July 1940, dropped from 9,617 flasks in 1940 to 2,590 in 1941 and to only 249 in the first 9 months of 1942. The cutting off of most of the domestic mercury supplies of the U. S. S. R. by the German advance into the Donets area brought large orders from the U. S. S. R. for United States metal. In the final quarter of 1942, 7,461 flasks were recorded as having left the United States for the U. S. S. R. This record, however, lagged behind the actual movement of metal because a much greater quantity is known to have gone. The statistical lag was picked up in records for the early months of 1943. In the 5-month period October 1942 to February 1943, inclusive, mercury exports to the U. S. S. R. aggregated nearly 21,000 flasks. Total exports of mercury in 1942 aggregated 7,807 flasks. No country other than Russia received as much as 100 flasks of mercury from the United States in the year. Brazil received the second-largest amount—64 flasks—followed by Canada with 40, Venezuela with 32, Trinidad and Tobago with 30, and 4 dozen others with lesser amounts ranging down to 1 pound.

Mercury exported from the United States, 1938–42

Year	Pounds	Value	Year	Pounds	Value
1938	54,161	$50,184	1941	196,837	$470,903
1939	91,789	137,427	1942	593,311	1,519,227
1940	730,877	1,743,149			

The Commerce Department began to report exports of mercury salts separately in July 1941. For July 1 to August 31, 1941, totals only were given for mercury salts and compounds; they amounted to 3,213 pounds. No annual comparisons are available for the 1942 totals shown in the following table, but data for the last 4 months of 1941 are given in a parallel column.

Mercury salts exported from the United States in 1941 (September–December) and 1942, in pounds [1]

	1941 (Sept.–Dec.)	1942		1941 (Sept.–Dec.)	1942
Mercurous chloride (calomel)	6,976	22,844	Mercuric oxide (red and yellow)	4,261	9,495
Mercuric chloride (corrosive sublimate)	9,496	7,261	Mercuric sulfate		15
Mercuric fulminate	6,020	39,595	Mercuric sulfide	62	6
Mercuric nitrate	222	477	Other compounds	5,170	8,518

[1] See preceding paragraph.

WORLD PRODUCTION

Reliable data are not available on production in Spain and Italy, which dominate the world mercury industry in normal times. Increased rates of operations in Western Hemisphere countries, however, have been such that new world-record tonnages probably were established in 1941 and 1942, even if these two principal countries were operating considerably below capacity. What information has come out of Europe, however, has pointed to heavy mercury operations in both Spain and Italy. The recent gains in Western Hemisphere countries place the United States, Mexico, and Canada among the five most important producing nations and could even have pushed the United States temporarily into second place. The latter is considered a possibility but not a likelihood.

World production of mercury, 1938–42, by countries

[Compiled by B. B. Waldbauer]

[1 metric ton=29.008 flasks of 76 pounds]

Country	1938		1939		1940		1941		1942	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	191	6.6	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Australia: Queensland			3	0.1	(1)	(1)	(1)	(1)	(1)	(1)
Bolivia (exports)			9	.3	(1)	(1)	(1)	(1)	(1)	(1)
Canada	10	.3	6	.2	2,024	69.8	7,057	243.3	13,470	464.4
Chile	44	1.5	(1)	(1)	(1)	(1)	1,305	45.0	1,740	60.0
China	[2] 65	[2] 2.2	[2] 13	[2] .4	[2] 6,260	[2] 215.8	[3] 6,000	[3] 206.8	(1)	(1)
Chosen	(4)	(4)	(4)	(4)	(1)	(1)	(1)	(1)	(1)	(1)
Czechoslovakia	2,900	100.0	[5] 2,669	[5] 92.0	[5] 2,582	[5] 89.0	(1)	(1)	(1)	(1)
Germany[3]	1,750	60.2	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Austria	(4)	(4)	(4)	(4)	(1)	(1)	(1)	(1)	(1)	(1)
Italy	66,748	2,301.0	67,154	2,315.0	(1)	(1)	(1)	(1)	(1)	(1)
Japan	592	20.4	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Mexico	8,519	293.7	7,376	254.3	11,653	401.7	23,137	797.6	32,443	1,118.4
New Zealand	10	.3					73	2.5	(1)	(1)
Peru									145	5.0
Rumania			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Southern Rhodesia			(6)	(6)	(1)	(1)	(1)	(1)	(1)	(1)
Spain	41,409	1,427.5	[2] 53,441	[2] 1,842.3	[2] 53,180	[2] 1,833.3	[3] 85,523	[3] 2,948.3	(1)	(1)
Tunisia	270	9.3	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Turkey	597	20.6	359	12.4	[2] 261	[2] 9.0	237	8.2	[7] 222	[7] 7.7
Union of South Africa					(1)	(1)	[8] 154	[8] 5.3	[9] 531	[9] 18.3
U. S. S. R.	8,700	[10] 300.0	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
United States	17,991	620.2	18,633	642.3	37,777	1,302.3	44,921	1,548.6	50,846	1,752.8
Total[3]	149,900	5,167.5	160,000	5,516.7	(1)	(1)	(1)	(1)	(1)	(1)

[1] Data not yet available.
[2] Exports.
[3] Conjectural.
[4] Estimate included in total.
[5] Slovak Metallurgical Works.
[6] Production less than 1 flask or 0.1 metric ton.
[7] January to June, inclusive.
[8] January to October, inclusive.
[9] January to November, inclusive.
[10] Production figure published by Metallgesellschaft.

Algeria.—The invasion of North Africa in 1942 returned the resources of most of that area to the United Nations. The Ras-el-ma mine is in the Department of Constantine near the main road from Philippeville to Constantine, in the area where fighting has been in progress. A report from a source believed to be reliable places the output of this mine as 94 flasks in 1939 and 743 flasks in 1940. The ore is said to be of poor quality, containing less than 0.5 percent mercury, and production has been possible only in periods of high prices. In 1940 it was reported that the French hoped to obtain a large part of their annual normal consumption of 130 tons of metal from this mine.

Canada.—Production of mercury in Canada has risen precipitously since World War II began. It totaled 6 flasks in 1939, 2,024 in 1940, 7,057 in 1941, and 13,470 in 1942, and further increases are anticipated. All known occurrences of mercury in Canada are in British Columbia. The chapters on Mercury in the two previous issues of Minerals Yearbook pointed out that the development of the mercury deposit in the Pinchi Lake area, Central British Columbia, by the Consolidated Mining & Smelting Co. of Canada, Ltd., had given the British Empire its only important producer of mercury. The small initial plant installed by the company has been enlarged twice and is reported to be capable of handling 500 tons of ore daily. The ore

treated is reported to contain 0.5 to 0.75 percent mercury. The geology of the area has been described recently by Armstrong.[13] Considerable stimulus has been given to prospecting for mercury in British Columbia by the development of the Pinchi Lake deposit and by the increase in United Nations requirements for the metal. The Bralorne Mines, Ltd., largest gold producer in British Columbia, became interested in developing a mercury property late in 1942. The claims are on Silver Creek east of Takla Lake, in the Omineca mining district. Several flasks of mercury were produced in 1941 at the Red Eagle group on Yalakom River, 30 miles northwest of Lillooet.

Italy.—About the only report on Italy's mercury production in recent months placed the output of Stabilimento Minerario di Sieli, second-largest producer, at 40,000 flasks in 1941. This output, if matched by those of other producers, would mean a new high record for Italy. There is every reason to believe that Italy can produce over 70,000 flasks of mercury annually if there is need for it. With a surplus available from Spain and restricted markets for both countries, the need for record rates of output in the two countries could only mean that Axis requirements for mercury had expanded out of proportion to United Nations gains. Large accumulations of stocks would be the alternative, but with manpower at a premium in Italy it would seem strange to expend energy for accumulating excess stocks. According to the October 17, 1942, issue of Mining Journal (London) the State is now directly participating, through the Agrarian Bank and the Iri Holding Trust, respectively, in the two leading mercury companies, Siele and Monte Amiata. Italy is still a member of the Italo-Spanish International Cartel. Virtually the only foreign customer is Germany, which uses I. G. Farbenindustrie as its sole buying agent.

Mexico.—The expectation of a rapidly increasing production of mercury in Mexico was amply justified, as indicated by the total of 32,443 flasks for 1942 compared with 23,137 flasks for 1941 and 11,653 for 1940. The exports of 30,029 flasks were destined preponderantly to the United States, to which 29,113 flasks were shipped; 763 flasks went to Argentina, 120 to Brazil, 26 to Colombia, 6 to Chile, and 1 to Costa Rica. The War Production Board of the United States anticipated that approximately as much metal would be shipped to the United States in 1943 as in 1942. Mexico is playing a most important role in the solution of United Nations mercury problems.

New Zealand.—Investigations of cinnabar occurrences by the New Zealand Mines Department are reported to have indicated that a small but worth-while tonnage of high-grade ore may be developed. The deposit at Puhipuhi appears to be the only one capable of sustained production.

Peru.—A 20-ton Gould rotary furnace was installed at the Huancavelica mine in 1942. Two additional plants, with an expected combined daily capacity of 300 tons, were to be erected, but temporarily at least permit difficulties prevented their leaving the United States after they had been completed.

Spain.—Reports emanating from Germany (Hamburger Fremdenblatt), quoted in Metal Bulletin (London) of October 9, 1942, stated that Spain produced 85,523 flasks of mercury in 1941 and that 40,695

[13] Armstrong, J. E., Geology of the Pinchi Lake Mercury Belt, British Columbia: Canadian Min. and Met. Bull. 362, June 1942, pp. 311–323.

flasks were sold (of which 706 were for use at home and 39,989 for export); also that stocks at the Almaden mine at the beginning of 1942 totaled 66,000 flasks. If this report is true, production was 18 percent higher in 1941 than in 1927 and therefore was at a new all-time record rate. It is rather difficult to understand, however, why an effort was made to produce a record quantity in view of the fact that the war has caused a shrinkage in Spanish markets. Metal is reliably reported to have moved from Spain to Germany in large quantities in the early part of 1941. It is only logical to assume, however, that with Italy able to supply much more mercury than is ordinarily required in Germany, purchases of Spanish metal in Germany would drop to insignificant proportions. Political considerations, of course, could affect German policy in this connection. In explanation of the high rate of production in Spain, an article in Engineering and Mining Journal of May 1942 says—

* * * By law, in Spain, no workman of regular crew may be laid off without long advance notice. Hence, either production must go on at a minimum rate, or payroll with no output must be maintained. It is for this reason that such a huge inventory has been accumulated * * *.

The cartel price had an adverse effect on sales to the United Kingdom. Purchases have been made in the United Kingdom since the war started, however, and in August 1942 the London price was raised from £48 to £69, the latter figure corresponding more closely with the cartel price.

Union of South Africa.—Output in the Union is increasing steadily according to Preller.[14] In the chapter on Mercury in Minerals Yearbook, 1941, it was pointed out that some anxiety was felt in that country regarding supplies of mercury. Preller states that production at Monarch Kop in 1942 had fallen not far short of requirements in the Union and that an excess over local consumption might result in 1943. The cinnabar at Monarch Kop occurs with lenticles of quartz and crystalline carbonate in chloride-carbonate schists through a thickness of 15 to 20 feet in places. The deposit is reported to show great promise as far as consistency and extent are concerned.

U. S. S. R.—The principal producing area in the U. S. S. R. has been the Donets Basin. Output from this source has been lost temporarily owing to German occupation of the territory. Production is now coming from other localities in Russia, notably from Kirghiz which started to produce before the war. Exploratory work in connection with mercury recently has been widespread, stretching from the Donets area to Eastern Siberia. Despite the efforts to increase output of this strategic metal, Russia depends largely on imports from China and other United Nations. Chinese metal has been going to Russia for some time, and late in 1942 large quantities of mercury began moving to Russia from the United States. Exports from the United States were largely "reexports" or metal imported from Mexico, Canada, and Chile, although domestic metal made up part of the total. According to the Department of Commerce, shipments to Russia from the United States totaled nearly 21,000 flasks from October 1942 through February 1943.

[14] Preller, G. S., The Place of Mercury in Peace and War: South African Min. and Eng. Jour., vol. 53 No. 2606, January 9, 1943, pp. 421-422.

TIN

By C. E. Nighman and J. B. Umhau

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GENERAL SUMMARY

An abrupt transition from an economy of abundance in tin to one of dearth marked the year 1942. In 4 months after the attack on Pearl Harbor the Japanese had added two-thirds of the world's tin resources and nearly three-quarters of the smelter capacity to the strategic metals assets of the Axis associates. There remained to what became known after January 1, 1942, as the United Nations a potential annual supply of only 80,000 to 90,000 long tons of virgin tin, a volume little greater than that consumed in the United States alone in 1940 (72,324 long tons) and much less than the 103,086 long tons used in the peak year 1941.

The terrific shock of the Japanese blitzkrieg in Malaya and in the Netherlands East Indies on the tin-consumption habits of the United States was fortunately cushioned by defensive measures undertaken coincident with the growth of an understanding of Japan's East Asia policies. Foremost among these measures were the inception of a stock-piling program and provisions for domestic smelting, with the acquisition of ore supplies.

At the close of 1941 there were on hand 45,572 tons of ore and concentrates containing over 23,000 long tons of tin. Total stocks, excluding the 7,433 tons held by the Navy and Procurement Division, contained over 126,000 tons of tin as metal and in concentrates. Although 1942 opened with an abnormally large, immediately available stock, prospective future supplies were limited essentially to about one-half of Bolivia's raw-material output and to the Belgian Congo's metal—sources that at best could furnish scarcely 40 percent of the virgin tin consumed in 1941. Drastic steps thus had to be taken to maintain a safe position in tin. Immediate and severe restrictions were placed upon use; broad substitution programs and expanded reclamation schemes were instituted and were frequently revised or amended during the year but always in the direction of a tightening control. Exports, which were already governed by the

Export Control Act of July 1940, were likewise subjected to further restrictions.

As a result of control and conservation, nonessential uses were almost abandoned, there was widespread degradation in bearing metals, and a transition was being effected in the major consumption areas of solder and tin plate to tinless solders and to thin electrodeposited, chemically treated, and black plates, accompanied by enforced shrinkage in volumes. Although the effect of the shift to electrolytic tin plate, with its estimated 60-percent decrease in tin used compared with hot-dipped plate, was slight because of the difficulty in obtaining and installing a vast amount of new and specialized equipment, tin consumption showed an uninterrupted monthly decline ranging from 7,500 tons in January to 3,200 tons in December 1942, with the year's virgin tin consumption reduced to 56,000 tons or less than 55 percent of that used in 1941.

Imports of metal were at the lowest point in more than 20 years and were only 18 percent of the 1941 tonnage; although the total tin content of the ores imported increased by about 9 percent, the over-all drop totaled 66 percent. Of the 57,000 tons received, about 15,000 tons of metal and 8,000 tons (tin content) of ore belatedly arrived from Malaya, the Netherlands East Indies, and China. Total stocks declined only 1.5 percent to the equivalent of 3⅓ years' supply at the indicated consumption rate in the last quarter of 1942.

Salient statistics for tin in the United States, 1925–29 (average) and 1938–42

	1925–29 (average)	1938	1939	1940	1941	1942
Production—						
From domestic mines, long tons	24	95	34	49	56.3	[1] 6.3
From domestic smelters, do				[2] 1,391	[2] 1,839	[2] 16,168
From secondary sources, do	30,600	21,000	26,000	29,700	37,500	33,900
Imports for consumption:						
Metal, do	78,009	49,699	70,102	124,810	140,873	26,002
Ore (tin content), do	175	(4)	500	3,000	28,670	31,212
Exports (domestic and foreign), do	1,740	[3] 205	[3] 2,105	[3] 2,664	[3] 1,094	409
Monthly price of Straits tin at New York:						
Highest, cents per pound	70.67	46.23	63.50	54.54	53.35	(5)
Lowest, do	39.79	36.84	45.62	45.94	50.16	
Average, do	56.64	42.26	50.18	49.82	52.01	
World production, long tons	163,000	163,000	176,000	236,000	245,000	126,000
Ratio—United States imports to world production, percent	48	30	40	54	69	45

[1] Subject to revision.
[2] Including tin content of ores used direct to make alloys.
[3] Figures for 1938–41 cover foreign only; domestic not separately recorded.
[4] Less than 1 ton.
[5] Ceiling price 52 cents.

Maintenance of this relatively comfortable position—one that appears to have been paralleled in Great Britain—appears unlikely. A lengthy campaign for the recovery and rehabilitation of Far Eastern mines and reduction works is indicated. China is essentially isolated; production in Bolivia and Nigeria declined below 1941 levels and was not offset by the increase from the Belgian Congo, with little likelihood that an appreciable net increase may be expected in 1943, with all shipments subject to the shortage of bottoms and German submarine warfare. In Great Britain consumption is said to be held at the "austerity" level that lies at approximately 14,000 tons. It has been

estimated that in the immediate pre-war years the U. S. S. R. apparently used about 15,000 tons annually, but its current actual needs are materially greater. (See section on Foreign Trade.) In the United States the principal remaining area of economy, which should be reached in 1943, lies in the substitution of thin electrodeposited and tinless plates for hot-dipped plate. However, the degree of substitution is limited by numerous factors, including the nature of the goods to be packed and the probable increasing volumes of plate and processed-food containers needed for Lend-Lease shipments and for overseas use, both military and civilian, all of which require higher-grade protective coatings than that serviceable for domestic use. With a probable consumption of around 50,000 tons in 1943 in this country, the total needs of the United States, Great Britain, and the U. S. S. R. seemingly exceed the maximum output of the United Nations that have an exportable surplus. Thus there may be no relaxation of controls; rather, more stringent enforcement and extensions are to be expected.

Controlled sales prices were effective throughout the year, in the United States at 52 cents per pound New York for Straits tin or equivalent grade, and in the United Kingdom at £275 for standard tin delivered buyers' works. Tin consumers have benefited greatly by these price-fixing policies. Under the revised contract with Bolivian producers the purchase price was set at 60 cents per pound at export ports, which has been estimated to be 62 cents or more New York. This represents an apparent subsidy of 10 cents per pound or approximately $3,500,000 on the pig tin produced in the United States in 1942 or over $5,150,000 based on imports from Bolivia.

GOVERNMENT ORE PURCHASES

No sizable ore-purchasing contracts were concluded in 1942, but deliveries under earlier agreements continued. (See Foreign Trade—Imports.) One cargo believed to have contained about 2,000 tons of tin was lost en route to the United States in May.

The original contract of November 4, 1940, with Bolivian producers was based upon a price of 48½ cents, c. i. f. New York, and contained a provision for price review at stated intervals. Pursuant thereto negotiations were undertaken, and as of June 30, 1942, the signing of an amended contract retroactive to January 1, effective through June 30, 1943, was announced. The price was raised to 60 cents per pound contained tin f. o. b. Chilean or Peruvian ports—an increase of nearly 30 percent, since freight and insurance fell to the account of the buyer. The contract also called for a minimum delivery of 1,500 tons per month and a maximum of 2,500 tons (tin content). Up to 20 percent of the shipments could range from 18 to 35 percent tin. Smelting charges were set at $32.25, $31.60, and $30.40 per ton for the three classes of acceptable materials, with a sliding scale of deductions for impurities.

GOVERNMENT TIN SMELTER

Construction of the Federally financed tin smelter was begun in October 1941, and the first metal was poured April 5, 1942. The original plans called for capacity to treat the portion of Bolivian ores made available to the United States, that is, about 50,000 tons per

year or 18,000 tons of tin. Subsequent enlargements raised its capacity to about 90,000 tons or enough to treat the entire United Nations ore supply. The total cost of the plant has been reported to be about $6,300,000.

A description of the smelter and methods of ore treatment, accompanied by flow sheets, has been published.[1] The plant was designed to treat complex, low-grade as well as high-grade ores. Over-all recovery is said to exceed 98 percent. Two grades of tin are produced: Longhorn 3 Star, over 99.8 percent pure, and Longhorn 2 Star, which on a selling-price basis would assay between 99.00 and 99.75 percent.

In the metal trade here and abroad there has been much speculation concerning the post-war position of the Texas City smelter and an inclination to believe that it will remain a competitive factor in world trade. Aside from any long-term ore-purchasing contract that may be made before the war's termination and the freedom of access to raw materials proposed under the Atlantic Charter, it occupies a strategic position geographically and with respect to fuel, hydrochloric acid, and power (somewhat offset, to be sure, by high unit labor costs). The additional advantages of a most modern and extremely flexible plant plus the accrued knowledge of efficient reduction processes for complex and off-grade ores endow the operating organization with considerable bargaining strength, especially in the low-grade or refractory ore field.

CONSERVATION

The loss of the major supply sources before a stock pile of adequate dimensions could be accumulated necessitated the application of rigorous use controls, with corollary substitution and reclamation programs. These orders frequently were modified or amended to effect closer regulation and were extended through auxiliary limitation and conservation orders to stop lesser loopholes in the restraining program.

The final effect of the multitudinous orders cannot yet be evaluated exactly, but as shown under Consumption by Uses the program was highly effective in 1942. Estimates of potential savings indicated that roughly one-half would be derived from nearly complete prohibition of use, such as for foil and collapsible tubes, and the remainder through down-grading in tin content and substitutions. In the last field the displacement of metal by glass containers, largely as a result of the limitation placed on use of steel, was the most important factor and has been estimated to have been as great as 30 percent. Fiber containers have found increasing use and to some extent are expected to remain competitive in peacetime. Ordinary black plate cannot be expected to take the place of much tin plate because it lacks corrosion resistance, but chemically treated (bonderized) black plate, enameled or lacquered, is claimed to be suitable for many general line and some sanitary cans. It is believed that it may take care of more than one-eighth of the total container production in 1943.[2] However, that product is still in an experimental stage, and its future application will depend in large measure on the availability of tin that has demonstrated value in food preservation. Only one plant was known to be operating in 1941, but it was expected that 18 to 20 bonderizing lines would be built in 1942.

[1] Henderson, Charles B., The Longhorn Tin Smelter: Min. and Met., vol. 24, No. 436, April 1943, pp. 196–200.

[2] Lippert, T. W., Food in Cans: Iron Age, vol. 149, No. 18, April 30, 1942, p. 30.

In the degradation area, the reduction in tin content of solders, extending to the tinless lead-silver solders, in bronzes and bearing and terne metals have effected pronounced economies in tin use. The greatest saving possibility in this field, owing to the huge quantities involved, lies in the reduction of thickness in tin-plate coating. By February 1942 this had been reduced from the customary 1.5 pounds per base box to the lowest practicable hot-dip limit of 1.25 pounds, with an appreciable resultant saving. However, the need of heavily coated tin plate for the large proportion of food packs intended for the armed forces and Lend-Lease so restricted the amount of tin available that it became imperative to employ an alternative method of coating that could provide the quantity of tin plate necessary for other consumers.

A metal coating of virtually any desired thickness can be electrodeposited. This method is not new, but its commercial application to tin plating on a plant scale is recent [3] and was still small in 1941 and 1942, amounting to only 2.85 and 3.4 percent, respectively, of standard coke tin-plate tonnage. To meet the expected demand—estimated to be as much as 40 percent of current tin-plate requirements—it was hoped to construct 26 or 27 electrolytic lines in 1942, but actual completion fell far behind the planned schedule owing to the inability to obtain the vast amounts of electric equipment and control apparatus needed.

Electrolytic tin plate having only 0.1 pound per base box has been made experimentally and may serve for some purposes. In general, a coating weight of 0.5 pound is required for many packs under conservation regulations. There is a tendency, however, to believe that a heavier plate, 0.75 to 1.0 pound, eventually will be found more satisfactory or necessary for the widest application.

The future economic position of thinly coated tin plate is not yet clear, as some time must elapse before it can be tested fully in practice. For numerous goods it would afford ample protection, and according to reports it can be soldered as well as the standard hot-dipped plate. In that respect and because it will withstand deformation—deep drawing or forming—without injury it is materially superior to bonderized lacquered plate and seemingly can be fabricated at much greater speeds. (See Review by Countries—Germany.) At present the 0.5-pound electrolytic plate has a price differential of 50 cents per base box in its favor. These and other advantages point to partial displacement of standard tin plate and chemically treated plate that some authorities have estimated as high as 40 to 50 percent.

INVESTIGATION OF DOMESTIC TIN DEPOSITS

Continuing their endeavors to find workable tin deposits in the United States and Alaska, the Bureau of Mines and the Geological Survey extended earlier explorations, undertook several new projects, and published eight reports.

The Geological Survey made reconnaissance surveys in Alabama of pegmatites and in the Black Hills of South Dakota. Reports on these projects are not yet available. A field study of the Temescal district, Riverside County, Calif., was concluded. It is understood

[3] The first plant for the plating of wide, continuous strip was erected by the Crucible Steel Co. at its Midland (Pa.) works in 1936. Shortly thereafter the Carnegie-Illinois Steel Co. installed an electrotinning line at Gary, Ind., and in 1941 the Crown Cork & Seal Co. put a line into operation at Baltimore, Md.

that the Metals Reserve Co. has approved the installation of machinery and that material for milling tests would be taken from open pits in the spring of 1943. Detailed studies of the Gorman district, northwest of Los Angeles, and mapping at Cima, San Bernardino County, were carried out.

The Bureau of Mines and Geological Survey continued field studies on the tin resources of New Mexico. Preliminary reports indicate that some very small placer areas can probably be mined under present conditions but that the lode deposits are not sufficiently rich to be developed economically at this time. In March 1943 the Geological Survey published an areal geological map of the tin district in the Black Range in Catron and Sierra Counties, N. Mex., accompanied by a descriptive text prepared by Fries and Butler.

The Bureau of Mines conducted an exploration project that included drifting, crosscutting, and long-hole drilling at the Majuba Hill mine in Pershing County, Nev., and the Geological Survey made a detailed study of the mine.

In Alaska, Geological Survey geologists studied and mapped tin placers in the Tozimoran, Morelock Creek, and Ruby-Long areas, all lying in the Yukon Basin region of the interior a considerable distance west of Fairbanks. The Bureau of Mines examined tin placers in the Buck-Creek-Potato Mountain areas at Cape Mountain near Tin City. In the Manley Hot Springs area near the junction of the Yukon and Tanana Rivers the Bureau of Mines examined tailings from early gold-placer operations. In July 1942 the Bureau of Mines began explorations in the Lost River tin area in western Seward Peninsula. The Geological Survey, in conjunction with Bureau of Mines engineers, made a supplementary examination. The Bureau's preliminary sampling in this area has indicated a large tonnage of low-grade tin-tungsten ore of about 0.8 percent tin and 0.25 percent WO_3. This district appears to offer the best possibilities for domestic tin production; however, immediate development will depend on the ability to obtain clearance and ship space for transporting materials and supplies to this remote area. The Bureau of Mines plans further exploration.

DOMESTIC PRODUCTION

MINE OUTPUT

Domestic tin production dropped to 6.3 long tons, the lowest point in 9 years, owing to virtually complete loss of Alaskan output following commercial exhaustion of the Tin City placers. No lode tin was obtained in 1942.

The prospect for a sizable increase in the immediate future is far from bright. The total recorded mine production from the United States and Alaska in the past one-third of a century amounted only to 1,521 tons valued at about $1,666,000,[4] of which nearly 95 percent was furnished by Alaska. No consequential deposits were brought to light in the United States proper. Alaska has a small potential; but that, as far as is now known, is largely concentrated in low-grade and narrow lodes that require much machinery and equipment for large-scale production and concentration.

[4] Data for 1910–38, inclusive, were published in Minerals Yearbook, 1939, p. 679.

Mine production of tin (content) in the United States, 1938–42, by States

Year	Long tons				Value
	Alaska	South Dakota	Other States [1]	Total	
1938	94	1		95	$90,000
1939	33	.5	0.5	34	38,100
1940	46	2	1	49	54,900
1941	46.8	1.4	8.1	56.3	65,600
1942	[2] 2.8	1.4	2.1	[2] 6.3	[2] 7,300

[1] 1939–40: Montana and New Mexico; 1941: Alabama, Montana, and New Mexico; 1942: Alabama, California, Nevada, and New Mexico.
[2] Subject to revision.

SMELTER OUTPUT

The major event of the year from a production standpoint was the revival of large-scale domestic smelting that had been dormant since 1923. Output for the first full month of operation (May) of the Longhorn smelter was 1,246 long tons, and it rose almost uninterruptedly to 2,343 tons in December, with a total for 1942 of 15,696 long tons, a little (65 tons) below the peak smelter output in 1920. Based upon the 2-month average for November–December 1942, however, production was at the annual rate of 28,000 tons. Shipments were 1,403 long tons. The 3 Star grade has received a favorable reception; the second or 2 Star grade, which is believed to assay about 99.5 percent tin, came on the market late in 1942.

Production from ores by privately owned smelters dropped 74 percent from the 1941 figure. Of the 472 long tons output, 243 tons (1941, 502 tons) appeared as pig tin and 229 tons (1941, 1,337 tons) in alloy form, principally solder. Companies reporting production in 1942 were the American Metal Co., American Smelting & Refining Co., Nassau Smelting & Refining Co., Phelps Dodge Refining Corporation, and Vulcan Detinning Co.

In 1942 one-quarter of the ore imports were from the Netherlands East Indies, which usually produced concentrates of approximately 72 percent tin content. Nearly all the remainder originated in Bolivia. The grade of these supplies is not available, but incomplete data on gross weight and tin content of the mine production give indicated grades for 1940, 1941, and 1942 of 51, 41, and 40 percent, respectively.[5]

SECONDARY TIN

Total recovery of secondary tin declined about 10 percent from the record high level of 1941 to 33,900 long tons in 1942. Most of the so-called secondary tin (80 percent or more) is contained in copper-tin or lead-base alloys, from which it is rarely extracted as metal but remains as a circulating constituent. In addition to the decline in volume of re-treated materials, down-grading with respect to tin content in important alloys, such as solders, bearing metals, and bronzes, as a consequence of the conservation program, was beginning to affect the quantity of tin recovered. The principal source of metal and of tin chemicals is clean tin-plate clippings and used containers

[5] These figures slightly understate the quality because the weight of sacks is included in the gross weight. The Metal Industry (London) of February 26, 1943, on the basis of grades of concentrates shipped in November 1942 and on the assumption that all the Patino-group product was delivered to England arrived at an average of about 36 percent for shipments to the United States.

treated at detinning plants. The quantity of tin reclaimed as metal by detinners rose about 4 percent to a new high of 4,700 long tons, but the tin content of chemicals declined 79 percent to a low of little more than 200 tons.

The collection of prepared, used tin cans has been highly disappointing—variously estimated to have been between a quarter and a third of the potential—but the amount of tin recovered jumped nearly 800 percent above the 1941 output of about 60 tons to over 530 tons in 1942. Although the weight of clippings treated dropped more than 15 percent from the 1941 level—a reflection of the restrictions placed on tin-plate manufacture—the amount of tin recovered receded only 6 percent to a little more than 4,160 long tons owing principally to the pronounced shift from chemical production as noted above. Further details will be found in the chapter on Secondary Metals—Nonferrous.

Secondary tin recovered in the United States, 1925–29 (average) and 1938–42

Year	Tin recovered at detinning plants			Tin recovered from all sources			
	As metal (long tons)	In chemicals (long tons)	Total (long tons)	As metal (long tons)	In alloys and chemicals (long tons)	Total	
						Long tons	Value
1925-29 (average)	900	2,000	2,900	7,500	23,100	30,600	$38,034,120
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	4,500	25,200	29,700	33,102,400
1941	•4,500	950	5,450	5,300	32,200	37,500	43,722,700
1942	4,700	200	4,900	5,200	28,700	33,900	39,434,700

CONSUMPTION

APPARENT CONSUMPTION

The apparent consumption of primary tin, calculated by adding smelter production to net imports, was 42,005 long tons in 1942 or roughly 30 percent of the 1941 record of 141,618 long tons. This method of reckoning consumption excludes all changes in metal stocks held by consumers and the Government, and in times of extraordinary movement, such as the period 1940–42, may present a highly distorted picture. Frequently, however, basic data for more accurate calculation are not available, hence apparent consumption statistics offer the only indicator of long-term trends. These data for 1910–38 were published in the Minerals Yearbook, 1939 (p. 680); those for 1938–42 follow.

Apparent consumption of virgin tin, 1938–42, in long tons

1938	49,494	1941	141,618
1939	67,997	1942	42,005
1940	123,537		

CONSUMPTION BY USES

The following tables show actual consumption of primary and secondary tin, as reported to the Bureau of Mines. Pronounced changes in the tin-consumption pattern arose during 1942 as a consequence of the metal's highly critical status. Tin plate retained its normal premier position, accounting for 51 percent of the consumption of virgin tin, although there was an absolute drop of 36 percent from

the 1941 record level. Solder that usually held second place, using about half as much tin (primary plus secondary) as tin plate, was displaced by bronze and brass that used 47 percent more primary and twice as much total tin as solder, with a new peak total consumption almost equal that of tin plate. Among the reasons for this shift were the recession in demand that followed cessation of automobile production at the end of 1941, the progressive down-grading in tin content in solders, and the continued expansion of armament output with the tremendous increase in the launchings of naval and merchant ships. Tin used for babbitt declined 42 percent, largely because of the decrease of approximately one-third in white-base antifriction-metals production and the substitution of lead-base for high-tin babbitts. The virtual elimination of tin for foil brought about a saving of approximately 3,700 tons or 87 percent of the 1941 use. Restrictions on the use of tin for collapsible tubes resulted in a drop of 75 percent compared with 1941. These uses in the immediate pre-war period, 1937–40, accounted for about 88 percent of virgin-tin consumption that averaged nearly 65,000 tons a year. In 1942 there was a relative rise to 91 percent but an absolute decline of 13,800 tons. A pronounced downward trend was in evidence in the remaining use fields, especially in tin oxide, galvanizing, and white metal, in which the enforced savings were roughly 90 percent of the preceding year's use. Changes in the application of secondary tin were much less pronounced, although alloy down-grading increased the proportions contained in solder, bronze, and brass. Secondary tin consumption in 1942 was 29,400 tons or 93 percent of that for the previous year, while the ratio of secondary to primary rose to 52 percent compared with the 24-percent peacetime (1935–39) average for which data are available.

Consumption of primary and secondary tin in the United States, 1938–42, in long tons

	1938	1939	1940	1941	1942
Stocks on hand January 1	25,984	25,260	29,025	56,999	[2] 67,421
Net receipts during year [1]	61,431	89,018	128,030	149,123	65,568
Available supply	87,415	114,278	157,055	206,122	132,989
Stocks on hand December 31	25,260	29,025	56,999	[3] 67,421	[3] 43,853
Total processed during year	62,155	85,253	100,056	138,701	89,136
Intercompany transactions in scrap (tin content)	2,122	2,390	2,190	2,936	2,547
Total consumed in manufacturing	60,033	82,863	97,866	135,765	86,589
Plant losses	[2] 259	435	712	1,070	902
Tin content of manufactured products	59,774	82,428	97,154	134,695	85,687
Primary	48,116	[4] 66,583	[4] 72,324	[4] 103,086	56,288
Secondary	11,658	15,845	24,830	31,609	29,399

[1] 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. 1940: Primary, 98,125; secondary, 5,409; terne, 1,086; scrap, 23,410. 1941: Primary, 114,281; secondary, 6,879; terne, 1,851; scrap, 26,112; 1942: Primary, 33,126; secondary, 5,096; terne, 405; scrap, 26,941.
[2] Not including 2,700 tons in transit or in warehouses.
[3] Not including 78 tons in transit.
[4] Includes small tonnage of secondary pig tin.

The total tonnage of primary and secondary tin used was reduced 49,000 tons or 36 percent from the 1941 high and was only 4 percent above the 1937–40 average. The true effectiveness of the conservation program is to be evaluated, however, by the economy in virgin metal. Primary tin consumption was 47,000 tons or 45 percent less

Consumption of tin in the United States, 1938–42, by finished products (tin content), in long tons

Product	1938			1939			1940			1941			1942		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	[1] 23,545	[1]	23,545	[1] 36,640	[1]	36,640	[1] 38,674	[1]	38,674	[1] 44,854	[1]	44,854	28,522		28,522
Terneplate	264	743	1,007	317	1,137	1,454	455	1,058	1,513	917	1,129	2,046	339	543	882
Solder	7,590	5,208	12,798	9,578	7,701	17,279	10,222	8,797	19,019	18,084	10,141	28,225	7,228	6,696	13,924
Babbitt	2,893	1,264	4,157	3,850	1,598	5,448	4,473	3,173	7,646	7,495	3,104	10,599	3,195	2,904	6,099
Bronze and brass	2,334	1,598	3,932	3,385	3,051	6,436	5,444	9,216	14,660	10,067	13,103	23,170	10,646	17,009	27,655
Collapsible tubes	3,427		3,427	3,507	[2]	3,507	3,512	[2]	3,512	4,233	212	4,445	1,048	51	1,099
Tinning	1,738	35	[2] 1,773	2,165	172	[2] 2,337	2,455	265	2,720	3,987	145	4,132	2,764	251	3,015
Foil	2,283	[2]	2,283	2,001	[2]	2,001	1,713		1,713	4,292		4,292	576		576
Chemicals (other than tin oxide)	166	910	[2] 1,076	167	288	[2] 455	52	330	[2] 382	280	690	1,970	36	210	246
Pipe and tubing [3]	948	[2]	948	606	[2]	606	661	[2]	661	1,325	[2]	[2] 325	143	18	161
Tin oxide	547	444	991	651	359	1,010	651	506	1,157	995	495	1,490	84	47	131
Type metal	134	978	1,112	149	990	1,139	84	1,048	1,132	287	1,528	1,815	40	1,113	1,153
Galvanizing	792		792	1,028		1,028	963		963	863	104	967	82		82
Bar tin	456	213	669	1,100	241	1,341	1,000	91	1,091	1,526	607	2,133	601	121	722
Miscellaneous alloys	238	19	257	404	45	449	353	11	364	480	137	617	558	256	814
White metal	390	44	434	466	42	508	953	83	1,036	[4] 2,463	[4] 98	[4] 2,561	[5] 83	[5] 156	[5] 239
Miscellaneous	371	202	573	569	221	790	659	252	911	938	116	1,054	343	24	367
	48,116	11,658	59,774	66,583	15,845	82,428	72,324	24,830	97,154	103,086	31,609	134,695	56,288	29,399	85,687

[1] Primary includes small tonnage of pig tin derived from detinning operations; Bureau of Mines not permitted to publish separate figures
[2] Small quantity included under "Miscellaneous."
[3] In 1937 pure tin tubing required 1,286 tons and tin-lined tubing 10 tons; not reported separately after 1937.
[4] Includes 454 tons of primary and 20 of secondary for Britannia ware and 64 tons of primary and 8 of secondary for pewter.
[5] Includes 9 tons of primary and 2 of secondary for Britannia ware and 2 tons of primary for pewter.

than in 1941 and nearly 13 percent below the 1937–40 average. In Great Britain the savings goal had been set at about 50 percent of the average pre-war use, which probably has been reached, and Germany appears to have made greater reductions. Commenting on the United Nations tin situation, The Metal Bulletin of London said [6] "The fact is that tin is of far less importance as a war metal than anybody had suspected" and, with respect to common use, "to a greater extent than was realized at the time, the use of tin was of the nature of a semi-luxury." The future of tin is not clear, but many of the displacements and substitutions forced upon the consuming industries by the exigencies of war, as indicated in the foregoing paragraphs, are likely to persist in the future.

FOREIGN TRADE [7]

The main constituents of the foreign trade of the United States until 1940 were the imports of pig tin and the exports of tin plate. In that year, owing to the newly initiated stock-piling program, metal imports reached a new high, which was then exceeded by the record importation of 141,000 tons in 1941. Total metal imports were 26,000 tons in 1942; but of that—the lowest figure in this century except in 1921 (24,197 long tons)—nearly 60 percent represented arrivals from Far Eastern countries that were cut off as sources early in the year.

In 1924–39, inclusive, the tin content of imported ores and concentrates had an annual range from less than 1 ton to 500 tons, with an average of only 150 tons. Ore imports attained an all-time record of 31,212 tons in 1942. Bolivia was the principal point of origin, furnishing 23,029 long tons or nearly 5 percent above its 1941 volume. Important because of the high quality and, for the near future, irreplaceable large share (26 percent) in imports were arrivals of 7,977 tons from the Netherlands East Indies. French Cameroun again supplied a small quantity—161 tons—and receipts from Mexico dropped to 45 long tons.

The major tin-export item of the United States, as usual, was tin plate (including terneplate). In 1942 an all-time export record of 594,000 tons was set up—the United States became essentially the sole anti-Axis-world supplier.

Foreign trade of the United States in tin and tin concentrates, 1938–42

Year	Imports				Exports of tin (metal)[1] (long tons)
	Tin (metal)		Tin concentrates (tin content)		
	Long tons	Value	Long tons	Value	
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
1941	140,873	149,569,328	28,670	27,671,689	1,094
1942	26,002	28,548,018	31,212	21,422,896	[3] 165

[1] Imported as pigs, bars, etc., and exported as such.
[2] Less than 1 ton.
[3] Also 244 tons of ingots, pigs, etc., as domestic exports accounted for in exports of miscellaneous tin manufactures. Figures for previous years not separately recorded.

[6] The Metal Bulletin, No. 2751, December 11, 1942, p. 7.
[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Tin [1] imported for consumption in the United States, 1941–42, by countries

Country	1941		1942	
	Long tons	Value	Long tons	Value
Australia	250	$270,956		
Belgian Congo	11,030	10,397,351	10,474	$11,153,143
Brazil			(2)	156
British Malaya	104,872	112,798,138	7,791	8,634,882
Canada	5	5,644	4	1,353
China	2,845	2,702,373	3,625	4,017,470
Hong Kong	4	4,248		
Indochina, French	487	545,814		
Netherlands Indies	17,739	18,883,180	3,922	4,485,899
Panama			(2)	100
Portugal			99	159,630
United Kingdom [3]	3,641	3,961,624	87	95,385
	140,873	149,569,328	26,002	28,548,018

[1] Bars, pigs, blocks, grain, granulated, or scrap, and alloys, chief value tin, n. s. p. f.
[2] Less than 1 ton.
[3] United Kingdom of Great Britain and Northern Ireland.

Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1938–42, 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
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 [1]	16,615	3,536	4,590	6,091	137	383,328
1941 [1]	22,600	180	4,952	8,321	109	354,940
1942 [1]	24,082		1,333	3,230	154	594,095

[1] In addition, 15,153 long tons of terneplate clippings and scrap valued at $474,374 were exported in 1940, 751 long tons valued at $43,545 in 1941, and 76 long tons valued at $4,350 in 1942; not separately classified before January 1, 1940.

Foreign trade in miscellaneous tin manufactures and tin compounds, 1938–42

Year	Miscellaneous tin manufactures		Tin compounds (pounds)	
	Imports [1]	Exports [2]	Imports	Exports
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
1941	2,266	1,456,353	7,224	137,424
1942	[3] 949	591,937		117,191

[1] Includes tin manufactures, n. s. p. f., tinfoil, tin powder, flitters, and metallics.
[2] Includes tin dross and tin-bearing scrap material other than tin-plate scrap.
[3] In addition, 505,346 pounds of tin dross, skimmings, and residues valued at $63,978 were imported; not separately classified prior to January 1, 1942.

Of special interest was the change in destination of exports. Australia and New Zealand were sent 27 percent, a striking example of Lend-Lease. Canada took 11 percent and Iran 5 percent, a large part of which was terneplate. The surprising volume of 50,000 tons for the U. S. S. R., taken in conjunction with the reported British shipments of 26,000 tons of tin for about 18 months after the German attack in June 1941 and the large volumes delivered from European

smelters in 1937–38, seem to indicate that Russia's wartime requirements exceed estimates of peacetime needs—contrary to experience in Canada, Great Britain, and the United States—and further suggest that its domestic production has not been as great as believed.[8]

Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1941–42, by principal countries

Country	1941		1942	
	Long tons	Value	Long tons	Value
Africa:				
British East Africa	3,695	$386,746	9,167	$957,913
Union of South Africa	23,909	2,758,649	31,325	3,871,715
Other British South Africa	426	47,402	3,915	490,770
Argentina	48,081	6,431,925	56,958	6,938,416
Australia	50,457	5,883,653	133,029	16,526,006
Brazil	63,506	7,697,843	37,600	4,495,220
British Malaya	13,018	1,459,758	683	64,252
Canada	30,023	3,453,480	64,146	7,255,969
Chile	8,984	1,096,287	10,683	1,277,202
China	1,811	184,013	102	13,491
Colombia	3,762	448,665	1,260	173,977
Cuba	17,271	2,161,000	14,003	1,807,870
Egypt	9,107	965,920	42,264	4,285,258
Greece	137	15,283	----	----
Hong Kong	2,537	257,765	----	----
India, British	6,456	728,044	17,821	1,907,633
Indochina, French	19	1,814	----	----
Iran	229	29,554	28,384	3,050,628
Mexico	16,888	2,070,121	14,371	1,853,260
Netherlands Indies	5,697	731,299	6,491	733,848
New Zealand	11,739	1,395,362	24,917	2,966,703
Palestine	145	16,197	5,118	566,629
Paraguay	1,819	223,508	4,535	563,280
Peru	2,843	334,254	3,169	356,960
Philippine Islands	6,091	694,044	----	----
Portugal	3,390	409,916	1,758	261,553
Spain	52	5,697	----	----
Sweden	49	5,037	----	----
Switzerland	10	1,265	----	----
Turkey	35	3,938	----	----
United Kingdom	28	3,967	2,409	278,714
U. S. S. R.	4,664	698,382	50,058	6,366,974
Uruguay	11,340	1,423,940	12,478	1,537,790
Venezuela	1,886	232,968	2,254	320,868
Other countries	4,836	577,450	15,197	1,774,256
	354,940	42,835,146	594,095	70,697,155

PRICES

Notwithstanding the actual spread of war to the four quarters of the globe and retention of only a third of the world production centers by the Allies, the control of tin-selling prices has been most effective. Immediately before the outbreak of the 1914–18 conflict, Grade A tin sold at 31.75 cents a pound, New York. When the United States entered that war in April 1917 the price had risen to 55.91 cents, and for a year before that date averaged 43.89 cents. In 1918 a maximum of $1.10 was reached, and the year's average stood at 86.80 cents. In August 1939, or just before the invasion of Poland, the average price was 48.76 cents, then rose sharply in September but receded to the October average of 55.25 cents, an average not reached in the following 21 months. For the year August 1940–July 1941, the average was 51.45 cents. Effective August 16, 1941, the price of Straits tin was fixed at 52 cents a pound, New York, and has remained stationary at that level. Domestic Longhorn 3 Star tin has commanded the same

[8] See Minerals Yearbook, 1940, pp. 700–701, and Minerals Yearbook, Review of 1940, p. 688.

price since it became available in April 1942. The 2 Star grade has been priced at 51.125 cents.

Dealings on the London Metal Exchange were suspended on December 9, 1941, under Control of Tin Order 3, which also established a basic price of £275 for 99 percent minimum tin (or £278.10 for 99.9 minimum), delivered consumers' works.

World prices became nonexistent when maximum prices were established in the major consuming countries and trading ceased on the world's principal tin markets, although small sales at exceptionally high prices have been reported from some countries.

Tin price data, 1925–29 (average) and 1938–42

	1925–29 (average)	1938	1939	1940	1941	1942
Average prices:						
New York: [1]						
Straits tin, cents per pound	56.64	42.26	50.18	49.82	52.01	[2] 52.00
99.75-percent tin (English refined), do	[3]	42.07	[4] 47.84	[5] 48.79	[6]	[7] 51.625
99-percent tin, do	55.50	40.84	[8] 46.35	[8] 49.98	51.26	[9] 51.125
London: [10]						
Standard tin, £ per long ton	254.6	189.6	226.3	256.6	[11] 261.6	[12] 275.0
Do, cents per pound [13]	55.17	41.39	44.81	[14] 43.87	[14] 47.09	49.54
Premium allowed over standard:						
Straits, £ per long ton	5.1	4.3	[3]	[3]	[3]	[3]
Banka, do	6.9	-------	[3]	[3]	[3]	[3]
English, do	−.7	1.3	[3]	[3]	[3]	[3]
Price indexes (1925–29 average=100):						
Straits tin (New York)	100	75	89	88	92	92
Copper (New York)	100	70	75	77	80	80
Lead (New York)	100	63	68	69	78	87
Nonferrous metals [15]	100	74	79	82	85	87
All commodities [15]	100	80	79	80	89	101

[1] American Metal Market.
[2] Maximum for Grade A, 99.8 percent or higher (includes Straits).
[3] Data not available.
[4] 10-month average.
[5] 7-month average.
[6] January–August, nominal; September–December, 51.62 cents.
[7] Maximum for Grade B, 99.75–99.79 percent, and Grade C, Cornish refined.
[8] 9-month average.
[9] Maximum for Grade D, 99.0–99.74 percent.
[10] Metal Bulletin, London, as compiled by International Tin Research and Development Council.
[11] 11-month average.
[12] British Government's maximum price.
[13] Conversion of British quotations into American money based upon average rates of exchange recorded by the Federal Reserve Board of the Treasury.
[14] Based upon free exchange rate.
[15] Based upon price indexes of U. S. Department of Labor.

Monthly price of Straits tin for prompt delivery in New York, 1940–42,[1] in cents per pound [2]

Month	1940			1941		
	High	Low	Average	High	Low	Average
January	48.75	45.12½	46.72	50.50	50.10	50.16
February	48.00	45.00	45.94	54.25	50.25	51.40
March	49.00	45.62½	47.09	52.62½	51.25	52.05
April	47.50	44.75	46.82	52.50	51.50	51.96
May	55.00	47.12½	51.48	52.25	51.75	52.16
June	58.00	42.12½	54.54	53.12½	52.12½	52.67
July	52.75	51.00	51.59	55.00	52.50	53.35
August	52.62½	50.50	51.18	53.00	52.00	52.36
September	51.50	50.05	50.32	52.00	52.00	52.00
October	51.87½	51.00	51.49	52.00	52.00	52.00
November	51.00	50.20	50.56	52.00	52.00	52.00
December	50.20	50.05	50.11	52.00	52.00	52.00
Year	58.00	44.75	49.82	55.00	50.10	52.01

[1] Ceiling price, 52 cents throughout 1942.

[2] Metal Statistics, 1942, pp. 425 and 427.

STOCKS

The total year-end tin content of all stocks in the United States was only 1½ percent below that at the end of 1941, but owing to the great curtailment in consumption they were equivalent to more than 3 years' supply without future increments at the indicated rate of use in the last half year. The make-up, as a result of Government control of acquisition and distribution, was materially altered. Industry pig-tin stocks were depleted to approximately half those on hand at the beginning of the year, whereas those in Government hands increased 28 percent; and ore supply (tin content), after increasing rapidly in the first 6 months, showed a slight loss in the second half but ended the year at 37,210 long tons or 55 percent higher than at the beginning.

Consumer surveys continued by the Bureau of Mines throughout 1942 showed year-end industry primary tin stocks at plants to be 32,100 tons, of which 20,600 tons were at tin-plate mills. Tin in transit ceased to be important in the supply situation and was 78 tons at the end of December. Secondary pig tin moved rapidly to consumers whose year-end stocks were estimated to be about 300 tons.

Data on world stocks have not been published since June 1941. Since control of tin supplies by governments is effective throughout the world and their distribution is earmarked, it may be said that visible stocks, as usually defined, no longer exist, although actual metal held in what has taken the place of private warehouses is probably more than double the visible stock averages of 1939–40.

Stocks of virgin pig tin in the United States, December 31, 1938–42, in long tons

	1938	1939	1940	1941	1942
Location of stocks:					
Afloat to United States [1]	4,150	12,663	22,627	[2] 15,000	[2] 900
At landings in New York [1]	1,837	2,415	6,106	3,129	([3])
In licensed warehouses in New York [1]	3,320	887	3,073	371	
Total visible supply [1]	9,307	15,965	31,806	18,500	[2] 900
Consumers' stocks [4]	17,851	21,111	46,574	[5 6] 56,922	[7] 31,226
Total stocks on hand	27,158	[8] 37,076	[8] 78,380	[6 8] 75,422	[8] 32,126

[1] As reported by Commodity Exchange, Inc.
[2] Estimated.
[3] Not available.
[4] As reported to the Bureau of Mines; does not include tin in process or secondary pig tin.
[5] Includes 2,700 tons in transit in the United States and at other warehouses not contained in figures above for "at landings" and "in licensed warehouses."
[6] Revised figures.
[7] Includes 78 tons in transit and 84 tons held by jobbers.
[8] Exclusive of Government purchases delivered for stock piling.

Visible stocks of tin in the world and in the United States at end of each month, 1925–29 (average) and 1938–42, in long tons [1]

Month	1925-29 (average)		1938		1939		1940		1941		1942 [2]	
	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World	U. S.
January	18,912	2,986	30,493	4,866	39,100	4,624	35,573	1,749	44,719	9,442		
February	19,620	3,027	29,002	5,116	40,035	5,486	33,148	2,078	44,107	7,489		
March	18,312	2,803	34,872	4,458	37,788	5,806	32,339	2,635	39,971	5,195		
April	17,765	2,189	35,359	4,447	37,224	3,385	32,149	2,964	38,788	5,016		
May	19,085	2,384	33,051	3,679	33,715	3,387	30,562	3,677	40,777	7,205		
June	18,250	2,390	35,844	4,247	30,039	4,388	31,869	5,300	38,600	2,846		
July	18,164	2,675	39,119	4,071	29,615	5,339	38,736	6,567	(2)	5,864		
August	18,339	2,450	41,701	5,232	26,338	3,613	38,040	6,583	(2)	2,393	(2)	(2)
September	18,317	2,425	40,544	4,573	31,168	3,413	39,450	9,438	(2)	1,767		
October	18,356	2,899	38,945	4,500	38,206	3,536	40,631	6,623	(2)	1,127		
November	19,058	2,373	37,145	5,060	38,035	3,283	40,046	4,362	(2)	2,186		
December	20,557	2,277	37,712	5,157	38,280	3,302	44,678	9,179	(2)	3,500		
Average	18,744	2,573	36,149	4,617	34,962	4,130	36,435	5,096	(2)	4,502		

[1] Metal Statistics, 1942, pp. 417 and 419. In this table figures for world stocks, 1938-41, include carry-over in the Straits Settlements (on lighters and warrants) and carry-over at principal European smelters.
[2] Publication of statistics suspended owing to war.

WORLD ASPECTS OF TIN INDUSTRY

WORLD MINE PRODUCTION

Official statistics from all tin-producing countries have not been available since 1939, but it appears probable that production in 1942 was not much more than half that of 1941. Production in countries accessible to the Allies was somewhat below expectations, especially in Bolivia, where a decline of about 9 percent from the 1941 output was reported. In the East, notwithstanding Japanese assertions, output from Burma, British Malaya, and Netherlands Indies was probably only a small fraction of normal. In Thailand, too, there was some interference with mining, as well as plant damage, and China's inaccessibility doubtless held production low.

World mine production of tin (content of ore), 1925–29 (average) and 1938–42, by countries, in long tons

[Compiled by B. B. Waldbauer]

Country	1925-29 (average)	1938	1939	1940	1941	1942
Restricted production:						
Belgian Congo	967	8,820	8,964	12,482	16,006	16,844
Bolivia (exports)	37,169	25,484	27,211	37,940	42,199	38,293
Indochina	691	1,599	1,470	2,098	[1] 1,430	[1] 1,400
Malay States:						
Federated	54,606	41,206	49,525			
Unfederated	2,206	2,041	1,994	85,384	[1] 78,000	[1] 15,000
Straits Settlements	25	114	206			
Netherlands Indies	33,266	27,299	27,755	43,193	[1] 51,000	[1] 10,000
Nigeria	8,319	8,977	9,427	12,012	[1] 15,000	[1] 12,500
Thailand (Siam)	8,204	14,704	[2] 17,325	17,447	[1] 16,250	[1] 12,000
Total signatory countries	145,453	130,244	143,877	210,556	220,000	106,000
Unrestricted production:						
Argentina	32	1,886	1,655	1,481	921	[1] 700
Australia	2,830	3,329	3,500	(3)	(3)	[1] 3,000
Burma	2,228	7,100	8,536	[1] 5,500	(3)	(3)
Cameroun, French		242	255	(3)	(3)	(3)
China	[2] 7,085	[2] 11,605	[2] 10,422	[2] 6,249	[1] 7,000	[1] 7,000
Germany	98	[1] 300	[1] 300	(3)	(3)	(3)
Italy		271	229	(3)	(3)	(3)
Japan	625	2,186	[1] 1,700	(3)	(3)	(3)

See footnotes at end of table.

World mine production of tin (content of ore), 1925–29 (average) and 1938–42, by countries, in long tons—Continued

[Compiled by B. B. Waldbauer]

Country	1925–29 (average)	1938	1939	1940	1941	1942
Unrestricted production—Continued.						
Mexico	2	249	289	345	212	365
Morocco, French	4	27	(3)	(3)	(3)	(3)
Peru		103	47	72	45	(3)
Portugal [4]	625	1,037	1,486	1,721	2,261	2,142
Portuguese East Africa	5	4	7	8	(3)	(3)
Rhodesia:						
Northern		3		(3)	(3)	(3)
Southern	15	267	451	(3)	239	162
Somaliland, Italian			[1] 40	(3)	(3)	(3)
South-West Africa	149	164	156	137	120	(3)
Spain	145	138	106	100	83	287
Swaziland	138	122	114	103	(3)	(3)
Tanganyika	22	241	229	258	251	(3)
Uganda	98	399	346	(3)	(3)	(3)
Union of South Africa	1,174	558	482	518	[5] 460	[6] 412
United Kingdom [4]	2,658	1,999	1,630	1,560	[1] 1,600	[6] 1,400
United States	24	95	34	49	56	6
Total nonsignatory countries	17,957	32,325	32,000	25,000	25,000	20,000
Grand total	163,000	163,000	176,000	236,000	245,000	126,000

[1] Estimate. [2] Exports. [3] Estimate included in total.
[4] Restricted production basis from 1934–36, inclusive.
[5] January to November, inclusive. [6] January to October, inclusive.

WORLD SMELTER PRODUCTION

Production from the world's smelters is likewise unknown, but it suffered severely when the British and Hollanders were forced from their Asiatic holdings. The Penang smelter, however, is believed to have continued in operation. Chinese inland smelter production doubtless did not exceed 7,000 or 8,000 tons; Japanese plants probably were operated at capacity. A small electric smelter was in operation in British Columbia. In less than 9 months, the Texas City smelter produced 15,696 long tons of tin; however, at the end of the year the annual production rate had risen to over 28,000 tons.

World smelter production of tin, 1925–29 (average) and 1938–42, by countries, in long tons

[Compiled by B. B. Waldbauer]

Country	1925–29 (average)	1938	1939	1940	1941	1942
Argentina		2,093	1,080	881	768	[1] 900
Australia	2,952	3,229	3,300	(2)	[1] 5,000	[1] 3,000
Belgian Congo		2,283	2,124	7,832	15,000	[1] 14,400
Belgium [1]	720	[3] 6,700	[3] 3,100	(2)	(2)	(2)
British Malaya	[4] 88,855	[4] 63,746	[4] 81,536	[3] 126,945	[1] 125,000	[1] 10,000
Canada					29	560
China	[5] 7,080	11,200	10,850	[1] 13,000	[1] 10,000	[1] 7,000
Germany [6]	3,444	3,000	[1] [3] 3,600	(2)	(2)	(2)
Italy		271	229	(2)	(2)	(2)
Japan	606	1,900	[1] [3] 2,000	[1] 1,800	(2)	[1] 4,000
Mexico	(2)	(2)	90	116	150	(2)
Netherlands	[7] 1,000	[1] 26,400	[1] 14,600	2,967	(3)	(2)
Netherlands Indies [5]	14,749	7,207	13,941	22,035	[1] 23,000	[1] 5,000
Norway	(2)	254	283	(2)	(2)	(2)
Portugal	[8] 2	39	30	781	1,481	[1] 2,000
Thailand (Siam)	[9] 113		(2)	(2)	(2)	(2)
Union of South Africa				(2)	[10] 143	[10] 268
United Kingdom [1]	45,800	36,200	37,400	(2)	40,000	30,000
United States				[11] 1,391	[11] 1,839	[11] 16,168
	165,000	164,500	174,100	(2)	(2)	(2)

[1] Estimated. [2] Data not available. [3] Yearbook of American Bureau of Metal Statistics.
[4] Exports plus difference between carry-over at end and beginning of year.
[5] Exports. [6] Includes production of some secondary tin. [7] Estimated production in 1929.
[8] Average for 1926–27. [9] Average for 1926–28. [10] Fiscal year ended July 31 of year stated.
[11] Including tin content of ores used direct to make alloys.

INTERNATIONAL TIN-CONTROL SCHEME

The third International Tin-Control Scheme expired December 31, 1941. A fourth was recommended for adoption in December 1941, but the outbreak of war in the Pacific and objections to proposed quotas by some of the participants delayed acceptance until September 9, 1942 (retroactive to January 1, 1942), when the agreement was formally ratified by representatives of the countries participating in the preceding Scheme, except Thailand and French Indochina.[9] The standard tonnages in the accepted form were those contained in the proposed text, except for the omission of Thailand. They vary considerably from the earlier bases, as actual experience with virtually unlimited production (130 percent of standard tonnage) for a year from July 1940 showed that some of the signatories could not attain the high quotas provided. Pending acceptance of the fourth agreement, tentative quotas had been set at 105 percent of the revised standard tonnages and were retained as far as known through 1942. The new agreement is to run for at least 5 years; the United States will have two representatives (nonvoting), one selected by the Government and the other a consumer representative, and there will be an additional representative for consuming countries other than the United States. Under the present war conditions the control agreement is purely nominal, but it does provide a continuing possibility of exercising some production control in the event of future wide fluctuation in demand.

In June 1938 a Buffer Pool was established, with the aim of stabilizing the price between £200 and £230. A stock of 15,512 tons was created between August 1, 1938, and July 1939; total purchases and sales were 66,428 long tons. In April 1942 it was decided to liquidate the remaining stock and complete the distribution of credit balances. The first distribution, in which all seven of the signatories to the Third Control Scheme participated, was made between November 1939 and February 1940 and amounted to £1,010,000. The final distribution of June–July 1942 amounted to nearly £2,285,000. In addition, balances to Thailand (£216,300) and to Indochina (£37,000) could not be paid because of legal difficulties arising under the Trading with the Enemy Act. It has been suggested that these funds be redistributed to the other parties to the Pool. The average realization without interest and before London overhead expense was £226.16.5 and the average distribution to the end of 1942 was £229.9.9.[10]

WORLD CONSUMPTION

Owing to the lack of basic statistical data for the past 3 or more years, the table of apparent world consumption is omitted from this review. Assuming the usual relationship between domestic and world consumption, the last named probably was about 125,000 tons in 1942 and may be expected to fall below that in 1943.

[9] American Metal Market, vol. 49, No. 251, December 31, 1942, p. 5, gives the full text of the agreement.
[10] The full report of the Executive was printed in American Metal Market, vol. 50, No. 96, May 20, 1943, pp. 5-6.

REVIEW BY COUNTRIES

Argentina.—Operations at the Pirquetas mine and the Pircas Creek placer continued during 1942, but with a smaller output than in 1941. The Buenos Aires smelter, which had treated most of the ore, could not produce enough tin to satisfy demands because of the contraction in ore supply, and some tin was imported.

Australia.—Production in 1942 has been estimated at 3,000 tons. Before the war, consumption of tin in Australia (including New Zealand) averaged 2,000 tons annually, and with the production of 3,000 to 4,000 tons there had been an exportable surplus. However, war needs have been greater than available supplies, and it was necessary to acquire a small tonnage from the United States for use in New Zealand. In 1943 mine output is expected to reach 4,000 tons but may not be realized owing to labor shortage and delays in obtaining dredges and other mining equipment. Some aid has been furnished through Lend-Lease, which also made available funds for canning equipment to expand production to provide food for American troops in Australia and New Zealand.

Effective May 1, 1942, the price of tin was set at £A371 per long ton, an increase of £A51. To encourage production from low-grade sources, it has been proposed to establish a pool for developing low-grade deposits by allocating £A10 per ton. The increased price of tin brought about a rise in output by small producers in 1942, but the lack of labor and continued withdrawal of competent men nullified the efforts of larger companies to expand their yield.

Belgian Congo.—The United States imported 10,474 tons of pig tin from the Belgian Congo during 1942 (11,030 tons in 1941). A sizable tonnage of pig tin was lost at sea through enemy action. Some cassiterite containing about 1,670 tons of tin mined in 1942 was to have been shipped to England. Mine output for 1943 has been estimated at 21,530 tons of tin, although it may not be reached because of a developing water shortage. The entire 1943 output of pig tin and cassiterite will be shipped to the United States. The Belgian Minister of Colonies is reported to have stated that by 1945 the Belgian Congo would be able to produce 35,000 tons of metallic tin annually.[11]

Bolivia.—The tin content of concentrates exported from Bolivia declined 8 percent from the 42,199-ton level of 1941 to 38,293 long tons in 1942, or 22 percent below the permissible quota of 49,106 tons (105 percent of standard) allowed under the Control Scheme. The United States was the destination of 53 percent of the 1942 export, and the remainder went to Great Britain. Inability to approach the quota was attributable to labor unrest that culminated in serious disorders at the end of the year, to a decline in grade of ore—the Patino Enterprises reported 2.83 percent in 1941 and 2.55 percent in 1942—accompanied by lower mill recoveries, and to general shortages in labor, equipment, and supplies. In an attempt to halt the downward production trend and if possible reverse it, financial aid and the assistance of numerous specialists were furnished by the United States.

[11] Tin, Belgian Congo: January 1943, p. 2.

At the request of the Bolivian Government a labor commission that worked jointly with Bolivian officials made a study of working conditions, wages, and security of workers, especially among miners. The commission submitted its report with recommendations to the Bolivian Government in March 1943, but its contents had not been disclosed in this country when this review was written. American technologists began studies of mining and metallurgical practices with the object of expanding output, especially at the smaller mines, and of improving the ore-dressing methods that are said to make recoveries of only about 50 percent at the plants of small and medium producers and of 72 to 80 percent by the major groups. To improve economic conditions and stimulate strategic materials output, the Bolivian Development Corporation was set up December 29, 1942, as a cooperative undertaking of the Bolivian Government and the Export-Import Bank, the latter furnishing credits of $15,500,000 out of a total capital of $26,000,000.

British Malaya.—The Japanese conquest of the Malay Peninsula was completed by the fall of Singapore on February 15, 1942. In 1941 about 68 percent of the output of the mines in the Federated Malay States came from European-owned and about 30 percent from Chinese-owned mines. About one-half of the production was obtained by dredging, and the bulk of the remainder by pumping, with small amounts from hydraulicking, open-cuts, and underground workings. Late in December 1941 the Government ordered the mine operators to destroy their properties. Annual reports of the principal British-owned companies indicate that many of them had sunk their dredges, destroyed power plants, and flooded their open-cast workings, but there is some doubt that the damage inflicted could have been as great as contemplated because of the rapid movement of the Japanese forces.

Burma.—The plant of Mawchi Mines, Ltd., was immobilized, and the property at Pazaung on the Salween River was evacuated under military orders on April 5, 1942. Lashio, the terminus of the Burma Road, was occupied by the Japanese April 29. The important tin mine area in lower Burma, south of Moulmein in the Tavoy and Mergui districts, was also gained by the Japanese.

Canada.—Although occurrences of tin have been reported from numerous localities in Canada, none has commercial importance. At present, however, Grade A tin is being produced at the Sullivan mine of the Consolidated Mining & Smelting Co. of Canada, Ltd., near Trail, British Columbia. At that mine cassiterite was discovered in the tailings from the lead-zinc concentrator in 1925, but as the amount of tin was small it was then considered only of academic interest. Subsequent and extensive research lead to the development of a satisfactory recovery process that is described in Canadian Institute of Mining and Metallurgy Bulletin 356, December 1941 (pp. 611–622). On March 1, 1941, a plant was put into operation, and in April 1942 an electric smelter that produced 560 tons of pig tin in 1942.

The discovery of a high-grade ore body carrying cassiterite and stannite in the Woolsey mine in the Revelstoke district, British Columbia, was reported.

In Manitoba the occurrence of tin has been known for many years. Great interest was aroused in the Rush Lake-Bird River district,

where a sample taken in 1940 had shown 0.3 percent tin. The Canadian Department of Mines and Resources examined what was believed to be the best cassiterite showing and recently issued a report.[12] Reviewing the current and earlier field work the writer concluded that "There is no known tin occurrence of commercial dimensions in Manitoba that contains sufficient tin to justify its recovery even under the stress of wartime requirements."

China.—Authentic statistical data on tin have been available only irregularly in recent years, but various estimates indicate that Chinese production rose from about 9,000 metric tons in 1935 to approximately 13,000 tons in 1940. The virtual isolation of southwestern China, serious inflation, the migration of workers to agricultural employment inducing a labor shortage, high wage levels, extremely high fuel and transportation costs, and inability to bring in supplies and equipment severely retarded development and production so that output in Yunnan fell to about 5,000 tons and that of China to roughly 7,000 tons in 1941, according to official figures.[13] The final closing of the Burma Road and some fighting along the Yunnan borders would have tended to hold down production in 1942, but the National Resources Commission has just reported that in Yunnan there was in 1942 a gain of about 1,000 tons over 1941;[14] total Chinese production may therefore have exceeded 7,000 tons. Although tin has not been mentioned specifically, it is believed a small tonnage was exported to Russia over the Northwest Highway in 1942, and a small amount has been flown out to India. Immediately after the attack on Pearl Harbor redoubled attempts were made to expedite the movement of tin over the Burma Road, and although a substantial amount did get through to the United States the unexpectedly early fall of Rangoon and evacuation of Burma resulted in the loss of large quantities of metal.

Germany.—Early in 1941 some authorities believed that Germany faced an immediate and dire tin shortage, a shortage more serious than in petroleum and food.[15] It is not yet, however, evident that a lack of tin has caused any pronounced decline in its war effort, because Germany has been and is waging a major war with very little supply. The German reserve position was probably better and the amount of loot greater than assumed. Civilian use of scarce materials had long since been reduced to negligible volume, and the use of substitutes even in essential industries had been strictly enforced. Intensive salvage campaigns had brought out much metal. At the same time, some new supply apparently reached Germany. Although the sinkings of several tin-carrying ships have been announced, it has been reported that since the fall of 1942 at least 26 vessels have run the blockade from Kobe to Bordeaux.

It has been claimed that great progress has been made in the substitution of bonderized lacquered plate for tin plate.[16] During the First World War considerable experience had been gained, presumably for general line cans, and much experimentation followed to determine the best basic coating, type of lacquer, and kind of plate to be used.

[12] Bateman, J. D., Tin in Manitoba: Canadian Min. Jour., vol. 64, No. 5, May 1943, pp. 273–278.
[13] Metal Bulletin (London), 1941 Chinese Output Down: December 22, 1942, No. 2754, p. 7.
[14] Foreign Commerce Weekly, May 22, 1943, vol. 11, No. 8, p. 34.
[15] Tin, Tin and Germany's War Effort: April 1941, pp. 3–4; quoted in part in Minerals Yearbook, 1941, p. 727.
[16] Schuster, Ludwig, Konservendosen aus phosphatiertem und lackiertem Stahlblech: Stahl u. Eisen, vol. 62, August 13, 1942, pp. 685–695.

It was also determined that bonderizing and lacquering should be carried out by the can maker rather than by the rolling mill to avoid damage to surface in transport and handling. Body seams of this type of can cannot be soldered, and recourse was had to welding, for which an automatic welder was developed. This system is said to save incidentally 330 pounds of steel per 100,000 cans because of a smaller overlap.

A commercial-scale plant was erected in 1938. Bonderizing and lacquering were carried out in separate plants, but subsequently both were combined into a single unit. The article describes one operating plant that has a capacity of 5,000 to 6,000 cans an hour. Other plants appear to be operating.

The bonderized-lacquered cans are said to be satisfactory for meats and vegetable packs and for some but not all fruits. Future development is a questlon of lacquers with further possibilities if a scheme of full welding, including the ends, can be devised.

Italy.—The output of tin in Italy was about 300 tons in 1942. The only productive tin mines are near Villacidro, Cagliari, Sardinia, where a concentrating mill of 50 tons daily capacity is said to be producing 1 ton of high-grade concentrate a day.

Japan.—The Japanese policy of enslaving subject peoples has been extended to cover mineral and other wealth as well. In December 1942 Premier Tojo declared that Japan must win each decisive battle and make every effort to retain control of all natural resources gained in the initial victories. Such avowal of a determined policy of exploitation of subjugated territories was confirmed by the repeated reports, mostly originating from Japanese sources, that many tin mines and some smelters were again in full operation. Nevertheless, it appears improbable that ore production would have greatly exceeded smelter capacity, which when last reported was about 5,000 tons in Japan. So far as is known, Indochina's small reduction works were not harmed, reports of the destruction of the Penang smelter were conflicting, and the Hong Kong smelters were probably in large measure available. Japan had then access to ample smelting facilities to meet its apparent requirements of about 12,000 tons annually. The extremely rapid rise in pre-war apparent consumption points toward a large wartime accumulation; and if, as reported, high-grade concentrates are flowing to Japan from Malaya and the Netherlands Indies, its internal smelting capacity would be enlarged without addition to plant. Thus the Japanese Empire has not only obtained self-sufficiency in tin but may be establishing a long-term reserve against any eventualities, and any excessive accumulation would present an economic threat to post-war tin-market stability.

Some tin, probably several thousand tons, was shipped to Germany and Italy during 1942 as the British have disclosed the interception, sinking, or scuttling of ships carrying tin cargoes.

Mexico.—Mine production of tin in Mexico was 365 long tons in 1942 compared with 212 tons in 1941. Most of the 1942 production was utilized within Mexico, as 93 long tons were exported (108 in 1941). The price of tin was extremely high, being quoted at about $1.25 (U. S. currency) per pound. This led to the relatively marked increase in production and a drop in exports.

A new smelter designed for Metalurgica de Mexico, S. A., to treat tin, mercury, and antimony ores was completed in May 1942 at Tlalnepantla near Mexico City.

Netherlands East Indies.—Authentic information is lacking on the quantity of tin produced in the Netherlands Indies during the early part of 1942 before they fell into Japanese hands. However, 3,922 tons of pig tin and 7,977 tons of ore (tin content) reached the United States from that source during 1942. It has not been reported what portion of this was derived from stocks. The Japanese announced in the latter part of 1942 that the tin mines at Banka, Singkep, and Billiton had resumed operations, but it is doubtful that any great volume has been produced.

Nigeria.—Nigeria failed to meet expectations in 1942, as mine output was only 12,500 tons of tin or 7 percent below the permissible quota of 16,135 tons under the new Tin-Control Scheme. This was a particularly disappointing result, as the producers had been requested by the Government to increase output to the limit, and several companies reported that they were "picking the eyes out" of their deposits, regardless of the future. In some quarters the falling off in production was attributed to the Government restriction on prospecting, which has not yet been lifted.

Production, including stocks on hand and in transit, was taken over by the Ministry of Supply, December 9, 1941, but freight and insurance remained for account of the seller until July 1942. After long negotiations, the price to be paid Nigerian producers has been tentatively established. It is based upon costs and profits for the year ended August 31, 1939, or the average of the 3 years ended on that date, with adjustments for increases or decreases from those of the base period. Freight, marine, and war-risk insurance will no longer be paid by the sellers. It is understood that the new basis is £217 per ton (the 3-year average price for the period ended August 31, 1939) and that £150 per ton will be paid at port of shipment, with final settlement after assay in England.

Wages paid native workers have been increased as a result of Government intervention. Compulsory labor regulations have been introduced. It was said that more than 14,000 laborers are now working under these regulations and that the total force exceeds 70,000. Production plans call for an annual output of 20,000 tons if labor can be found.

Portugal.—Portuguese smelters have flourished in a small way owing to wartime conditions, as ore formerly exported is now treated within the country. A Metal Control Commission has been set up to control production and distribution and to fix prices. All tin must be offered to the Commission at a fixed price. Of the tin purchased, 25 percent is to be reserved for use in Portugal and the remainder is to be distributed between Axis and United Nations purchasers. Germany was offering very high prices for Portuguese tin early in 1942.

Spain.—Although it has been believed that Spain has sold tin to Germany the volume appears to have been small owing to the generally short supply. According to the Metal Bulletin of February 12, 1943, Spain had to import about 90 percent of its needs or 1,000 to 1,500 tons a year.

Union of South Africa.—The Zaaiplaats Tin Mining Co., Ltd., treated 42,690 tons of ore and recovered 182 long tons of concentrates in the year ended July 31, 1942, compared to 194 in the previous year. From its own and custom ores, the smelter produced more than 268 tons of pig tin in 1942 (143 tons in 1941). A third furnace has been added to the plant.

South-West Africa.—In the fall of 1942, discovery of a promising tin prospect at Kaokoveld, South-West Africa, was announced. The district lies in the northeastern part of the mandated territory near the Bechuanaland Protectorate border and is southwest of Caprivi Zipfel.

United Kingdom.—The consumption of primary tin in the United Kingdom has been brought down to around 14,000 tons annually compared with 30,000 tons in 1941 and 29,225 tons in 1940. Rigid control, under strict Government allocation, is exercised, and new measures for economizing in tin consumption are constantly coming forward. The tin-plate industry normally consumes about 40 percent of the tin used in the United Kingdom. The Welsh tin-plate industry operated at a very low level; permits to purchase tin plate were small, and most of the orders were for plate for lacquering. The electrolytic tin-plate process has been under investigation, but reaction appears unfavorable to the use of the thinly coated plate. Nevertheless, at the year end a small electrolytic unit was nearing completion.

Imports of ore from Bolivia and Nigeria apparently were lower in 1942 but were, however, adequate to meet smelter requirements. Trade journals generally believe that the tin position is comfortable in the United Kingdom.

U. S. S. R.—Russia has been almost wholly dependent on imports for its requirements, as its domestic production probably does not exceed 2,000 tons annually. It is believed that some tin was received from China during 1942; whether any was acquired from Japanese sources is unknown. Since June 1941 Great Britain has sent 26,000 tons of tin to Russia. It is unknown whether any was lost at sea from enemy action. According to The Metal Bulletin (London), "Japan might conceivably ship tin to Russia, who would be an equally ready buyer. At the moment, however, we have no information as to what trade, if any, is still going on between Russia and Japan."[17] It has been reported, however, that Japan is selling rubber and other products to Russia.

[17] The Metal Bulletin, Japan and Tin: No. 2733, October 9, 1942, p. 6.

ARSENIC

By Allan F. Matthews

SUMMARY OUTLINE

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GENERAL STATEMENT

Domestic production of white arsenic in 1942 fell 12 percent below the 1941 record, but this decrease was more than balanced by a 59-percent increase in imports, permitting consumption to advance 5 percent. More than a third of the new supply of arsenic in the United States in 1942 came from Mexico. The quoted price of white arsenic remained at 4 cents a pound throughout 1942. Arsenic was placed under allocation control by the War Production Board May 22, 1942 (Order M–152).

Salient statistics for white arsenic in the United States, 1938–42

	1938	1939	1940	1941	1942
Production, short tons	16,685	22,341	24,983	32,481	28,681
Imports for consumption, do.	14,238	14,674	9,929	10,292	16,350
Exports (by producers only), do.	2,267	3,178	1,639	1,616	305
Consumption, do.	[1] 25,100	[1] 33,900	[1] 31,600	40,442	42,411
Average value of producers' sales:					
Crude, cents per pound	1.4	1.0	1.1	1.5	2.1
Refined, do.	1.7	1.4	1.5	2.2	2.7

[1] Apparent consumption.

DOMESTIC PRODUCTION

Production of white arsenic in the United States in 1942 declined 12 percent compared with 1941, chiefly because all stocked residues were consumed in 1941. The four producers were the American Smelting & Refining Co., Anaconda Copper Mining Co., Getchell Mine, Inc., and U. S. Smelting, Refining & Mining Co., which derived their output from bag-house and Cottrell dust and speiss. The Getchell company mines gold ores at Red House, Humboldt County, Nev.[1], and in 1942 began to recover the arsenic content by means of a Cottrell precipitator and accessory equipment. Of the domestic white arsenic production in 1942, 89 percent was crude (79–98 percent As_2O_3) and 11 percent was refined (99+ percent As_2O_3).

[1] Van Voorhis, Jr., B. W., Mining Gold-Arsenic and Tungsten Ores at the Getchell Mine: Min. World, vol. 4, No. 12, December 1942, pp. 5–8.

White arsenic produced and sold by producers in the United States, 1938–42

Year	Crude			Refined			Total		
	Production (short tons) [1]	Sales		Production (short tons)	Sales		Production (short tons)	Sales	
		Short tons	Value [2]		Short tons	Value [2]		Short tons	Value [2]
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
1941	26,843	28,661	844,793	5,638	6,123	274,527	32,481	34,784	1,119,320
1942	[3] 25,658	[3] 27,981	1,198,424	3,023	3,057	161,942	28,681	31,038	1,360,366

[1] Excludes crude consumed in making refined.
[2] Partly estimated.
[3] Includes production of 290 tons of white arsenic and sales of 279 tons contained in compounds made directly from arsenic-bearing ores.

The Anaconda Copper Mining Co. was the sole domestic producer of metallic arsenic in 1942. The Rare Metal Products Co., Belleville, N. J., manufactures arsenic sulfides.

FOREIGN TRADE [2]

Imports of white arsenic—principally from Mexico—increased 59 percent in 1942 compared with 1941. Exports of white arsenic, calcium arsenate, and lead arsenate declined materially.

White arsenic imported for consumption in the United States, 1938–42, by countries

Country	1938		1939		1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Belgium	565	$16,100	323	$10,098	15	$1,152				
Canada	689	29,854	471	24,760	339	18,016	862	$58,850	1,449	$32,977
France	1,176	30,843	2,200	50,224	1,654	25,799				
Germany	112	5,656	(1)	4						
Japan	482	17,199	963	30,079	224	10,307	193	10,668		
Mexico	8,422	415,180	8,124	377,568	7,520	393,413	9,237	528,488	14,901	859,836
Norway					1	187				
Sweden	2,792	93,197	2,593	69,304	176	4,156				
	14,238	608,029	14,674	562,037	9,929	453,030	10,292	598,006	16,350	892,813

[1] Less than 1 ton.

[2] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Arsenicals imported into and exported from the United States, 1938–42, by classes, in pounds

Class	1938	1939	1940	1941	1942
Imports for consumption:					
White arsenic	28,475,783	29,347,810	19,857,310	20,583,253	32,700,351
Metallic arsenic	16,868	39,197	13,228	2,240	6,854
Sulfide	241,602	656,498	220,445	11,025	----------
Arsenic acid (H_3AsO_4)	55	210	----------	----------	----------
Calcium arsenate	400,000	1,627,193	432,785	1,230,960	215
Lead arsenate	----------	11,557	----------	----------	----------
Sheep dip	168,932	306,900	341,556	264,350	272,540
Paris green and london purple	103,556	45,823	25,603	12,000	----------
Sodium arsenate	11,881	7,482	----------	----------	----------
Exports:					
White arsenic [1]	4,534,000	6,356,933	3,278,558	[2] 3,231,536	610,206
Calcium arsenate	5,242,882	6,731,103	4,879,391	5,897,598	3,941,722
Lead arsenate	1,021,345	1,712,583	2,900,250	9,594,483	592,029
Paris green (cupric acetoarsenite)	[3]	[3]	[3]	[4] 224,976	171,464

[1] As reported to Bureau of Mines by the producers.
[2] Dealers exported an additional 1,077,244 pounds.
[3] Not separately classified.
[4] Figures cover July to December; not separately classified before July 1.

CONSUMPTION AND USES

Consumption of white arsenic in the United States in 1942, according to the War Production Board, is estimated at 42,411 short tons—73 percent in insecticides, 11 percent in weed killer, 4 percent each in glass and arsenic trichloride, 3 percent in dyes, 2 percent in wood preservative, 0.7 percent in gas purification, 0.4 percent in metallurgy, and 0.3 percent in pharmaceuticals. The results of a special consumer survey for 1941, conducted by the Bureau of Mines, are shown in the following table.

White arsenic consumed in the United States in 1941, by uses

Consumed in—	White arsenic consumed		Arsenicals manufactured (short tons)
	Short tons	Percent of total	
Insecticides:			
Lead arsenate (normal)	11,231	27.8	36,656
Calcium arsenate	11,192	27.7	29,684
Paris green	1,523	3.8	2,073
London purple	255	.6	673
Other insecticides [1]	479	1.2	[1]
Weed killer: Sodium arsenite	7,123	17.6	[2] 14,074
Poison bait: Sodium arsenite	414	1.0	781
Glass	4,281	10.6	----------
Wood preservative and wall board	1,366	3.4	----------
Dyestuffs	417	1.0	----------
Metal and alloys	246	.6	----------
Miscellaneous [3]	1,915	4.7	----------
Total white arsenic consumed	40,442	100.0	----------

[1] Includes zinc arsenate, basic lead arsenate, copper arsenate, etc.; figures not available for quantity manufactured.
[2] Partly estimated.
[3] Includes cattle dip, gas purification, arsenic trichloride, pharmaceuticals, paint, etc.

Calcium arsenate is the principal insecticide used to combat the boll-weevil, leaf-worm, and boll-worm infestations in the Cotton Belt; and lead arsenate is employed largely as a spray for apple and pear trees to exterminate codling and gypsy moths and for treating soil in the East to destroy Japanese-beetle grubs. The Department of

Agriculture anticipates an output of 45,000 tons of calcium arsenate, 31,000 tons of lead arsenate, and 1,250 tons of paris green in 1943. The 1943 outlook was summarized by W. H. Moyer, Insecticides and Fungicides Unit, War Production Board, as follows:

While it has been necessary to curtail sharply many normal uses of arsenic and to require substitution of less scarce materials in many directions, the basic requirements of agriculture for arsenical insecticides should be well provided for during 1943. In some cases, however, farmers will be urged to make greater use of items such as nicotine sulfate and cryolite, which are more plentiful than arsenicals.

Arsenic is an important reagent in glass manufacture, but antimony and cerium [3] are possible substitutes should such use become restricted. The effects of arsenic in glass, described in a recent paper,[4] are summarized as follows:

(1) *Blocking agent:* Chunks of arsenious oxide thrown into the glass pot sink to the bottom and rapidly volatilize with consequent beneficial stirring action. (2) *Fining agent:* Arsenic takes oxygen from niter and later liberates it as bubbles which sweep out carbon dioxide, steam, and other gaseous impurities. (3) *Oxidizing agent:* The oxidizing effect of arsenic helps keep the melt colorless by inhibiting the reduction of ferric oxide to green ferrous oxide. (4) *Reducing agent:* Arsenic is a reducing agent in respect to manganese and chromium, thus serving to tone down intense manganese colors and to improve chrome greens by removing the yellowish cast of chromates. (5) *Color stabilizer:* Since both the trioxide and pentoxide are colorless, arsenic is an excellent buffer to absorb variations in oxidizing-reducing conditions and thereby protect changes in the shade of sensitive colors. (6) *Opacifying agent:* The use of arsenic in making opal (milky-white) glass was widespread in the early days of the industry but is now limited primarily to the white calibration stripes on thermometers and laboratory glassware.

There are a number of disadvantages of using arsenic in glass: (*a*) Arsenic presents a health hazard to workers. This might be minimized by utilizing calcium or lead arsenate instead of arsenious oxide. (*b*) Excess additions cause cloudiness, as indicated by its use in opacification. (*c*) Arsenic is believed to attack glasshouse refractories, but this subject is controversial. (*d*) Arsenic cannot be used with cerium or neodymium decolorizers because glasses containing such combinations turn brown on exposure to sunlight. (*e*) Tubing and other glass that is reworked must not contain arsenic, because reheating is apt to precipitate gray or brown spots of metallic arsenic.

Sodium arsenite is used as a weed killer and as the lethal constituent of poison bait for fighting grasshoppers, Mormon crickets, and white-fringed beetles. Arsenic trichloride is used in the manufacture of lewisite poison gas and arsenic acid for khaki dyes. Arsenic wood-preservative paste and arsenic in other forms are employed to preserve telephone poles, fence posts, cane-fiber insulating board, railroad ties, and mine timbers. White arsenic is utilized in the Thylox method of purifying producer gas. White arsenic and metallic arsenic, its derivative, have limited application in the manufacture of antimonial lead and lead anodes and as a flux or alloying element in copper, brass, white bearing metal, and other alloys. According to the Public Health Service, manufacturers and distributors of arsenical drugs (chiefly the arsphenamines) sold 33 million doses in 1942 for the treatment of syphilis, compared with 18 million in 1941 and 13 million in 1940.

[3] Ceramic Industry, Cerium—Logical Arsenic Substitute in Glass Batches: Vol. 40, No. 3, March 1943, pp. 37–38.

[4] Weyl, Woldemar A., The Use of Arsenic in the Glass Industry: Glass Ind., vol. 23, No. 7, July 1942, pp. 253–257, 276.

STOCKS

Producers' year-end stocks of white arsenic totaled 2,187 short tons in 1942 compared with 4,518 tons in 1941 and 6,944 tons in 1940. The 1942 figure excludes several thousand tons of 79-percent material held by Getchell Mine, Inc. The objective of the Government white arsenic stock pile to be accumulated by the Metals Reserve Co. was set in June 1942 at 6,000 short tons to be delivered by January 1943; this was augmented in July 1942 to provide for an additional 30,000 tons from Peru in 1943–44. The Government stock pile received its first shipment of white arsenic in October 1942 and by the end of the year had on hand 2,693 short tons—1,900 tons from Mexico and 793 tons from domestic sources. Producers' stocks of calcium arsenate and lead arsenate September 30, 1942, totaled 3,030 and 1,679 short tons, respectively, according to the Agricultural Insecticide & Fungicide Association.

PRICES

The average value of producers' sales of white arsenic was 2.1 cents a pound for crude and 2.7 cents a pound for refined arsenic in 1942 compared with 1.5 and 2.2 cents, respectively, in 1941.

Quotations on arsenic compounds at the end of 1942, according to Oil, Paint and Drug Reporter, were as follows (cents per pound for carlots at Eastern points): White arsenic, 4 cents; calcium arsenate, 7–8 cents; lead arsenate, 11–12 cents; sodium arsenite, 6¾–7¾ cents; sodium arsenate, 8 cents; paris green, 24 cents; and arsenic trisulfide (less than carlots), 30–35 cents. As compared with prices listed at the beginning of the year, these quotations represent a ½-cent increase for calcium arsenate and a 1- to 2-cent advance for lead arsenate; otherwise, they are unchanged. A quotation on arsenic metal has not appeared since 1940, when it was nominally 75 cents a pound.

Ceiling prices were placed on arsenic compounds by the Office of Price Administration in the first few months of 1943. The base price of lead arsenate in carlots was set at 11–11½ cents a pound February 8 (Maximum Price Regulation 315). An amendment effective April 6 fixed the base ceiling price of other insecticides as follows (cents per pound in carlots): Calcium arsenate, 7–7½ cents; paris green, 20–25 cents; london purple, 7–8 cents; magnesium arsenate, 15.3–18 cents; zinc arsenate, 10–11 cents; and zinc arsenite, 11¾–13¼ cents.

WORLD ASPECTS

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

World production of white arsenic, 1936–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1936	1937	1938	1939	1940	1941	1942
Australia:							
New South Wales	124			(2)	(2)	(2)	[3] 2,640
Western Australia	3,526	2,087	4,063	1,439	3,385	(2)	
Belgium-Luxemburg (exports)	2,731	3,039	2,706	3,332	(2)	(2)	(2)
Brazil	732	717	519	713	1,088	1,203	(2)
Canada	619	630	987	790	950	1,605	4,273
China	(2)	(2)	(2)	(2)	800	(2)	(2)
Chosen	230		(2)	(2)	(2)	(2)	(2)
France	9,750	6,501	(2)	(2)	(2)	(2)	(2)
Germany (exports)	2,739	2,852	2,845	(2)	(2)	(2)	(2)
Greece	85	234	77	113	(2)	(2)	(2)
Hungary		100	(2)	(2)	(2)	(2)	(2)
Italy			810	(2)	(2)	(2)	(2)
Japan	2,629	(2)	(2)	(2)	(2)	(2)	(2)
Mexico	8,527	10,762	8,894	7,063	9,268	12,844	18,520
Portugal	150	112	1	426	410	(2)	(2)
Rumania		6	3	(2)	(2)	(2)	(2)
Southern Rhodesia			19		(2)	(2)	[4] 17
Sweden (sales) [5]	8,647	(2)	(2)	(2)	(2)	(2)	(2)
United Kingdom	155	97	66	(2)	(2)	(2)	(2)
United States	13,952	15,253	15,136	20,267	22,664	29,466	26,019
	55,700	56,000	59,000	63,000	71,000	(2)	(2)

[1] Arsenic is also believed to be produced in Czechoslovakia, Iran, Peru, Turkey, and U. S. S. R. Production figures are not available for these countries.
[2] Data not available; in 1936 to 1940, inclusive, estimate included in total.
[3] Estimated.
[4] August to December, inclusive.
[5] Arsenic content of ores mined was as follows—1936: 23,312 tons; 1937: 20,954 tons; 1938: 21,480 tons; data not available for later years.

Australia.—More than 90 percent of Australia's output of white arsenic in 1942 was produced by the A. V. Leggo Co., Wiluna, Western Australia, from gold ores of the Wiluna and Moonlight mines. This source is being exhausted, but about 500 tons of white arsenic could be recovered annually from roaster fumes at the Comet mine, Marble Bar, Western Australia.

Canada.—Production of arsenic in Canada in 1942 was several times that in 1941. White arsenic is produced by Beattie Gold Mines, Ltd., Duparquet, Quebec; O'Brien Gold Mines, Ltd., Cadillac Township, Quebec; and Deloro Smelting & Refining Co., Ltd., Deloro, Ontario. The Deloro company has a contract with the United Kingdom to supply refined white arsenic at 7¾ cents a pound for the first 2,000 tons and 6¾ cents for additional quantities.[5] Wampum Gold Mines, Ltd., a company controlling the property of Douglas Lake Mines, Ltd., in Saskatchewan about 3 miles southwest of the Flin Flon mine, is developing an arsenopyrite body containing more than 10,000 tons of ore averaging 22 percent As and 0.5 ounce of gold per ton and 40,000 tons of lower-grade ore. The company has a contract to deliver 2,500 short tons of white arsenic within 2 years to the Metals Reserve Co., United States Government stock-piling agency.[6] The possibility of recovering 350 tons of white arsenic monthly from the Hard Rock and MacLead-Cockshutt gold mines in the Little Long Lac district of Ontario was considered seriously in 1942,[7] but the proposition later was abandoned.[8] Three mines in British Columbia—Hedley Mascot Gold Mines, Ltd., Kelowna Exploration Co.,

[5] Northern Miner, vol. 28, No. 49, February 25, 1943, p. 4.
[6] Canadian Mining Journal, vol. 63, No. 11, November 1942, p. 742.
[7] Northern Miner, vol. 28, No. 35, November 19, 1942, p. 5.
[8] Northern Miner, vol. 28, No. 50, March 4, 1943, p. 1.

Ltd., and Bralorne Mines, Ltd.—ship arsenic-bearing concentrates to the Tacoma (Wash.) smelter of the American Smelting & Refining Co. The Canadian Pacific Railway uses antimonial lead babbitt containing 0.75–1.25 percent As and thus conserves appreciable quantities of tin.[9]

Ecuador.—A deposit containing 5–10 percent realgar has been located at Macas, Province of Cotopaxi, Ecuador.

Mexico.—Both production and exports of white arsenic in 1942 increased 44 percent over 1941. Exports totaled 18,065 metric tons—18,040 tons to the United States and 25 tons to Argentina.

Peru.—During the first half of 1942 the Oroya smelter of the Cerro de Pasco Copper Corporation produced 76 metric tons of lead-antimony bars containing 1.9 percent As. The corporation has a contract with the Metals Reserve Co., United States Government stockpiling agency, to deliver 10,000 tons of refined white arsenic during 1943.

Sweden.—Arsenic is recovered from Boliden ores in such quantities as to make Sweden the world's largest producer. White arsenic now stored in concrete silos in that country is believed to exceed 300,000 tons. It is reported that Great Britain has obtained an agreement from Sweden not to ship any of this material to Germany during the present war.

United Kingdom.—Refined white arsenic in 20-ton lots was quoted at £40 per long ton and metallic arsenic at £375 per long ton at the end of 1942, according to Metal Bulletin.

[9] Sylvester, I. I., Alternative Babbitts: Eng. Jour., vol. 25, No. 9, September 1942, pp. 502–504.

BISMUTH

By Allan F. Matthews

SUMMARY OUTLINE

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GENERAL STATEMENT

Bismuth production in the United States in 1942 increased one-fourth over 1941, and consumption doubled. As there were no imports of metal to bridge the gap, stocks declined. Allocation control was instituted by the War Production Board over metallic bismuth February 1, 1943 (Order M–276), and over bismuth chemicals April 1, 1943 (Order M–295). The tariff on metallic bismuth was reduced 50 percent July 29, 1942.

PRODUCTION

Bismuth metal production in the United States reached an all-time high in 1942 and exceeded by one-fourth the record set in 1941. The Bureau of Mines is not at liberty to publish data showing domestic production of bismuth. Three primary producers recover by-product bismuth principally from domestic and imported lead and copper ores and from Mexican bismuth-lead bullion bars. The American Smelting & Refining Co. produces bismuth-lead alloys at its Selby (Calif.), Perth Amboy (N. J.), and Monterrey (Mexico) plants for refinement at Omaha, Nebr. From Montana copper and Utah lead ores the Anaconda Copper Mining Co. at Tooele, Utah, produces bismuth-lead bullion, which is refined by its subsidiary, International Smelting & Refining Co., East Chicago, Ind. The United States Smelting, Refining & Mining Co. ships bismuth-lead bullion from Midvale, Utah, for refinement at East Chicago, Ind., by its subsidiary, the U. S. S. Lead Refinery, Inc. The principal importer-consumer is the Cerro de Pasco Copper Corporation, New York, which produces large quantities of bismuth in Peru.

As a conservation measure, the use of metallic magnesium in debismuthizing lead was prohibited by the War Production Board November 14, 1941 (Order M–2b). The situation was allayed somewhat in 1942 by the allocation of magnesium turnings and sawings for this purpose, and in June 1943 it appeared that pure magnesium metal would again be available for debismuthizing lead.

FOREIGN TRADE [1]

Imports.—There were no "imports for consumption" of metallic bismuth in 1942, but "general imports" totaled 222,684 pounds—all of which apparently was either in bonded warehouses at the end of the year or had been reexported. Except for 570 pounds from Canada in 1938, all entries of metallic bismuth in 1938–42 were from Peru. As a result of the Reciprocal Trade Agreement with Peru, effective July 29, 1942, the tariff duty on metallic bismuth imports from "most-favored nations" has been reduced to 3¾ percent ad valorem compared with the former level of 7½ percent set by the Smoot-Hawley Tariff Act of 1930.

Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1938–42

Year	Bismuth		Compounds, mixtures, and salts of bismuth	
	Pounds	Value	Pounds	Value
1938	92,298	$74,583	2,004	$3,387
1939	182,832	154,339	297	649
1940	123,880	118,260	4	31
1941	223,477	223,463	41	744
1942			7	22

Exports.—Bismuth exports in 1942 and in the latter part of 1941 are shown in the accompanying table. Earlier data are not available.

Bismuth exported from the United States, 1941–42

Bismuth commodity	1941 (September-December) [1]		1942	
	Pounds	Value	Pounds	Value
Matte	[1] 4,708	[1] $3,250	11,495	$6,387
Metal and alloys	[1] 433,652	[1] 441,721	14,827	10,254
Nitrate and mixtures	31,818	41,633	146,769	98,812
Carbonate and mixtures	20,732	34,143	70,356	91,674
Gallate and mixtures	11,269	17,772	19,012	28,748
Iodide and mixtures	82,990	126,667	1,002	1,965
Oxide and mixtures	163	677	450	1,701
Chloride and mixtures	111	356	317	832
Sulfate and mixtures			30	45
Saccharate and mixtures	25	35	2	4
Other compounds and mixtures	4,854	8,897	25,129	36,651

[1] Figures for matte and for metal and alloys cover July to December, inclusive; earlier data not available.

CONSUMPTION AND USES

Consumption of bismuth in 1942 was double that of 1941 and quadruple that of 1940. Bismuth metal shipped by producers and importers is estimated to have comprised 45 percent for use in pharmaceuticals and other compounds; 31 percent in solders and bearings; 15 percent in spotting fixtures, die setting, anchoring machine-tool bushings, and tube bending; and 9 percent in miscellaneous applications. Corresponding estimates for these four categories in 1941 are

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

60, 10, 15, and 15 percent, respectively. The data for 1942 are adjusted to exclude a significant quantity of metal stocked for use in 1943 but shipped in 1942 with the intention of using it in solder for armor-piercing shells, a requirement eliminated by the decision to employ crimping as an alternative of soldering. The year 1942 was the first in which the metallurgical applications of bismuth were quantitatively more important than the pharmaceutical.

Bismuth compounds are used in treating indigestion, venereal diseases, and wounds; in controlling blue mold on tobacco; and as a constituent of cosmetic powders. Alloys of bismuth are important because of their low melting point and because their volume either expands or is unchanged upon solidification from melts. Bismuth is a constituent of certain tin-lead solders; a recent series designed to conserve tin contains 75 to 82.5 percent Pb, 10 to 20 percent Sn, 3 to 5 percent Bi, 1.5 to 2 percent Ag, and 0.5 to 1 percent Sb. Low-melting alloys of bismuth (43–55 percent) with lead, tin, and cadmium are used in spotting fixtures, die setting, anchoring machine-tool bushings, and tube bending. Similar alloys, some with melting points as low as 117° F., are used in sprinkler apparatus, fire-detector systems, and valve seats for high-pressure gas containers. Additions of 0.1 to 1.5 percent bismuth to stainless steel, copper, and aluminum alloys improve machinability.

STOCKS

Inventories of bismuth held in the United States by the three domestic producers and the principal importer-consumer dropped 51 percent in 1942. In part the trend represented transfers from producer to Government stocks; thus, the over-all change in inventories at this level was a 33-percent decline.

Government-owned Metals Reserve Co. began stock-piling bismuth in July 1942 and by the end of the year had on hand 352,701 pounds—all refined in the United States but including 211,660 pounds imported from Mexico in bismuth-lead bullion. The Government stock pile comprised 592,586 pounds in mid-May 1943. The recommended stock-pile objective for bismuth was set in May 1942 at 500,000 pounds, in October at 1,500,000 pounds, and in November at 2,000,000 pounds.

PRICES

Bismuth metal continued throughout 1942 to be quoted at $1.25 a pound, ton lots, according to E&MJ Metal and Mineral Markets. Prices of bismuth compounds (in fiber drums)—likewise unchanged—were listed by Oil, Paint and Drug Reporter as follows, per pound: Subnitrate, $1.20; subcarbonate, $1.50; subgallate, $1.40; subsalicylate, $2.50; subiodide, $4.13; and trioxide, $3.65. Despite the steady base price, the quotation on subnitrate, subcarbonate, and subgallate in small lots (5-pound bottles) declined 11 to 15 percent in 1942.

WORLD ASPECTS

World production of bismuth approximated 1,700,000 kilograms (3,700,000 pounds) in 1942 compared with 1,400,000 kilograms (3,000,000 pounds) in 1941. It appears that the United Nations control about 88 percent of the new supply. The principal producing countries are the United States, Peru, Canada, and Mexico.

World production of bismuth, 1937–42, by countries, in kilograms[1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Argentina	[2] 3,560		[2] 2,860	4,880	[3]	[3]
Australia (in ore)[4]	[3]	4,600	2,200	2,800	2,200	4,800
Bolivia (in ore and bullion exported) [5]	30,818	17,194	12,653	18,700	22,604	8,896
Canada: Metal			135,722	18,479	6	156,027
In bullion	2,590	4,316		8,069	3,401	1,043
Mexico (in impure bars)	141,684	185,797	163,683	185,433	97,971	128,041
Norway (in ore)	360	470	[3]	[3]	[3]	[3]
Peru: Metal	67,002	201,961	402,027	387,479	276,907	[6] 338,000
In lead-bismuth alloy	18,415	13,178	52,430	56,314	178,138	[6] 12,000
Spain (in ore)				41,830	[3]	[3]
Union of South Africa (in ore)	167	2,636	1,379	[3]	[3]	[3]
United States	[7]	[7]	[7]	[7]	[7]	[7]
	700,000	1,000,000	1,300,000	1,400,000	1,400,000	1,700,000

[1] Bismuth is also believed to be produced in Brazil, Burma, China, France, Germany, Japan, Rumania, Sweden, Uganda, U. S. S. R., United Kingdom, and Yugoslavia. Production figures are not available for these countries, but estimates by author are included in total.
[2] In ore.
[3] Data not available. Estimate included in total.
[4] Partly estimated. Excludes content of some bismuth-tungsten concentrates.
[5] Excludes bismuth content of tin concentrates exported.
[6] Preliminary figure.
[7] Production included in total; Bureau of Mines not at liberty to publish figure.

Mexico.—Impure bismuth bars containing lead and small quantities of gold and silver are recovered as a byproduct of lead by the American Smelting & Refining Co., Monterrey, Nuevo Leon, Mexico, and are exported to the company Omaha (Nebr.) plant for refining. The lead operations at Monterrey of Campañia Metalurgica de Peñoles, S. A., subsidiary of the American Metal Co., Ltd., yield an unrefined lead-bismuth alloy which is treated on toll basis by the American Smelting & Refining Co.

Peru.—In 1942 Peru exported 355,728 kilograms of refined bismuth bars, containing 325,737 kilograms of bismuth, and 38,744 kilograms of bismuth-lead bars, containing 20,244 kilograms of bismuth. Of these exports, 73 percent went to the United Kingdom, 26 percent to the United States, and 1 percent to Chile. Bismuth ores are mined in the Department of Junin, principally at the San Gregorio mine and secondarily at the Colquijirca mine, and are smelted at Oroya by the Cerro de Pasco Copper Corporation.

Spain.—Bismuth ore produced in Spain, all in the Province of Córdoba, had a content of 42 metric tons of bismuth in 1940 compared with 95 in 1935, 180 in 1934, and 77 in 1933; there was no production in 1936–39 as a consequence of civil war. Some of the ore is consumed domestically, and the resultant output of bismuth metal was 11 metric tons in 1940 compared with none in 1936–39, 44 in 1935, 46 in 1934, and 26 in 1933.

United Kingdom.—London bismuth quotations were unchanged throughout 1942, according to Metal Bulletin. Bismuth ore, 30 to 35 percent, was listed at £110 to £125 a long ton, high-grade metal at 6s. 3d. a pound, and matrix alloy at 4s. 1d. a pound. Bismuth compounds and preparations were placed under export license control November 16, 1942.[2]

[2] Metal Bulletin (London), No. 2741, November 6, 1942, p. 5.

MAGNESIUM

By JOHN H. WEITZ AND M. E. TROUGHT

SUMMARY OUTLINE

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SUMMARY

Spurred onward by the unprecedented demand for airplanes and incendiary bombs, magnesium in the short space of a year has increased greatly in importance among the nonferrous metals. Production in 1942 exceeded the combined output of the industry from its inception in 1915 through 1941. On the basis of military requirements, the War Production Board announced the second expansion program early in 1942, increasing annual capacity to 725,000,000 pounds; this goal was cut back to 610,000,000 pounds and finally to 586,000,000 pounds later in 1942. Production of primary magnesium in 1942 totaled 97,925,684 pounds—200 percent more than in 1941 (32,589,052 pounds) and 682 percent greater than in 1940 (12,521,726 pounds). Magnesium output, having reached an annual rate of 218,800,000 pounds in December 1942, is expected to total nearly 375,000,000 pounds during 1943.

Salient statistics of the magnesium industry in the United States, 1940–42

	1940	1941	1942
Production of primary magnesium, pounds	12,521,726	32,589,052	97,925,684
Quoted price per pound [1], cents	27.0	22.5	22.5
Exports, pounds	1,718,444	[2] 3,098,424	[2] 8,090,449
World production (estimated), short tons	49,500	85,500	154,400

[1] Lowest nominal price (New York) for primary metal ingot 99.8 percent pure, carlots.
[2] Magnesium metal in primary form.

Dow Chemical Co. and Dow Magnesium Corporation produced the largest proportion of the domestic output and began operating a third plant during 1942. The carbothermic reduction plant of Permanente Metals Corporation continued production throughout the year, and most of the technical difficulties appear to have been solved. Permanente began production from a new ferrosilicon plant at Manteca, Calif., during the year, and seven new companies in the field began operations in 1942, contributing substantially to the year's output. These included Diamond Magnesium Co. at Painesville, Ohio; Basic Magnesium, Inc., at Las Vegas, Nev.; Ford Motor Co.

at Dearborn, Mich.; International Minerals & Chemicals Corporation at Austin, Tex.; Magnesium Reduction Co. at Luckey, Ohio; Mathieson Alkali Works, Inc., at Lake Charles, La.; and New England Lime Co. at Canaan, Conn.

Domestic consumption of primary and secondary magnesium in 1942 totaled 84,525,700 pounds compared with 29,346,600 pounds in 1941. As in 1941, demand for the metal continued greater than the available supply, and magnesium topped the list of critical metals issued periodically by the War Production Board. The situation had eased somewhat by mid-1943, but virtually all the metal was still being allocated to direct military uses and to Lend-Lease account and will probably continue to be so allocated for the duration of the war. Of the primary magnesium shipped or used in 1942, approximately 58 percent went into the production of magnesium-base alloys, virtually all for structural products; 12 percent into other alloys, chiefly aluminum; 17 percent into magnesium products, chiefly nonstructural; 11 percent for export account; and 2 percent into other uses. No primary magnesium was imported, but more than 8,000,000 pounds were exported in 1942. The second major price reduction in less than 2 years was made when the Dow Chemical Co. reduced its price on 99.8-percent magnesium ingot, carlots, from 22.5 cents to 20.5 cents a pound on January 1, 1943. The Office of Price Administration ordered that, effective February 1, all ingot sales except those to Metals Reserve Co. would be regulated by a ceiling price of 20.5 cents a pound.

World magnesium output reached a new peak in 1942, and estimates based on meager statistical data indicate that Germany remained the largest producer. Axis and Axis-dominated nations produced an estimated 52 percent of the world output in 1942, but it is anticipated that the United Nations will greatly exceed Axis production in 1943.

PRODUCTION

Primary magnesium.—Domestic production of primary magnesium in 1942 totaled 97,925,684 pounds, a 200-percent advance over the 32,589,052-pound output of 1941. Primary magnesium shipped or used (sales) totaled 94,840,771 pounds, or 205 percent more than in 1941 (31,056,947). Although the Dow Chemical Co. and the Dow Magnesium Corporation produced most of the output, the Permanente Metals Corporation, New England Lime Co., Mathieson Alkali Works, Inc., Ford Motor Co., Basic Magnesium, Inc., Diamond Magnesium Co., Magnesium Reduction Co., and International Minerals & Chemicals Corporation contributed a substantial share.

United States production is expected to reach nearly 375,000,000 pounds in 1943 and 530,000,000 pounds in 1944. By June 1944 it is estimated that domestic facilities will be producing at their rated ultimate capacity of 586,000,000 pounds. In early 1941 peak estimates of military requirements amounted to only 72,000,000 pounds, but by June 1941 requirements had increased to an estimated 411,000,000 pounds, according to the Office of Production Management; of this total, 153,000,000 pounds was for so-called "contingency requirements." The first expansion, increasing capacity to 400,000,000 pounds annually, to take care of revised requirement schedules, was announced June 13, 1941.

At the end of 1941, military requirements had risen to the point where peak possible consumption was stated as 670,000,000 pounds, including 470,000,000 pounds for Chemical Warfare Service and for bombs to be exported (now estimated at only 170,000,000 pounds). In February 1942 the War Production Board announced its second expansion program designed to increase total annual primary metal capacity to 725,000,000 pounds. Requirements were again revised—this time downward to approximately 600,000,000 pounds—and the construction program was cut back to 610,000,000 pounds. The goal was again cut back to 586,000,000 pounds, and this capacity, plus about 32,000,000 pounds of secondary metal, is expected to supply enough magnesium for all requirements planned at present. About 90 percent of all the domestic magnesium-producing capacity will be Government-owned when the expansion programs are completed.

Dow Chemical Co., the largest domestic producer during 1942, produced metal from an underground brine containing 3.2 percent $MgCl_2$ at its 18,000,000-pound Midland (Mich.) plant and from sea water at its 36,000,000-pound Freeport (Tex.) plant. At Midland the bromine and the sodium and calcium salts are removed from the brine by evaporation, filtration, and fractional crystallization, and some chlorine is added during the process. The purified magnesium chloride solution remaining is concentrated further by crystallization to give $MgCl_2 \cdot 6H_2O$ (hexahydrate). The hexahydrate is dried to give a nearly anhydrous magnesium chloride ($MgCl_2 \cdot H_2O$) and, with some added sodium chloride, is then electrolyzed in the fused state in rectangular cast-steel cells. At Freeport, Tex.,[1] vast quantities of sea water containing only about 0.12 percent magnesium (0.48 percent $MgCl_2$) are treated with hydrated oystershell lime. Magnesium hydroxide is precipitated and then reacted with hydrochloric acid produced from gases given off by the electrolytic cells. The resulting solution is evaporated to give crystals of the hexahydrate, which are dried and treated as at Midland.

Dow Magnesium Corporation was formed to construct and operate two 72,000,000-pound magnesium plants at Velasco, Tex., and Marysville, Mich., both using the standard Dow process. The Velasco plant uses the same process as the Freeport (Tex.) plant of the Dow Chemical Co., and is only 7 miles away; it began producing magnesium from sea water in June 1942. On April 8, 1943, the mammoth Marysville plant began to produce magnesium.[2] Ultimately this plant will use magnesium chloride shipped from Ludington, Mich., where 10-percent magnesium chloride brines were tapped and developed in 1941. The Ludington feed plant was not completed and could not supply the Marysville reduction plant for the first 2 months of operation; during this period magnesium chloride was shipped from Texas in hopper-bottomed cement cars. Although the process used to convert magnesium chloride to metal at Marysville is essentially the same as at Midland, the new plant embodies many notable advances in chemical engineering. Because of the shortage of copper, silver bus bars carry electric current in the Marysville plant. The silver—2,000,000 pounds valued at $20,000,000—was loaned to the Defense Plant Corporation by the Government and will be returned when the bars can be replaced by copper.

[1] Wilson, P. D., Enlarging Magnesium Output: Met. Ind., vol. 16, No. 13, September 25, 1942, pp. 203-204.
[2] Van Antwerpen, F. J., The First Magnesium Poured at Dow's Sixth Plant: Chem. and Eng. News, vol. 21, No. 8, April 25, 1943, pp. 546-547.

The Mathieson Alkali Works, Inc., which, up to June 6, 1943, was producing only small amounts of metal from a pilot plant at Lake Charles, La., began production from the first unit of its 54,000,000-pound plant on that date. Mathieson has developed a special electrolytic cell jointly with the Consolidated Mining & Smelting Co. (Trail, B. C.) known as a Trail-Mathieson cell.[3] Advantages claimed for this cell over the standard Dow cell are that concentrated chlorine gas is produced instead of hydrochloric acid gas and that a lower consumption of electric current per pound of metal is indicated. The raw material used is dolomite, $Mg,Ca(CO_3)_2$, which is calcined and treated with waste calcium chloride liquor from the company Solvay process. Hot waste carbon dioxide gas from the calcining kilns is passed through the solution; calcium carbonate is precipitated and filtered off. The magnesium chloride brine is concentrated, evaporated to hexahydrate, and dried to a nearly anhydrous form for electrolysis.

Production began at the 36,000,000-pound plant operated by the Diamond Magnesium Co. at Painesville, Ohio, late in September 1942. Like Mathieson Alkali, Diamond treats dolomitic lime with the chloride waste liquors from its Solvay ammonia-soda process to produce magnesium hydroxide and calcium chloride. The slurry is carbonated by kiln gases, and calcium carbonate is precipitated. The remaining solution is concentrated and crystallized, and the crystals are dried to produce a nearly anhyrous magnesium chloride cell feed. In addition to the recovery of magnesium chloride by using waste chloride liquors, Diamond treats some calcined dolomite directly with hydrochloric acid from the cell gases. The regular Dow-type cell is used in electrolytic decomposition of the chloride.

Magnesium was produced by International Minerals & Chemicals Corporation at its 24,000,000-pound plant at Austin, Tex., starting in November 1942, from purchased magnesium chloride cell feed. Union Potash & Chemical Co. at Carlsbad, N. Mex., a subsidiary of International, began supplying the Austin plant with magnesium chloride cell feed derived as a byproduct from its potash operations in the early summer of 1943. Part of the cell feed for the Austin plant is being obtained from hydrated dolomite quarried in Burnet County, Tex., which is carbonated with kiln gases and treated with byproduct hydrochloric acid from the Dow-type electrolytic cells.

On August 31, 1942, Basic Magnesium, Inc., began production from its huge 112,000,000-pound plant at Las Vegas, Nev. The plant, which uses the M. E. L. process developed by I. G. Farbenindustrie, A. G., in Germany and later used by Magnesium Elektron, Ltd., at Clifton Junction, England, is the largest magnesium plant in the world and is patterned after the Magnesium Elektron (Ltd.) plant in England. Production was slow in getting under way, owing to concentrating difficulties at the magnesite mine in Gabbs Valley, Nev., and to other factors. During the summer and fall of 1942 charges of company mismanagement were made by Senator Bunker of Nevada and others, and in late October it was announced that the 52½-percent interest in the company owned by Basic Refractories, Inc., of Cleveland, Ohio, had been purchased by the Anaconda Copper Mining Co. for a reported $75,000. Production during April 1943 had risen to about 63 percent of rated capacity. Raw magnesite

[3] Center, A. A., Electrometallurgy: Eng. and Min. Jour., vol. 144, No. 2, February 1943, pp. 106-108, 151.

and magnesium oxide sinter are ground and briquetted with coke and British Columbia peat moss. To produce a completely anhydrous magnesium chloride, the briquets are roasted and treated with chlorine gas obtained partly from the cells and partly from the electrolysis of sodium chloride. The principal difference between the electrolysis in the M. E. L. process and in the Dow process is that the latter uses a monohydrated magnesium chloride cell feed whereas the former uses a completely anhydrous feed.

Permanente Metals Corporation operated two plants using different processes during 1942. One plant which began operations late in 1941 uses the so-called Hansgirg process, a carbothermal reduction method, but was a great disappointment throughout most of 1942. Production lagged far behind schedule, and reports of accidents and explosions were numerous; however, in the latter part of 1942 and during the first half of 1943 production has increased markedly, and there are indications that most of the technical difficulties have been overcome. In the Hansgirg process, coke and caustic calcined magnesia are mixed and heated in a 3-phase 8,000-kv.-a. electric-arc furnace to about 2,100° C. The coke reduces the magnesia, and the magnesium becomes vaporized. Shock cooling by natural gas at 200° C. and collection of the dust by Cottrell precipitators yields a finely divided magnesium powder mixed with carbon, magnesia, and other impurities, which is collected as a doughy mixture in oil. The mixture is redistilled, and the magnesium is removed as high-purity crystals from the top of the distilling furnace. Sea-water magnesia for the process was obtained from the Westvaco Chlorine Products Co. until late in 1942, when Permanente began operating its own sea-water magnesia plant at Moss Landing, Calif. The other metal plant operated by Permanente is at Manteca, Calif., and uses the new ferrosilicon process developed by Dr. L. M. Pidgeon of Canada. Production at this plant began in August 1942.

Including the Permanente Metals Corporation plant at Manteca, six companies are operating plants using the ferrosilicon process.[4] The other five are: Ford Motor Co., Dearborn, Mich.; Electro Metallurgical Co., Spokane, Wash.; Magnesium Reduction Co. (National Lead Co.), Luckey, Ohio; Amco Magnesium Co. (American Metals Co.), Wingdale, N. Y.; and New England Lime Co., Canaan, Conn. Research on this process was pioneered by Dr. L. M. Pidgeon of the Canadian Research Council, the Ford Motor Co. at Dearborn, Mich., and the Electro Metallurgical Co. at Niagara Falls, N. Y. Dolomite, a double carbonate of calcium and magnesium occurring in virtually limitless quantities in the United States,[5] is the magnesium-bearing raw material used. Dead-burned dolomite and ferrosilicon (75-percent grade) are briquetted and charged into a horizontal or vertical nichrome-steel retort equipped with a condenser unit and heated at about 1,150° C. under a high vacuum. The magnesium oxide in the calcined dolomite is reduced by the ferrosilicon, and the metal is vaporized and collected at the cooled end of the retort. After most of the magnesium has been driven off the charge, the retort is opened, and a ring of high-purity magnesium crystals is

[4] Stedman, G. E., Ford Makes Magnesium: Chem. and Met. Eng., vol. 49, No. 9, September 1942, pp. 134–137. Ramsay, R. H., Dominion Magnesium—Trail Blazer: Eng. & Min. Jour., vol. 144, No. 5, May 1943, pp. 56–61.

[5] Weitz, John H., High-Grade Dolomite Deposits in the United States: Bureau of Mines Inf. Circ. 7226, 1942, 86 pp.

removed. The residue in the retort—largely dicalcium silicate, calcium oxide, and some magnesium oxide and ferrosilicon—is removed and disposed of, and the cycle is begun again with a fresh charge of briquets. Approximately 12 pounds of dolomite and 1 pound of ferrosilicon are required to produce 1 pound of magnesium metal. The process was adopted because it requires less electric power than the electrolytic processes, it employs dolomite (a cheap and abundant raw material), and the plants utilizing it require a minimum of time for construction.

The Ford Motor Co. plant, which began operations in May 1942, experienced trouble with collapse of its retorts owing to internal and external corrosion and the shock of heating. Research showed that if the retorts could be embedded in a bath of molten silicate glass, the possibility of collapse would be lessened and a mild low-carbon steel could be used. Original plans were changed to include 24 Toledo furnaces and 12 silicate furnaces at the Dearborn plant.

Vertical internally heated retorts are used at the Electro Metallurgical Co. plant at Spokane, Wash., which began operation on May 26, 1943. This company is building its own 48,000,000-pound ferrosilicon plant, which is already in partial operation at Spokane.

In September 1942 the plant of the New England Lime Co. at Canaan, Conn., began producing magnesium. After several months of operation, difficulties were experienced with the collapse of retorts; but the company's experiments showed that the life of these retorts could be prolonged by the simple expedient of blowing them up again with compressed air.

Magnesium Reduction Co. at Luckey, Ohio, began operations in December 1942, using high-grade Ohio dolomite, and Amco Magnesium Co., Wingdale, N. Y., began production in April 1943 using purchased lime. Local dolomite will be employed by Amco as soon as the calcining kilns are completed.

Explosions and fires destroyed the plants of Magnesium Products, Inc., Los Angeles, Calif. (aircraft castings), and National Magnesium Corporation, Newark, N. J., during 1942. In March 1943 the plant of the Pacific Coast Chemical Co. at Aberdeen, Wash., was destroyed by a series of explosions and a large fire.

Among old and new companies that expanded or began to fabricate magnesium in 1942 and the first half of 1943 through the Defense Plant Corporation were: American Radiator & Sanitary Corporation, Elyria, Ohio, and Louisville, Ky.—castings for aircraft engines and wheels (3,600,000 pounds at each plant annually); Chevrolet Motor Division, General Motors Corporation, Saginaw, Mich.—castings (4,800,000 pounds annually); Bendix Aviation Corporation, Bendix, N. J.—castings (1,920,000 pounds annually); Deere & Co., East Moline, Ill.—castings (2,400,000 pounds annually); Dow Chemical Co., Bay City, Mich.—sand castings (1,680,000 pounds annually), and Midland, Mich.—extrusions (2,640,000 pounds annually); Ebaloy Foundries, Inc., Rockford, Ill.—castings (1,800,000 pounds annually); Ferro Enamel Corporation, Bedford, Ohio—powder (200,000 pounds monthly); Hills-McCanna Co., Chicago, Ill.—sand castings (600,000 pounds annually); Howard Foundry Co., Chicago, Ill.—sand castings (6,000,000 pounds annually); Humphreys Mfg. Co., Mansfield, Ohio—castings (2,400,000 pounds annually); Marshall Stove Co., Lewisburg, Tenn.—castings (4,200,000 pounds annually); Maryland Sani-

tary Mfg. Co., Baltimore, Md.—castings (6,000,000 pounds annually); Michigan Light Alloys, Grand Rapids, Mich.—castings (4,200,000 pounds annually); Revere Copper & Brass, Inc., Baltimore, Md.—sheet (6,000,000 pounds annually), and Rome, N. Y.— forgings; Springfield Bronze & Aluminum Co., Springfield, Mass.—castings (3,600,000 pounds annually); U. S. Radiator Corporation, Geneva, N. Y.—castings (3,600,000 pounds annually); and Wellman Bronze & Aluminum Co., Cleveland, Ohio—castings (3,600,000 pounds annually).

Secondary magnesium.—Recovery of secondary magnesium totaled 6,238 short tons (including secondary magnesium incorporated in primary magnesium ingot) in 1942 and required the consumption of 7,317 tons of magnesium scrap, which was almost entirely new scrap. Of the quantity of magnesium recovered, 6,045 tons were as ingot, and 93 tons went into castings, 46 into aluminum alloys, 2 into lead alloys, 1 into zinc alloys, and 51 into chemical reagents. Additional information on secondary magnesium will be found in the chapter on Secondary Metals—Nonferrous.

CONSUMPTION

Magnesium remained under strict priority control during 1942 to insure that virtually all of the metal was channeled into military uses for the production of airplanes and incendiary bombs. Apparent consumption totaled 86,750,322 pounds—an increase of 210 percent over 1941. Of the primary magnesium shipped or used in 1942 (94,840,771 pounds), approximately 58 percent was used in the production of magnesium-base alloys, virtually all for structural products; 12 percent in other alloys, chiefly aluminum; 17 percent in magnesium products, chiefly nonstructural; 11 percent for export account; and 2 percent in other uses.

Actual consumption of magnesium (from primary and secondary sources) totaled 84,525,700 pounds. Of this, 75 percent was used

Production, sales, exports, and apparent consumption of primary magnesium in the United States, 1940–42, in pounds

Year	Production	Sales	Exports	Apparent consumption[1]
1940	12,521,726	12,823,633	[2] 1,668,765	11,154,868
1941	32,589,052	31,056,947	3,098,424	27,958,523
1942	97,925,684	94,840,771	8,090,449	86,750,322

[1] Does not consider fluctuations in consumers' stocks and metal derived from scrap. Withdrawals from producers' stocks totaled 301,907 pounds in 1940; additions to producers' stocks totaled 1,447,615 pounds in 1941 and 3,084,913 in 1942.
[2] Of the 1,718,444 pounds of metal exported, 49,679 pounds consisted of magnesium alloy.

Actual domestic consumption of primary and secondary magnesium (magnesium content), 1941–42, by uses, in pounds

Use	1941	1942	Use	1941	1942
Structural products[1]	21,951,900	63,519,400	Chemicals	27,600	22,900
Aluminum alloys	6,762,200	14,317,200	Other	32,300	23,300
Other alloys	59,000	[2] 431,100			
Scavenger and deoxidizer	130,400	211,800	Total	29,346,600	84,525,700
Pyrotechnics	383,200	6,000,000			

[1] Castings, sheet, extruded shapes, forgings, etc.
[2] Includes 396,100 pounds of magnesium contained in 50-50 aluminum-magnesium alloy.

in the manufacture of magnesium-base alloy structural products, 17 percent in aluminum alloys, 7 percent in pyrotechnics, and 1 percent in other uses.

Magnesium-base alloy structural products manufactured and sold or used in the United States increased 233 percent over 1941. The manufacture of nonstructural products sold or used increased 658 percent. Of the structural products sold or used, sand castings comprised 70 percent, permanent mold castings 24 percent, die castings 3 percent, sheet 2 percent, and other structural products 1 percent. Of the nonstructural products, powder comprised 59 percent, stick 40 percent, and shavings, turnings, wire, ribbon, and other products 1 percent. The value of sand castings manufactured in 1942 averaged $2.22 a pound, permanent mold castings $0.83, die castings $1.87, and all castings $1.87 a pound (compared with $2.03 in 1941).

Magnesium products (other than ingot) manufactured in the United States and sold or used by the companies manufacturing the products, 1940–42

Product	1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value
Structural products:						
Castings:						
Sand	3,973,757	$7,345,050	11,944,618	$24,669,146	32,024,393	$71,176,648
Permanent mold					10,800,023	9,015,586
Die	699,212	653,289	768,162	1,155,048	1,346,077	2,518,697
Sheet	322,664	246,476	431,306	309,749	876,577	684,122
Structural shapes, rods, tubing (extrusions)	410,912	349,123	451,394	313,638	475,137	342,970
Forgings	25,938	34,602	25,734	79,605	44,989	87,247
Other structural	43,047	134,251	54,119	84,718	9,674	18,958
Total structural products	5,475,530	8,762,791	13,675,333	26,611,904	45,576,870	83,844,228
Nonstructural products:						
Stick	435,483	128,500	407,470	121,105	4,417,319	1,310,281
Powder	349,429	410,859	982,078	1,305,418	6,416,879	5,956,132
Shavings, wire, ribbon, and sawdust			52,111	37,163	95,357	38,013
Total nonstructural products	784,912	539,359	1,441,659	1,463,686	10,929,555	7,304,426
Grand total	6,260,442	9,302,150	15,116,992	28,075,590	56,506,425	91,148,654

Of the magnesium-alloy structural products sold or used, the aircraft industry took 79 percent, incendiary-bomb casings 21 percent, and other industries less than 1 percent. Of that going into the aircraft industry, 66 percent was for the manufacture of engines

Consumption of magnesium-base alloy structural products, 1941–42, by uses, in pounds

Use	1941	1942	Use	1941	1942
Aircraft:			Portable machine equipment and tools	146,427	123,070
Engine	7,943,998	[1] 23,630,270	Textiles	90,811	228
Frame	1,358,988	2,638,369	Foundry equipment	55,097	22,341
Wheel	2,878,833	8,323,380	Oil-field equipment	2,395	
Accessories	885,666	1,295,432	Printing	8,293	102
Incendiary bomb casings	15,116	9,469,573	Other industries	62,143	71,150
Automotive	181,972		Total	13,675,333	45,576,870
Stationary machines	45,594	2,955			

[1] Includes some alloy used in the manufacture of aircraft frame, wheel, and accessories.

(including propellers), 23 percent for wheels, 7 percent for frames, and 4 percent for accessories. Sand, die, and permanent mold castings comprised 96 percent of all the magnesium-alloy structural products sold or used in aircraft.

Fabricators of magnesium structural products increased from 38 in 1941 to 59 in 1942 and of nonstructural products from 6 to 19. By the end of 1942, 32 companies were producing sand castings, 17 permanent mold castings, 11 die castings, 3 extruded products, 3 forgings, and 20 powder. The largest producers of alloy structural products were the American Magnesium Corporation, Dow Chemical Co., Bohn Aluminum & Brass Corporation, Doehler Die Casting Co., Wright Aeronautical Corporation, Eclipse Aviation Co. (subsidiary of Bendix Aviation Corporation), Ford Motor Co., Wellman Bronze & Aluminum Co., International Silver Co., Superior Bearing Bronze Co., Stewart Die Casting Division of Stewart Warner Corporation, Hills-McCanna Co., Magnesium Products Corporation, and Dalmo Victor Co. Producers of powder included American Magnesium Corporation, California Fuel & Utilities, Inc., Imperial Paper & Color Corporation, Magna Manufacturing Co., Metals, Inc., National Fireworks, Inc., National Magnesium Corporation, New England Magnesium Co., Pilgrim Ordnance Works, Reade Manufacturing Co., Universal Match Co., and U. S. Magnesium Corporation.

WAR MEASURES

The magnesium General Preference Order (M–2–b) now in force was originally issued on November 14, 1941, to conserve and direct the distribution of magnesium, and was to expire October 31, 1942. On October 31 the War Production Board announced that the order would continue in force until December 31, 1942. On December 31 the Director General for Operations announced a simplification of order M–2–b to bring it into line with the form of allocation orders then being issued. The amended order eliminates all references to preference ratings because the supply of magnesium and magnesium products is directly allocated to users. Provision was also made for stricter segregation of scrap in accordance with A. S. T. M. alloy designations to facilitate its handling and reprocessing.

PRICES

At the request of the Office of Price Administration, Dow Chemical Co. reduced its base price of standard four-notch magnesium ingot from 22.5 to 20.5 cents a pound on January 1, 1943. Effective February 1, the Office of Price Administration, in Maximum Price Regulation 314, established 20.5 cents as the maximum price per pound for standard four-notch ingot except for sales to the Metals Reserve Co. Magnesium-alloy ingot maximum prices included in the above regulation were: Incendiary bomb alloy, 23.4 cents; 50-50 magnesium-aluminum alloy, 23.75 cents; A. S. T. M. B80–41 T No. 11 and A. S. T. M. B94–41 T No. 13, 25 cents; and all other alloys, 23 cents. On February 1, 1943, in Revised Maximum Price Regulation 125, the price of magnesium castings was reduced 3 cents a pound. Magnesium scrap and remelt ingot were controlled under the General Maximum Price Regulation during 1942, but on January 20, 1943, specific prices for various types of scrap and various grades of ingot were established under Maximum Price Regulation 302.

FOREIGN TRADE [6]

Imports of magnesium in all forms during 1942 totaled 1,386 pounds valued at $856, of which 57 pounds were scrap from Canada; 902 pounds, alloys from the United Kingdom (magnesium content); 24 pounds, classed as sheets, tubing, ribbon, etc., from Canada; and 403 pounds, powder from Canada (257 pounds) and the United Kingdom (146 pounds). Exports of magnesium metal in primary form during 1942 aggregated 8,090,449 pounds valued at $1,945,164, of which 7,118,469 pounds went to the United Kingdom, 971,380 to Canada, and 600 to the Union of South Africa. Comparable exports in 1941 were 3,098,424 pounds valued at $860,486. Exports of magnesium metal in other forms during 1942 totaled 298,595 pounds valued at $99,517, of which 265,000 pounds were consigned to the United Kingdom, 33,559 to Canada, 35 to Argentina, and 1 to New Zealand. Magnesium powder exported during 1942 totaled 43,582 pounds valued at $66,038, of which 21,292 pounds were sent to Canada, 11,200 to Turkey, 6,380 to Australia, 2,005 to Cuba, 1,250 to China, 1,120 to New Zealand, 200 to Portugal, 72 to Iceland, and 63 to Argentina. Comparable export figures for magnesium powder and magnesium in other forms, excluding primary, are not available for 1941, as official records date only from July 1, 1941. Magnesium metal has been under export control since November 5, 1940.

TECHNOLOGIC DEVELOPMENTS

The outstanding development of 1942 was the introduction of the ferrosilicon process [7] for extracting magnesium metal from dolomite. The process was worked out by Dr. L. M. Pidgeon of the Canadian National Research Council in 1941, and refinements were added during 1942 by engineering departments of the various companies that began using the process in 1942 and 1943. This and other methods have been described herein under Production.[8] The Bureau of Mines continued to investigate the Doerner[9] process, whereby magnesium is produced directly by electrothermic reduction of the oxide with carbon and the magnesium vapor is shock-cooled and condensed by a light oil spray; research was also continued on the direct reduction of magnesium oxide in an electrolytic cell. At Pullman, Wash., the Bureau is also investigating the production of pure magnesium oxide from Washington magnesite and dolomite by the carbon dioxide leaching process.

Several extensive dolomite and magnesite deposits in the Boulder Dam area that may be used as additional sources of raw material for the Basic Magnesium (Inc.) plant at Las Vegas are described in a Bureau publication.[10] At Boulder City, Nev., work was done on several methods to extract pure magnesium oxide from high-grade Nevada dolomites, and a small-scale plant has been proposed by the

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

[7] Stedman, G. E., Ford Makes Magnesium: Chem. and Met. Eng., vol. 49, No. 9, September 1942, pp. 134–137.
Ramsay, R. H., Dominion Magnesium—Trail Blazer: Eng. and Min. Jour., vol. 144, No. 5, May 1943, pp. 56–61.

[8] Metallurgia, Magnesium and Its Production: Vol. 27, No. 161, March 1943, pp. 195–198.

[9] Doerner, H. A., Holbrook, W. Floyd, Dilling, E. Don, and Harris, Dwight C., Magnesium by Electrothermic Reduction: Bureau of Mines Rept. of Investigations 3635, 1942, 47 pp.

[10] Schlocker, J., Magnesium-Bearing Minerals in the Boulder Dam Area for the Production of Magnesium Metal: Bureau of Mines Inf. Circ. 7216, 1942, 16 pp.

Bureau to be built and operated in cooperation with Basic Magnesium, Inc. Metallurgists at the Bureau's Norris (Tenn.) station are endeavoring to develop a low-cost process for extracting magnesium oxide from olivine, which occurs in large quantities in Georgia, North Carolina, and Washington.[11]

All-magnesium planes have been brought within the realm of possibility by the development, after 2 years of research by engineers of the Northrop Aircraft Co., Inc., of a new welding process by which magnesium can be arc-welded in an atmosphere of helium.[12] "Heli-arc" welding has proved successful where other welding methods have failed in dealing with high-temperature melting and heat-resisting magnesium alloys. Concise metallographic techniques most desirable for routine examinations of macro- and micro-structures in magnesium alloys have been worked out,[13] and research work has led to increased knowledge of the treatment and properties of magnesium alloys.[14]

The rapidly growing demand for magnesium and magnesium-base alloys has led to a great deal of research on corrosion characteristics.[15] The early belief that magnesium and its alloys were much less resistant to corrosion than other alloys in engineering use has been abandoned in the light of more precise knowledge. If cutting tools are properly designed and maintained, magnesium alloys may be machined dry with safety, as shown by current British practice.[16] Recent research has shown that silver can be plated on magnesium, after cathodic cleaning and anodic treatment of the surface, in a boric acid cyanide electrolyte.[17]

Numerous patents relating to magnesium were granted during 1942, including the following: Thermal reduction of magnesium oxide with calcium carbide to produce magnesium metal and subsequent recovery from the residue and recycling of carbon and calcium carbonate (United States Patent 2,289,627); thermal reduction of magnesia in a calcined magnesia-containing ore with carbon, whereby metallic magnesium is liberated as a vapor and a molten residue is generated which exerts a washing action on the vapor and reduces the dust problem (United States Patent 2,286,209); a new method for producing magnesium-zirconium alloys in any desired shape—hitherto considered impossible (United States Patent 2,286,311); production of aluminum-clad magnesium by first coating an extruded slab of magnesium alloy with zinc (United States Patent 2,301,332).

WORLD PRODUCTION

World production of magnesium in 1942 reached an unprecedented high mark of more than 140,000 metric tons—81 percent more than the production in 1941. Although the statistical background for many

[11] Pawel, G. W., Olivine; Potential Source of Magnesia: Min. and Met., vol. 23, No. 426, June 1942, pp. 331–333.
Gwinn, G. Richards, Olivine: Bureau of Mines Inf. Circ. 7239, 1943, 11 pp.
[12] Pavlecka, H. V., Helium-Shielded Arc Welding: Iron Age, vol. 150, No. 12, September 17, 1942, pp. 74–76.
[13] Hess, J. B., and George, P. F., The Metallography of Magnesium Alloys: Met. Ind., vol. 62, No. 8, February 1943, pp. 114–116, 136–138.
[14] Fox, F. A., Some New Developments in Magnesium Alloy Technology: Metallurgia, vol. 27, No. 158, December 1942, pp. 47–50.
[15] Bushrod, C. J., The Corrosion of Magnesium and Magnesium-Base Alloys: Met. Ind., vol. 61, No. 21, November 20, 1942, pp. 324–326.
[16] Garner, H. Mills, Dry Machining of Magnesium Alloys: Iron Age, vol. 150, No. 4, July 23, 1942, pp. 52–54.
[17] Bowen, F. J., and Gilbertson, L. I., The Electro-deposition of Silver on Magnesium: Metal Finishing, vol. 41, No. 5, May 1943, pp. 271–274.

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of the production figures is weak, it is estimated that about 52 percent of the output was under Axis control and 48 percent under control of the United Nations. Production in 1943 will greatly eclipse the 1942 total, and the United Nations will greatly improve their position with respect to Axis and Axis-dominated countries.

Estimated world production of magnesium, 1938–42, by countries, in metric tons

Country	1938	1939	1940	1941	1942
Australia				200	430
Canada					230
France	1,800	2,500	2,000	3,000	3,000
Germany	14,100	16,500	25,000	35,000	50,000
Italy	102	300	500	2,500	5,000
Japan	1,500	2,000	3,000	5,000	12,000
Norway				100	2,000
Switzerland	750	750	750	1,000	1,500
U. S. S. R.	500	1,000	1,500	4,000	5,000
United Kingdom	2,200	4,831	6,500	12,000	16,500
United States	2,918	3,039	5,680	14,782	44,418
Total	23,900	30,900	44,900	77,600	140,100

Australia.—The 1,000-ton magnesium plant owned by Broken Hill Proprietary Co., Ltd., at New Castle, New South Wales, began operations in July 1941 and produced at nearly 50 percent of rated capacity in 1942. Local magnesite is ground, calcined, and reduced under vacuum with ground calcium carbide to produce magnesium metal. Attention has recently been given to the possibility of producing magnesium from the extensive deposits of dolomite at Smithton, on the northwest coast of Tasmania. Magnesite deposits in the Dial Range are also being investigated as a possible source of the metal.

Canada.—Production began in early fall of 1942 in the new ferrosilicon-process plant of Dominion Magnesium Co., Ltd.,[18] at Haley's Station, near Renfrew, Ontario. The rated capacity, reportedly attained in February 1943, is 10 tons of magnesium a day. The retorts are charged with briquetted ferrosilicon and calcined dolomite and heated, after evacuation, by silicon carbide globars. After an 8-hour period the retorts are opened, the crystalline magnesium and the dicalcium silicate slag removed, and fresh briquets introduced immediately. The Pidgeon process is used and funds for the proving of the method up to the pilot-plant stage were furnished by Bobjo Mines, Ltd., one-third owner of Dominion Magnesium Co., Ltd. The cost of the plant ($5,000,000) was borne by the Canadian Government, and production is supervised by Wartime Metals Corporation. Dominion Magnesium Co., Ltd., is a private concern incorporated to build and operate the plant without fee or profit.

Exclusive Canadian and United States rights to the Blackwell-Turner high-frequency induction process for the production of magnesium have been granted to the International Industrial Research Corporation of Freeman, Ontario, by the Lancashire Metal Subliming Corporation, Ltd., of Liverpool, England. Plans are to produce the metal from olivine or serpentine at a point near adequate ore deposits and power. Facilities are also planned for the production of magnesium castings, extrusions, forgings, and sheet. Magnesium Devel-

[18] Ramsay, R. H., Dominion Magnesium—Trail Blazer: Eng. and Min. Jour., vol. 144, No. 5, May 1943, pp. 56–61.

opment Co., Ltd., was formed in 1942 under a British Columbia charter with an authorized capitalization of 100,000 shares at a par value of $1 a share.

France.—Output of magnesium is controlled by the Pechiney, Ugine, and Bozel-Maletra concerns, which produce the metal from dolomite and Mediterranean sea-water brine. Production is reportedly being expanded with active cooperation of the Germans, who are supplying funds through the Aero-Bank, the Paris branch of the German Bank für Luftfahrt, A. G.

Germany.—Deutsche Magnesit, A. G., founded in 1929 at Salzburg, has been transferred to Munich, where its magnesium-production activities will be associated with those of Oesterreichische Magnesit, A. G. A new research organization will be formed jointly with I. G. Farbenindustrie, A. G., and will be known as Studiengesellschaft für Metallgewinnung, G. m. b. H. This research group will study the patents of J. März covering thermal reduction of calcined magnesite by carbon and by calcium carbide. Germany has two main sources for the production of metallic magnesium at its disposal—the potash mines in Hanover and Saxony and the magnesite deposits in Bavaria and Austria. These sources can supply all the raw material that the expanded German magnesium industry can use; the limits on expansion are thus not due to a raw-material shortage but to shortages of labor, power, and equipment.

Hungary.—According to a report from the official German news agency, the Hungarian State Iron, Steel, and Engineering Works has obtained a license from I. G. Farbenindustrie, A. G., for the production of metallic magnesium. The new works, the location of which has not been announced, will be operated by a company known as the Hungarian Magnesium & Elektron Co.

United Kingdom.—The Lancashire Metal Subliming Co. is reported to have started the production of magnesium from magnesite using a direct thermal reduction of the oxide. Calcined magnesite is mixed with a reducing agent and heated by high-frequency induction coils to a temperature above the sublimation point of the metal. The metallic vapor is then collected and crystallized under reduced pressure. The Minister of Aircraft Production issued Magnesium Control Order 4 late in 1942, providing a standardized price for all unfabricated magnesium and magnesium alloys and reducing the price of powder to 4s. a pound for all grades. Controlled prices for billets and slabs were also specified.

ANTIMONY

By A. L. Ransome

SUMMARY OUTLINE

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SUMMARY

Under the use limitations in effect during 1942 the total supply of antimony in all forms, although less than in 1941, was more than adequate to meet military and essential civilian requirements. As in 1941, the supply came largely from Mexico and Bolivia. Imports were augmented by a greatly increased domestic production that helped measurably in alleviating a rather tight situation. By the first part of 1943 stocks had been built up to the point where antimony was classed as a material available in sufficient quantity to be used as a substitute for more critical metals in the strategic minerals list.

The relatively high price for ore in effect at the end of 1941 continued with but little change throughout 1942, owing largely to informal Government control through the Office of Price Administration. The 50- to 55-percent ores quoted at $2.00 to $2.15 per short-ton unit, New York, at the beginning of 1942 were priced at $2.10 to $2.20 at the close of the year. The quotation for domestic metal—14.00 cents per pound, New York, on January 1, 1942—increased to 16.049 cents by the end of the year. This latter figure includes the 3-percent excise tax effective December 1, 1942. The average price of 15.55 cents in 1942 compares with 14.00 cents for both 1940 and 1941.

Domestic production of antimony ore increased 102 percent over 1941, and the metal content gained 143 percent—an indicated rise in the average grade from 35 percent in 1941 to 42 percent in 1942. The antimony content of antimonial lead produced from all classes of foreign and domestic ores increased 10 percent over the 1941 figure and was the largest recorded since 1928. The contents of the total production of antimonial lead at primary refineries from all raw materials—scrap and domestic and foreign ores—increased less than 1 percent but was still the largest since 1929. Although primary antimony available for consumption decreased 20 percent, actual consumption of antimony, including primary material and antimony recovered from the treatment of scrap, was probably the same or even

somewhat more than in 1941. Stocks of metallic antimony at producers' plants, as reported to the Bureau of Mines, decreased from 730 tons on December 31, 1941, to 477 tons on December 31, 1942—a continuation of the down trend noted in 1941. A small increase in metal production at the Kellogg (Idaho) electrolytic plant augmented by an appreciable addition to the total supply from the new electrolytic plant at Big Creek (Idaho) was insufficient to offset a slight decline

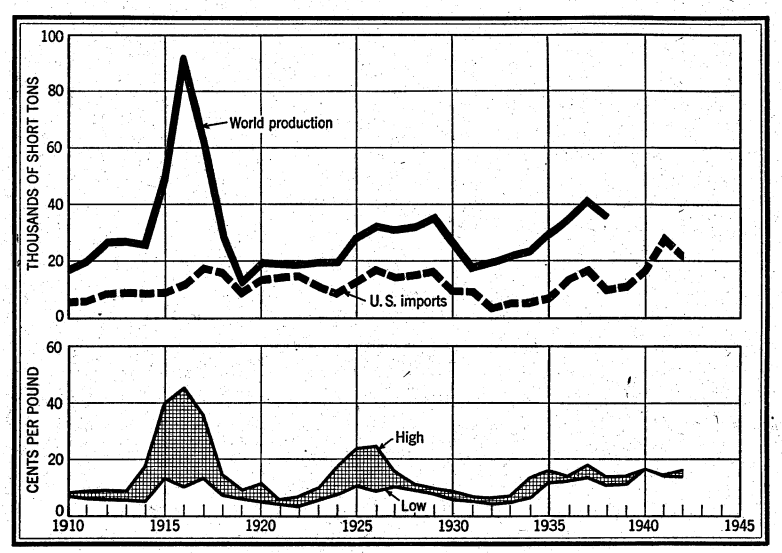

FIGURE 1.—Trends in world production, 1910–38, and United States imports and New York price of antimony, 1910–42.

in the much greater output at Laredo, Tex. No metal was produced by the Los Angeles smelter in 1942.

Figure 1 shows trends in world production from 1910 to 1938 and United States imports and prices from 1910 to 1942.

Salient statistics for antimony in the United States, 1938–42

	1938	1939	1940	1941	1942
Production of antimony ore and concentrates.....short tons..	2,730	3,174	1,124	3,460	6,980
Antimony contained.....do....	650	393	494	1,214	2,944
Antimony content of antimonial lead produced from domestic and foreign ores.....short tons..	2,080	1,108	2,077	2,958	3,267
Secondary antimony produced.....do....	8,500	9,810	11,421	21,629	18,200
Imports for consumption:					
Antimony in ore.....do....	8,322	9,448	15,733	19,386	20,946
Needle or liquidated antimony.....do....	90	228	113	638	522
Metal.....do....	821	1,045	209	7,469	127
Oxide.....do....	414	167	------	------	------
Exports of foreign antimony.....do....	711	58	276	70	(1)
Primary antimony available for consumption.....do....	11,557	11,609	17,955	29,994	23,852
Stocks of antimony in bonded warehouse at end of year short tons..	345	685	3,417	416	(2)
Average price of antimony at New York: [3]					
Chinese.....cents per pound..	14.59	14.44	[4] 16.50	[4] 16.50	[4] 16.50
American.....do....	12.35	12.36	14.00	14.00	15.55
World production.....short tons..	35,400	(2)	(2)	(2)	(2)

[1] Less than 1 ton.
[2] Figures not yet available.
[3] According to American Metal Market.
[4] Nominal.

WAR AGENCY REGULATIONS

The most outstanding effect of Government control on the antimony industry during 1942 was indicated by the reclassification of antimony from group II to group III of the Material Substitutions and Supply List of strategic minerals, effective February 1, 1943. As compiled by the War Production Board, Conservation Division, this list, divided into three groups, reflects the relative essentiality and the current relative supply status of materials useful to the war program. Group I includes critical materials, supplies of which are insufficient for existing war demands; group II—essential war materials, supplies of which are in balance with immediate demand; group III—materials available in significant quantities, which are particularly recommended as substitutes for critical materials.

On March 30, 1942, allocation control over antimony was ordered by the Director of Industry Operations of the War Production Board, with issuance of General Preference Order M–112, effective May 1. Under this order deliveries of antimony were strictly controlled, and all forms of antimony (except alloys containing less than 50 percent by weight of antimony) were placed under complete allocation. Subsequently on July 11, 1942, Order M–112 was amended to allow up to 50 tons a month of contained antimony in ore or concentrates to be delivered by domestic producers, including Alaskan producers, without restriction. Order M–112 was again amended on March 8, 1943. No change was made in the 50-ton limit on the permissible antimony content of unallocated ores and concentrates, but the limit on unallocated deliveries of antimony metal and alloys (50 percent or more antimony contained) was raised from 25 pounds to quantities up to 2,240 pounds. Restrictions were also relaxed to permit the use of greater amounts of antimony in battery grids, in nonacid resisting enamels, and in other antimonial lead uses. An additional indirect curtailment in the use of antimony was effected by the War Production Board Order M–38–c of January 10, 1942, which restricted the use of lead. This order was subsequently relaxed because of the easier supply position.

Because of informal Government control through the Office of Price Administration, the price of antimony showed no change during 1941 and the first months of 1942. The price of 14.00 cents per pound, New York, in effect at the beginning of 1942 was allowed to advance to 15.955 cents on March 23 for small case lots; this was subsequently adjusted upward to meet an advance in freight rates. On April 28, antimony metal was placed under the General Maximum Price Regulation. Effective December 1, a 3-percent excise tax was placed upon property transportation, and being payable by the consumer the quoted price of 16.049 cents reflected this action.

On April 7, 1942, the Metals Reserve Co. agreed to resell antimony ore imported from Bolivia in accordance with a schedule of prices acceptable to the Office of Price Administration. Similarly, on April 27 the War Production Board, in cooperation with the Office of Price Administration, worked out a schedule of informal maximum prices for importers of Mexican antimony ore who applied to the War Production Board for import licenses. Effective May 11, 1942, antimony ores and concentrates were excepted from the General Maximum Price Regulation.

DOMESTIC PRODUCTION

MINE OUTPUT

Output from 31 operating antimony mines in 1942 more than doubled that of 1941 from 37 properties and established a new record. The marked gain was due almost entirely to increased output from the Yellow Pine mine in Idaho. In addition, mines containing ores that are produced principally for their value in other metals, mainly gold, silver, copper, and lead, have augmented the supply of antimony for domestic consumption. A large proportion of this increased supply in 1942 resulted from the operations of the Bunker Hill & Sullivan Mining & Concentrating Co. plant at Kellogg, Idaho, and the new Sunshine Mining Co. plant at Big Creek, Idaho.

In 1942, 6,980 short tons of material, containing 2,944 tons of antimony, classed as antimony ores and concentrates were produced compared with 3,460 tons containing 1,214 tons of antimony in 1941. Upon the basis of antimony content the record total for 1942 was 143 percent higher than in 1941 and 40 percent above the previous record of 2,100 tons produced in 1915.

Alaska.—The Stampede mine, Kantishna district, was the only antimony property reporting shipments in 1942. Although the mine was reportedly acquired by Earl Pilgrim early in 1942 from Morris P. Kirk & Son, Inc., production data for 1942 were submitted by Kirk as owner and operator.

Several other antimony properties were prospected and developed in 1942, but no definite figures on production or shipments, if any, were obtained. The Hi Yu Mining Co. was reported to be developing a deposit on Fairbanks Creek near Fairbanks, and a property owned by Sam Gamblin at the head of Tok River reportedly has a good showing of stibnite ore.

In the latter part of the year the first shipment of antimony ore, amounting to 16 tons assaying 38.09 percent antimony, was received at the Fairbanks purchasing depot of the Metals Reserve Co. operated by the Territorial Department of Mines.

California.—The Bishop mine in Inyo County produced and shipped antimony ore in 1942. Smaller shipments came from two additional properties in Inyo County and two in San Benito County. Some ore was produced in less than 1-ton lots.

Production for the State amounted to 68 tons of ore containing 29 tons of antimony, an increase over the 51 tons of ore containing about 15 tons of antimony in 1941.

Idaho.—Not only was Idaho the principal producer of antimony ores and concentrates in 1942, but the total was greater than the entire United States output for any previous year. It amounted to 6,225 tons containing 2,715 tons of antimony; the Yellow Pine mine, owned and operated by the Bradley Mining Co., produced 5,950 tons containing 2,597 tons of antimony. This mine is the largest single source of the metal in the United States. The Antimony Ridge mine, owned and operated by United Mercury Mines, is the second-largest antimony property in Idaho and took second place in the United States in 1942.

In addition to antimony ore, large amounts of antimony came from ores classified as silver ores, copper ores, and others not included in this report as mine output of antimony. The Coeur d'Alene Mines

Corporation of Burke and the Sunshine Mining Co. of Kellogg, both produced substantial tonnages of approximately 20-percent antimony concentrates from silver-copper-antimony ore. Production from the former was shipped to the Bunker Hill smelter, whereas concentrates from the latter were treated at the company electrolytic plant built in 1942 for the express purpose of processing such material into antimony metal.

Montana.—Production of antimony ores in Montana increased in 1942 to 280 tons containing 51 tons of antimony from the 1941 total of 113 tons containing 43 tons of antimony. This gain is due largely to the development, by the Sunshine Mining Co., of the Burns antimony district, Sanders County, between Burke, Idaho, and Thompson Falls, Mont. This district embraces a wide section of the Bitterroot Range at the head of Prospect Creek, the main mineralized outcrop occurring along a flat-bedded structure for several miles. Until acquired by Sunshine, under lease, the Prospect Creek deposits had been prospected sporadically for several years with only partial success. Mines and claims reported to have been active were the Stibnite Hill, Eureka, Ellis, and Interstate.

Nevada.—Although the number of reportedly active antimony properties was less than in 1941, the total was greater than in any other State. Nearly every section of the State was represented; and the producing counties, in order of descending importance in 1942, were: Pershing, Nye, Washoe, Lander, Humboldt, and Mineral. There were 11 producers of more than 1 ton; but the average size of the operations was small, and the average grade of the ore was low. Total 1942 production for the State was 305 tons containing 96 tons of antimony—a drop from the 1941 total of 691 tons containing 146 tons of antimony.

Oregon.—Production and shipments of antimony ore in 1942 were made from the Jay Bird mine in Jackson County and the Gray Eagle (Koehler) mine in Baker County. The latter property, in the Virtue district near Baker, was a producer during World War I.

Washington.—The Lucky Knock mine in Okanogan County was the only property to report production and shipment of antimony ore in 1942.

SMELTER OUTPUT

In 1942 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; Sunshine Mining Co., Big Creek, Idaho; and Texas Mining & Smelting Co., Laredo, Tex. In addition, metallic antimony was again produced by the American Smelting & Refining Co. at its Omaha (Nebr.) plant. This material was used for conversion into other products and was not sold as metal.

The Harshaw Chemical Co. produced no antimony metal at its El Segundo (Calif.) plant in 1942, the output being restricted to antimony oxide. In September 1942, the full-size electrolytic antimony plant of the Sunshine Mining Co., under construction earlier in the year, went into limited operation. This followed the successful experimental operation of a pilot plant from December 1, 1940, to June 1, 1942. Although the plant capacity is rated at approximately 100 tons of metal a month, production by the end of 1942 and during the first quarter of 1943 had not reached capacity owing to a shortage of under-

ground labor at the company mines. The greater proportion of the output is from antimony concentrates from tetrahedrite ore, the balance being from company-mined low-grade stibnite ore.

Imports of antimony ore in 1942 amounted to 50,021 short tons containing 20,946 tons of antimony compared with 41,662 tons in 1941 containing 19,386 tons of metal, an increase of 8 percent in terms of antimony content. Industrial receipts of foreign antimony in the United States in 1942 amounted to 48,005 tons of ore compared with 40,434 tons in 1941. These totals are 96 and 97 percent of the total amount imported. The difference in each instance can be accounted for by the usual lag between reporting imports on one hand and receipts on the other, plus the variable tonnage of material in transit at the end of the year which is not statistically counted in the receipts on that date. Receipts exceeded consumption in 1942, and stocks of antimony ore increased 67 percent (gross weight). In 1941 the reverse was true, and stocks decreased 56 percent. Receipts gained 19 percent over 1941, and consumption of 44,944 tons (containing approximately 20,000 tons of antimony) in 1942 was 3 percent less than the reported consumption of 46,211 tons (containing 20,530 tons of antimony) in 1941. The following table shows industry stocks, receipts, and consumption of foreign antimony ore upon the basis of gross weight.

Consumption and stocks of foreign antimony ore in the United States, 1940–42, gross weight in short tons

	1940	1941	1942
Stocks at beginning of year	7,775	10,323	4,546
Received during year	34,530	40,434	48,005
Consumed during year	31,982	46,211	44,944
Stocks at end of year	10,323	4,546	7,607

Production of antimonial lead at primary 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, 1938–42, in short tons

Year	Production	Antimony content				
		From domestic ores	From foreign ores [1]	From scrap	Total	
					Quantity	Percent
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
1941	40,237	2,586	372	552	3,510	8.7
1942	51,762	2,396	871	257	3,524	6.8

[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 1942 totaled 18,200 tons—a 16-percent decrease from the 21,629 tons produced in 1941. Primary antimony available for consumption in the United States in 1942 totaled 23,852 tons. Total antimony available was therefore 42,052 tons, including 57 percent primary and 43 percent secondary; comparable proportions in 1941 were 58 and 42 percent.

Refined metallic antimony is rarely, if ever, produced from scrap metals, the output being in the form of lead-base and tin-base alloys. Most of the plants treating scrap metals containing antimony consumed some other antimony materials, including antimony ore or metallic antimony, for the purpose of adjusting the antimony content of the products. 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. Additional information on secondary antimony is given in the chapter on Secondary Metals—Nonferrous.

DOMESTIC CONSUMPTION

Data on the consumption of primary antimony in the United States, based upon quarterly surveys conducted by the Bureau of Mines in 1942, are not yet available in complete form summarizing the entire year. Upon completion this information will be published in a supplemental release. 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, 1938–42, in short tons [1]

	1938	1939	1940	1941	1942
Domestic antimony recovered in antimonial lead	1,871	929	1,915	2,586	2,396
Imports for consumption (antimony content):					
Antimony ore	8,322	9,448	15,733	19,386	20,946
Needle or liquated [2]	63	160	79	447	365
Compounds [3]	336	138	4	2	(4)
Type metal, etc	355	121	191	202	35
Regulus	821	1,045	209	7,469	127
Total available	11,768	11,841	18,131	30,092	23,869
Exports under draw-back	211	232	176	98	[5] 17
Available for consumption [6]	11,557	11,609	17,955	29,994	23,852

[1] Excludes domestic antimony recovered as miscellaneous alloys, oxides, and other compounds.
[2] Content estimated at 70 percent.
[3] Content estimated at 80 percent.
[4] Less than 1 ton.
[5] January to June, inclusive.
[6] Figures are low owing to somewhat incomplete data concerning some items of domestic production.

Primary antimony available for consumption in 1942 decreased 20 percent below the total for 1941 but was 33 percent over 1940. Imports of ore continued to advance; and domestic production, even though still comparatively small, increased to more than twice the

1941 total in terms of antimony content. Data on the amount of antimonial lead used in making storage batteries during 1942 are not yet available. This battery metal so used, containing 4 to 12 percent antimony, probably was less than the 131,000 tons consumed in 1941 as reported by the American Bureau of Metal Statistics. Most of the antimony recovered in battery metal is from scrap, though a substantial amount of new metal is added to raise the alloy to the required antimony content.

An important use of antimony is in white-base antifriction bearing metals. According to the Bureau of the Census, shipments of this material produced for sale and for plant consumption in 1942 totaled 22,091 tons—a 33 percent decrease from 33,146 tons in 1941. The manufacturers reporting data that give the above totals represent almost the entire industry. As is true of so many metals during the present war, the decreased consumption does not necessarily indicate lessened importance; rather it reflects relative scarcity of materials coupled with regulatory conservation measures.

Less antimony was used in making chemicals in 1942 than in 1941, the production of oxide and other compounds decreasing 18 percent to 11,950 short tons (preliminary figure) containing approximately 9,703 tons of antimony. Figures on the production of compounds in the 4 preceding years, with the estimated antimony content in parentheses, are as follows: 1941, 14,588 tons (11,590); 1940, 10,211 tons (8,223); 1939, 7,668 tons (6,188); 1938, 4,393 tons (3,539). Nearly all this material was made from foreign ores. Oxide, the most important compound, is used extensively in paints, lacquer, synthetic enamel, porcelain enamel, and glass. A rapidly growing use for oxide, particularly as a war material, is the treatment of canvas and other textiles against rotting and fire.

PRICES

The price of domestic brands of antimony was quoted at 14.00 cents a pound for less than carlots in New York during January and February 1942, the same as throughout 1940 and 1941. On March 23 the quotation was listed at 15.955 cents by authority of the Office of Price Administration. Effective April 13, the price was adjusted to 16.013 cents to meet a 6-percent advance in freight rates, and this adjusted price remained unchanged until December 28, when the quotation was raised to 16.049 cents to include the 3-percent excise tax on transportation effective December 1 and payable by the buyer for delivered metal. These prices were still unchanged by the end of May 1943. The average 1942 price for domestic antimony was 15.55 cents (l. c. l. ex store, New York). Very little Chinese metal was available in 1942, and the quotation of 16.50 cents, in effect since November 1939, remained unchanged in 1942 and was the same at the end of May 1943; the price was nominal.

Prices for English regulus (minimum, 99 percent antimony) and foreign regulus (spot deliveries from warehouse) remained unchanged throughout 1942 at £120 and were the same at the end of May 1943.

Average monthly quoted prices of antimony, prompt delivery at New York, 1938–42, in cents per pound

Month	Chinese brands (duty paid) [1]					American brands [2]				
	1938	1939	1940 [3]	1941 [3]	1942 [3]	1938	1939	1940	1941	1942
January	15.56	14.00	16.50	16.50	16.50	13.75	11.68	14.00	14.00	14.00
February	15.74	14.00	16.50	16.50	16.50	13.75	11.25	14.00	14.00	14.00
March	15.75	14.00	16.50	16.50	16.50	13.75	11.27	14.00	14.00	14.62
April	15.65	14.00	16.50	16.50	16.50	13.65	11.50	14.00	14.00	15.90
May	14.46	14.00	16.50	16.50	16.50	12.46	11.70	11.00	14.00	16.01
June	13.94	14.00	16.50	16.50	16.50	11.73	12.00	14.00	14.00	16.01
July	14.00	14.00	16.50	16.50	16.50	11.02	12.00	14.00	14.00	16.01
August	14.00	14.00	16.50	16.50	16.50	10.88	12.00	14.00	14.00	16.01
September	14.00	14.00	16.50	16.50	16.50	11.32	12.87	14.00	14.00	16.01
October	14.00	14.24	16.50	16.50	16.50	12.06	14.00	14.00	14.00	16.01
November	14.00	16.50	16.50	16.50	16.50	12.25	14.00	14.00	14.00	16.01
December	14.00	16.50	16.50	16.50	16.50	11.56	14.00	14.00	14.00	16.02
Average	14.59	14.44	16.50	16.50	16.50	12.35	12.36	14.00	14.00	15.55

[1] From daily issues of American Metal Market, except 1938 and 1939, which were taken from Metal Statistics, 1940, p. 529.
[2] Metal Statistics, 1943, p. 543.
[3] Nominal.

Quotations for antimony ore on January 1, 1942, according to E&MJ Metal and Mineral Markets, were as follows: "Per (short-ton) unit of antimony contained, at New York, 50 to 55 percent, $2.00@$2.15; 58 to 60 percent, $2.15@$2.25; 60 to 65 percent, $2.25@$2.35. London, 60 to 65 percent, 14s. 9d. per long-ton unit." These prices fluctuated slightly throughout the first months of 1942 but by April steadied to $2.15@$2.20, $2.20@$2.30, and $2.30@$2.40 for the lower, intermediate, and higher grades at which they remained until December. Prices were lowered slightly in December, the quotations being $2.10@$2.20, $2.15@$2.20, and $2.20@$2.30 for the three different grades. These were unchanged by the end of May 1943. The London price for the higher grade ore decreased from the opening quotation to 12s. 6d. by August, advanced slightly to 12s. 9d. in September and decreased again to 12s. 6d. in October, at which point it remained unchanged by the end of May 1943. Prices were nominal.

FOREIGN TRADE [1]

The following tables show imports and exports of antimony and antimony products.

Antimony imported for consumption in the United States, 1938–42

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						
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
1941	41,662	19,386	2,717,472	638	126,018	7,469	2,056,678	2	537
1942	50,021	20,946	3,947,772	522	101,164	127	28,910	(1)	5

[1] Less than 1 ton.

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

Antimony imported for consumption in the United States, 1941–42, by countries

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1941					
Belgium				22	$4,248
Bolivia	11,695	7,094	$1,210,118		
Burma	30	18	3,673		
China	2	1	145	7,115	1,950,990
Costa Rica	28	17	2,250		
Honduras	24	11	1,970		
Mexico	28,706	11,664	1,399,896	328	100,309
Peru	1,177	581	99,420	4	1,131
	41,662	19,386	2,717,472	7,469	2,056,678
1942					
Belgium-Luxemburg				108	24,132
Bolivia	12,112	7,355	1,985,401		
Canada	1,678	861	212,229		
Guatemala	25	13	3,500		
Honduras	125	80	15,145		
Mexico	35,491	12,302	1,693,193		
Peru	590	335	38,304		
United Kingdom [1]				19	4,778
	50,021	20,946	3,947,772	127	28,910

[1] United Kingdom of Great Britain and Northern Ireland.

Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1938–42, in short tons [1]

Year	Type metal and antimonial lead	Other alloys [2]	Total	Year	Type metal and antimonial lead	Other alloys [2]	Total
1938	[3] 59	296	355	1941	202		202
1939	59	62	121	1942	35		35
1940	191		191				

[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, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	711	$96,836	1941	70	$19,690
1939	58	16,736	1942	(1)	181
1940	276	75,440			

[1] Less than 1 ton.

Imports of antimony ore in 1942 again came principally from Mexico and Bolivia. The total from Mexico was 24 percent more than in 1941, and Bolivian exports to the United States gained nearly 4 percent. The small tonnage of needle or liquated antimony, credited from China, came from bonded warehouse, as there was no actual importation of Chinese antimony in 1942.

In addition to the exports of foreign metal reported in the last table above, 17 tons were exported in finished products under the draw-

back provisions of the tariff law from January to June, inclusive; draw-back exports amounted to 98 tons in all of 1941 and 176 tons in 1940.

WORLD PRODUCTION

Data on world production of antimony during the war years since 1938 are incomplete, although additional information has become available for 1939 and 1940 since the figures were last published in the Antimony chapter, Minerals Yearbook, Review of 1940. Although data from countries that supplied 54 percent of the world total in 1938 indicate an 86-percent increase over that year in total world production during 1942, estimates by the Bureau of Mines place the total world mine production of antimony during 1942 at about 50,000 short tons (recoverable antimony content in ores mined). Of this amount the United Nations controlled or had access to approximately 70 percent.

World production of antimony, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
North America:						
Canada	[2] 18	34	[2] 550	1,083	1,329	1,263
Honduras				[4]	23	[4]
Mexico [5]	9,788	7,391	7,243	11,286	10,241	10,759
United States	1,056	542	328	412	1,013	2,457
South America:						
Argentina	31	174	97	91	107	[4]
Bolivia (exports)	6,556	8,682	9,255	10,813	13,680	16,231
Peru	1,296	753	775	809	1,440	[2] 1,430
Europe:						
Czechoslovakia	997	[2] 800	[2] 1,012	[2] 1,104	1,645	[4]
Germany (Austria)	200	145	[4]	[4]	[4]	[4]
Greece			1	[4]	[4]	[4]
Italy	414	740	[4]	[4]	[4]	[4]
Portugal	49	131	174	247	[4]	[4]
Spain	35	44	172	137	[4]	[4]
Yugoslavia	1,447	2,739	3,337	[2] 4,860	[4]	[4]
Asia:						
Borneo, British	4		14	41	[4]	[4]
Burma	28	84	[4]	[4]	[4]	[4]
China [6]	14,702	7,797	6,497	5,493	[4]	[4]
Chosen	8	[4]	[4]	[4]	[4]	[4]
India, British		11	[4]	[4]	[4]	[4]
Indochina	5	83	19	9	[4]	[4]
Turkey (Asia Minor)	536	398	460	[7] 264	[4]	[4]
Africa:						
Algeria	778	744	[4]	[4]	[4]	[8] 137
Morocco:						
French	20	125	[4]	[4]	[4]	[9] 72
Spanish	158	93	[4]	64	[4]	[4]
Southern Rhodesia	64	63	50	[4]	[4]	[4]
Union of South Africa		10	6	126	[9] 324	[9] 325
Oceania:						
Australia:						
New South Wales	13	12	7	9	128	[4]
Queensland	[10]	8		8	25	[4]
Victoria	145	195	100	14	15	[4]
Western Australia	[2] 245	324	296	214	297	[4]
New Zealand		1		1	8	[4]
	38,600	32,100	[4]	[4]	[4]	[4]

[1] Approximate recoverable metal content of ore produced exclusive of antimonial lead ores. 92 percent of reported gross content is used as basis for calculations in nearly every instance. Japan produces antimony but data on production are not available.
[2] Recoverable metal content of concentrates exported.
[3] Estimated.
[4] Data not available.
[5] Includes antimony content of antimonial lead.
[6] Figures represent antimony content of regulus, crude antimony, and oxide exported.
[7] Exports.
[8] January to April, inclusive.
[9] January to October, inclusive.
[10] 442 kilograms.

REVIEW BY COUNTRIES

Algeria.—Antimony has been found in several localities in the Department of Constantine in Algeria, but reserves are meager. The most important mine is the Hamminate-Sanza, 19 miles southeast of Constantine. The Taya-Khenez mine, 25 miles east of Constantine, ranks second in antimony production. Both of these properties are controlled by the Soc. Nouvelle des Mines de la Lucette. Although potential monthly production of concentrates has been estimated at 200 tons, production for the first 4 months of 1942 was only 331 tons, averaging 35 percent antimony.

Argentina.—Antimony production in Argentina is small, and production figures for 1942 are not available. Part of Argentina's supply of antimony is secured as a byproduct of the lead ores imported from Bolivia. Mines are small and in the mountains of Jujuy and La Rioja Provinces.

Australia.—The March 1943 issue of Mineral Trade Notes, published by the Bureau of Mines, gives the most recent available information on the antimony industry in Western Australia. The section concerning antimony is quoted in full:

> The lode carrying antimonial ore at the Wiluna mines, the chief producer of antimony in Western Australia, is nearing depletion, and other sources are being sought. Many antimony occurrences have been examined but were found suitable only for individual operations. The Blue Spec mine, 15 miles east of Nullagine, offers prospect of reasonable production; and the Federal Government, on recommendation of the State Government, has advanced the company £A15,000 for expanding operation. The mineralized area is 11 miles long and has been opened at a number of places, six localities showing good shoots of antimonial ore. Reserves of proved and probable ore total 17,000 long tons averaging 17 dwt. of gold a ton and 3 percent antimony. The antimonial concentrate obtained assayed 56 percent antimony and 5.5 ounces of gold. The company plans to sink a new main shaft 300 feet deep and open a new level. An adjoining lease will be developed.

Bolivia.—Mining for antimony in Bolivia started as early as 1903, and since that time Bolivia has become the world's second largest producer. The antimony deposits are scattered throughout various Provinces, with the most important near Tupiza in the Department of Potosí and Challapata in the Department of Oruro. Most of the mines are small and are worked intermittently by individual operators depending largely upon the market price of the ore.

Exports of antimony in 1942 reached 17,642 metric tons (content in ore) as compared with 14,870 tons in 1941. On March 18, 1942, the Metals Reserve Co. of the United States contracted with Bolivian antimony producers for all antimony and antimonial lead concentrates produced from February 1 to December 31, 1942, except for material sold to Great Britain and Argentina and for domestic consumption in Bolivia. The established price ranged from $1.85 to $2.21 a short-ton unit, f. o. b. Pacific ports, depending on the grade of ore. Exports of concentrates to the United States through the Antofagasta consular district during the first 11 months of 1942 totaled 7,960 metric tons.

Canada.—The Austin Antimony Syndicate reportedly drilled its property south of Wabigoon, Ontario, in 1942 in a search for antimony. The deposit, originally trench-sampled for gold, showed a 10-percent stibnite content, and assays of more recent samples show even a higher antimony content. Bulk samples were shipped to Haileyburg for testing by the Wah Chang Corporation in New York. The deposit is approximately 250 feet long and about 10 feet wide.

China.—China reportedly still has under its control the bulk of the antimony mines that in pre-war years made it the largest producer of antimony in the world. Official Chinese statements indicate that the annual production amounts to about 7,500 tons. A plan mapped out in 1940 by the Ministry of Economic Affairs provided for the production of 1,000 metric tons of antimony in the Szechwan-Sikang area in 1940 and for 1,500 in 1942. With the closing of the Burma Road early in 1942, contract antimony shipments to the United States through the Metals Reserve Co. stopped. Presumably some metal has been getting through to Russia, although no data indicating the extent of such trade are available.

Cuba.—Antimony occurs in the MacKinley area in the northwestern part of the Isle of Pines, and should the need for antimony become great enough to warrant prospecting and mining of the ore this deposit could be developed. The Gaudalupe mine about 13 miles west of Nueva Gerona on the Isle of Pines was originally located for gold about 20 years ago. No work was done, and the claim lapsed. The same area was relocated in 1939 for antimony. The Antimony Co. of Cuba, S. A., was formed, but only a few tons of surface ore were mined. It is reported that $70,000 has been spent in development since February 1941.

Honduras.—Mineral Trade Notes, September 1942, published by the Bureau of Mines, gives the following information concerning antimony developments in Honduras:

> Casa Uhler, S. A., shipped 5 tons of antimony ore to the United States in February. Ore was obtained from the property of Sr. Hector Lainez at Suyatel, approximately 50 kilometers from Tegucigalpa. Casa Uhler, S. A., has contracts with other suppliers and will make additional shipments in the future.

India.—Exploration within the past 2 years has revealed sources of antimony in India sufficient to justify the installation of a plant to treat and refine the ores.

Japan.—The latest information available is that Japan proposed a semigovernmental antimony company to increase production. This was necessary because Japan produces only a fractional amount of antimony to meet its needs and Bolivian exports to Japan had been cut off.

Mexico.—Mexican production of antimony in 1942 amounted to 11,695 metric tons contained in antimony ore and a small quantity of antimonial lead ore, a 5-percent increase over the 1941 total of 11,132 tons. Exports in 1942 totaled 11,283 tons compared with 10,734 tons in 1941.

A detailed description of the antimony deposits and mines of Mexico may be found in Minerals Yearbook, 1941, as abstracted from the November 20, 1941, issue of Mineral Trade Notes, published by the Bureau of Mines.

The decreased production and exports during the latter part of 1942 are partly attributable to the change in operating methods at the Lejocotes mines of the Compañia Minera de Oaxaca, near Tlaxiaco, Oaxaca. The conversion from underground to open-pit mining, accomplished with the financial aid of the Board of Economic Warfare, should be completed early in 1943. As a result, output in 1943 is expected to increase.

Morocco.—The annual production of antimony for both Algeria and Morocco totals less than 1,000 tons. Production figures for the

first 4 months of 1942 list 131 tons of 60-percent concentrates for Morocco. Stocks on May 1, 1942, were 715 tons. The ore is an antimony-lead sulfide occurring in veins in Carboniferous schists. The small reserves are being worked at Gouard ou Fellous and at Tafoudeit near Ouldjet in Soltane. For the past 10 years the annual production has ranged from 100 to 200 tons of antimony concentrates; however, potential production is estimated at 150 tons per month.

Peru.—Estimated production of antimony ores in Peru totaled 3,548 metric tons containing approximately 1,550 tons of antimony in 1942 as compared with 2,813 tons containing 1,565 tons of metal in 1941. Exports from Peru in 1942 totaled 2,557 metric tons of ore and concentrates, containing 1,247 tons of antimony, and 6 tons of antimony bars containing 90 to 95 percent metallic antimony.

Although antimony is produced chiefly by the Cerro de Pasco Copper Corporation, mining is done largely by small producers. There are about 70 small antimony mines in Peru, scattered throughout the Departments of Puno, Tima, La Libertad, Huánuco, Ancash, Junin, and Huancavelica. The deposits of the Puno district, which supply half of the total output of Peru, are reportedly large but are not fully developed and produce only part of their potential total. The antimony occurs as concentrations of stibnite in quartz veins traversing belts of slate and schist. The mines are generally worked without mechanical equipment by the most primitive methods.

The new Cerro de Pasco Copper Corporation plant for treating Cottrell dust began operations in a small way in August 1942. As certain metallurgical problems remained to be solved at that time, it was thought that several months would elapse before the plant would be operating properly and at capacity.

Turkey.—Stibnite is mined in the Turhal region southwest of Amasya.

In 1941, the last year for which figures are available, Turkish production of antimony totaled only 120 metric tons (antimony metal content), but as development of small mines progresses the annual output should increase. In 1940, 638 tons of antimony concentrates were produced, of which 395 tons were exported to France and 243 tons to Japan. Production of concentrates in 1939 totaled 1,300 tons.

CADMIUM

By Allan F. Matthews

SUMMARY OUTLINE

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GENERAL STATEMENT

Cadmium was in strong demand during 1942 for the protective plating of armament parts and by the end of the year was considered the fifth most critical nonferrous metal. Primary production increased only 2 percent in 1942, but new recovery units were installed that will boost the 1943 output appreciably. Cadmium was placed under priority control by the Office of Production Management January 17, 1942 (Order M–65)—amended by the War Production Board June 24 to provide for direct Government allocation. A ceiling price on cadmium at 90 to 95 cents a pound was established by the Office of Price Administration January 19, 1942 (Schedule 71).

Salient statistics of the cadmium industry in the United States, 1938–42, in pounds

	1938	1939	1940	1941	1942
Production (primary)	4,294,400	4,790,500	6,363,600	7,233,500	7,370,969
Imports (metal)	22,582	309,874	27,491	147,378	53,298
Exports	(1)	(1)	387,118	171,858	283,630
Consumption	[2] 4,100,000	[2] 5,900,000	6,178,000	7,766,000	7,659,000
Stocks (year-end)	(1)	(1)	2,844,200	2,610,643	2,408,992

[1] Data not available. [2] Apparent consumption.

DOMESTIC PRODUCTION

Primary cadmium production established a new record in 1942 as the result of a 2-percent increase over 1941. Producers' shipments also advanced, but imperceptibly. The geographic distribution of primary cadmium production, based upon location of plants that produced metal or compounds (not upon origin of cadmium-containing ores), was as follows in 1942: 70 percent from 4 plants in four Western States, 20 percent from 10 plants in seven Central States, and 10 percent from 8 plants in four Eastern States. Cadmium is obtained only as a byproduct in the recovery of the common nonferrous metals, particularly zinc. Cadmium output will be stepped up in 1943; according to an estimate by the Board of Economic Warfare, 31 percent will come from domestic zinc-lead concentrates, 19 percent from imported Mexican flue dust, and 50 percent from imported zinc concentrates.

Cadmium produced and shipped in the United States, 1938–42, in pounds

	1938	1939	1940	1941	1942
Production:					
Primary: [1]					
Metallic cadmium	4,077,961	4,411,530	6,154,200	6,937,931	7,323,346
Cadmium compounds (Cd content) [2]	216,400	[3] 379,000	209,400	295,600	47,623
Total primary production	4,294,400	[3] 4,790,500	6,363,600	7,233,500	7,370,969
Secondary (metal and Cd content of compounds) [2 4]	(5)	([3 5])	227,900	379,500	316,345
Shipments [6] by producers:					
Primary:					
Metallic cadmium	2,525,666	5,190,273	6,467,260	7,044,417	7,233,043
Cadmium compounds (Cd content) [2]	211,000	[3] 401,200	205,900	265,700	78,059
Total primary shipments	2,736,700	[3] 5,591,500	6,673,200	7,310,100	7,311,102
Secondary (metal and Cd content of compounds) [2 4]	(5)	([3 5])	227,200	376,500	304,894

[1] Figures showing primary cadmium production for 1940–42 are strictly comparable. The data for 1938–39 are exactly comparable with 1940–42 as to totals, but in the former period the cadmium content of some compounds made from metal is included with the compounds and excluded from the metal.
[2] Excludes compounds made from metal.
[3] Some secondary compounds included with primary compounds; Bureau of Mines not at liberty to publish figures separately for primary cadmium compounds.
[4] Bureau of Mines not at liberty to publish figures separately for secondary cadmium compounds.
[5] Data not available.
[6] Figures for 1938–39 represent sales.

The following companies produced primary cadmium metal in 1942.

	Location of plant
American Smelting & Refining Co.	Denver, Colo.
American Zinc Co. of Illinois	Fairmont City, Ill., and Dumas, Tex.
Anaconda Copper Mining Co.	Great Falls, Mont.
Eagle-Picher Mining & Smelting Co.	Henryetta, Okla.
Harshaw Chemical Co.	Elyria, Ohio.
National Zinc Co.	Bartlesville, Okla.
Neo-Metal & Chemical Corporation.	Whitestone, N. Y.
New Jersey Zinc Co.	Palmerton, Pa.
St. Joseph Lead Co.	Herculaneum, Mo., and Josephtown, Pa.
Sherwin-Williams Co.	Coffeyville, Kans.
Sullivan Mining Co.	Kellogg, Idaho.
U. S. Smelting, Refining & Mining Co.	Midvale, Utah.
U. S. Steel Corporation	Donora, Pa.

Cadmium compounds are produced principally from metal, although some are made directly from primary residues and secondary materials. Total production of cadmium compounds (in terms of Cd content) decreased 48 percent from 1941 as a consequence of conservation measures.

Cadmium compounds produced in the United States, 1940–42, in pounds

Compound	1940		1941		1942	
	Gross weight	Cd content	Gross weight	Cd content	Gross weight	Cd content
Sulfide [1]	2,287,608	759,500	3,304,478	1,141,500	1,001,124	300,414
Oxide [2]	318,393	250,800	410,748	361,300	594,018	519,586
Nitrate	29,594	10,800	138,951	50,600	9,710	3,546
Hydrate	[3] 19,799	[3] 14,100	42,995	31,500	[4] 24,207	[4] 15,821
Chloride	15,475	7,600	57,828	30,100	15,225	7,924
Carbonate	14,733	9,600	36,806	24,100	14,012	9,076
Bromide	6,289	2,500	17,041	7,000	(4)	(4)
Sulfate	4,324	2,200	6,771	3,400	5,442	2,584
Iodide	(3)	(3)	4,047	1,300	1,201	369
Acetate	1,103	500	1,300	600	948	406
Total production	2,697,318	1,057,600	4,020,965	1,651,400	1,665,887	859,726

[1] Includes cadmium lithopone and cadmium sulfoselenide.
[2] In addition to quantities shown, cadmium oxide consumed in making other compounds shown was produced as follows: 1940, 33,186 pounds (Cd content, 28,700 pounds); 1941, 33,649 pounds (Cd content, 27,500 pounds); 1942, 38,721 pounds (Cd content, 33,881 pounds).
[3] Iodide included with hydrate to avoid disclosure of confidential figures.
[4] Bromide included with hydrate to avoid disclosure of confidential figures.

FOREIGN TRADE [1]

Imports.—All the cadmium metal imported in 1942 came from Belgian Congo and was added to the Government stock pile held by the Metals Reserve Co. Domestic cadmium production is partly from imported flue dust which in 1942 contained 1,723,728 pounds of cadmium—all from Mexico—and in 1941 contained 2,321,426 pounds—1,984,698 from Mexico, 334,137 from South-West Africa, and 2,591 from the Union of South Africa.

Metallic cadmium imported for consumption in the United States, 1938–42

Country	1938		1939		1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Belgian Congo									53,298	$40,363
Belgium	20,067	$28,815	197,454	$84,904	27,491	$9,520				
Canada			30,068	14,642			136,280	$139,898		
Germany	55	163	50	148						
Italy	2,240	1,406	35,304	14,847						
Netherlands			38,038	12,649						
Norway			6,720	2,822						
Poland and Danzig	220	190	2,240	961						
United Kingdom							11,098	12,166		
	22,582	30,574	309,874	130,973	27,491	9,520	147,378	152,064	53,298	40,363

Exports.—Cadmium exports totaled 283,630 pounds (251,059 of metal and 32,571 in compounds) in 1942 compared with 171,858 pounds (65,851 of metal and 106,007 in compounds) in 1941 and 387,118 pounds (286,529 of metal and 100,589 in compounds) in 1940. These figures were compiled by the Bureau of Mines from exporters (except that the figure for compounds in 1942 was estimated from data for gross weight obtained from the Department of Commerce); corresponding data for previous years are not available. All but an insignificant quantity of the cadmium metal exported in 1942 went to Russia under Lend-Lease agreement.

[1] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

CONSUMPTION AND USES

Consumption.—Domestic consumption of cadmium totaled 7,659,000 pounds in 1942 compared with 7,766,000 pounds in 1941, a 1-percent decline.

Estimated distribution, by uses, of cadmium consumed in the United States, 1940–42

Use	1940		1941		1942[1]	
	Pounds	Percent of total	Pounds	Percent of total	Pounds	Percent of total
Electroplating	3,692,000	59.8	4,586,000	59.1	6,661,000	87.0
Bearing alloys	1,300,000	21.0	1,504,000	19.4	282,000	3.7
Solders	73,000	1.2	130,000	1.7	201,000	2.7
Copper alloys	204,000	3.3	80,000	1.0	47,000	.6
Zinc alloys	36,000	.6	54,000	.7	9,000	.1
Low-melting alloys	23,000	.4	43,000	.6	32,000	.4
Type metal	3,000	[2]	3,000	[2]	1,000	[2]
Other alloys	15,000	.2	41,000	.5	9,000	.1
Total metal and alloys	5,346,000	86.5	6,441,000	83.0	7,242,000	94.6
Paints and varnishes	288,000	4.7	392,000	5.0	93,000	1.2
Ceramics	256,000	4.2	389,000	5.0	231,000	3.0
Printing inks	105,000	1.7	126,000	1.6	4,000	.1
Rubber	50,000	.8	100,000	1.3	2,000	[2]
Laboratory reagents	44,000	.7	68,000	.9	47,000	.6
Leather	35,000	.6	75,000	1.0	1,000	[2]
Gas-detector paper			30,000	.4	35,000	.5
Photography	5,000	[2]	11,000	.1	3,000	[2]
Other pigments[3]	49,000	.8	134,000	1.7	1,000	[2]
Total pigments and chemicals	832,000	13.5	1,325,000	17.0	417,000	5.4
Total cadmium consumed	6,178,000	100.0	7,766,000	100.0	7,659,000	100.0

[1] Distribution based in part on data from War Production Board.
[2] Less than 0.1 percent.
[3] Includes plastics, textiles, artists' colors, etc., and some unclassified.

Electroplating.—The most important use of cadmium in the United States is as a protective coating for steel. Of the cadmium consumed in electroplating in this country in 1942, according to the War Production Board, aircraft took 42 percent, ordnance 24 percent, communications 7 percent, automobiles and tanks 6 percent, ships 5 percent, and electrical equipment 3 percent. To relieve the cadmium shortage, many parts whose specifications formerly called for cadmium plating are now galvanized, but there is little agreement regarding the extent to which zinc can be substituted for cadmium.

Alloys.—Certain bearings containing over 95 percent cadmium and small quantities of nickel, silver, and copper are made for heavy-duty applications. Of the cadmium bearings produced in 1942, according to the War Production Board, aircraft took 45 percent, automotive vehicles 31 percent, rolling mills 12 percent, ships 11 percent, and industrial motors and ordnance 1 percent. Solders made of cadmium and various proportions of silver, lead, and zinc are being used more widely and are helping to conserve tin supplies. The addition of about 1 percent cadmium to copper trolley wire improves strength and wear resistance without seriously reducing electrical conductivity. Low-melting alloys containing 4 to 25 percent cadmium are used as a filler in bending thin-walled tubing, as a material for making spotting fixtures and jigs, and as a constituent of fire-detector systems, sprinkler apparatus, and valve seats for high-pressure gas containers.

Compounds.—Cadmium sulfide and cadmium sulfoselenide are standard agents for imparting bright resistant yellow and red colors, respectively, to paints, ceramics, inks, rubber, leather, and other products. Papers coated with cadmium sulfide act as mustard-gas detectors. Cadmium nitrate is used in white fluorescent lamp coatings; the oxide, hydrate, and chloride in electroplating solutions; the carbonate in ceramics; and the halides in photography.

Toxicology.—The causes, effects, and prevention of cadmium poisoning, based upon a study of the 345 cases reported to date, were summarized by the Public Health Service.[2]

STOCKS

Total stocks of cadmium in the United States declined 8 percent in 1942, owing to reducing of consumers' inventories. Stocks of metallic cadmium held by producers, distributors, and the Government increased 20, 60, and 76 percent, respectively.

Cadmium stocks at end of year, 1941–42, in pounds

	1941[1]			1942		
	Metallic cadmium	Cadmium compounds (Cd content)	Total cadmium	Metallic cadmium	Cadmium compounds (Cd content)	Total cadmium
Producers	452,004	104,339	556,343	544,301	83,360	627,661
Compound manufacturers	53,507	146,814	200,321	11,895	126,736	138,631
Distributors[2]	82,258	15,369	97,627	131,443	28,311	159,754
Consumers[3]	1,536,000	106,000	1,642,000	1,199,000	83,000	1,282,000
Government	114,352		114,352	200,946		200,946
Total stocks	2,238,121	372,522	2,610,643	2,087,585	321,407	2,408,992

[1] Revised figures.
[2] Comprises principally 6 largest dealers.
[3] Partly estimated. Includes some material in process. Excludes stocks of compounds held by pigment and chemical consumers.

PRICES

Cadmium metal was quoted at 90 cents a pound for sticks and 95 cents for anode shapes throughout 1942. This level was established in 1941 through agreement between producers and distributors and the Office of Price Administration and was made mandatory January 19, 1942 (Schedule 71). The order was modified to permit, after June 22 (Amendment 1), sales of metal in small containers (5 pounds or less) at October (1941) price levels and to allow adjustable pricing contracts after October 26 (Amendment 2). The Office of Price Administration fixed ceiling prices on partly used anodes at 94 cents a pound, cadmium oxide at 95 cents a pound, and cadmium scrap at 35 cents per pound of contained cadmium, effective October 21, 1942 (Order 6, Maximum Price Regulation 204). The maximum prices are f. o. b. plant of the Udylite Corporation, Detroit, Mich., which was appointed by the Government-owned Metals Reserve Co. as its agent to assist in the cadmium stock-piling program and in the redistribution of idle or frozen materials.

Shipments of metallic cadmium, as reported to the Bureau of Mines by primary producers, had an average value of 79 cents a pound in 1942 compared with 78 cents in 1941 and 70 cents in 1940. Producers' quotations, according to Metal and Mineral Markets, averaged 90 cents in 1942 compared with 88 cents in 1941 and 80 cents in 1940.

[2] United States Public Health Service, Cadmium Poisoning: Public Health Repts., vol. 57, No. 17, April 24, 1942, pp. 601-612; Reprint 2371, 12 pp.

Prices for compounds remained unchanged during 1942. Cadmium sulfide was quoted at $1.10 a pound, cadmium lithopone yellow at 55 to 65 cents a pound, cadmium lithopone red at $0.80 to $1.25 a pound, and cadmium bromide at $1.65 to $1.91 a pound, according to Oil, Paint and Drug Reporter.

WORLD ASPECTS OF CADMIUM INDUSTRY

The United Nations control over four-fifths of the world new supply of cadmium, but nevertheless there were dire shortages of the metal in the United States, Great Britain, and Russia during 1942. Germany got along with about 16 percent of the supply by confiscating stocks in conquered countries, restricting the use of cadmium to solders and and other alloys, and adopting widespread substitution of galvanizing for cadmium plating.

World production of cadmium, 1937–42, by countries, in kilograms

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942
Australia (Tasmania)	210,608	199,326	175,150	(1)	(1)	(1)
Belgian Congo					[2] 400	[2] 28,000
Belgium	271,000	182,000	[3] 530,800	(1)	(1)	(1)
Canada	338,018	317,122	426,234	411,917	567,573	511,907
France	99,000	116,000	(1)	(1)	(1)	(1)
Germany	355,000	432,000	(1)	(1)	(1)	(1)
Italy	90,850	69,000	(1)	(1)	(1)	(1)
Japan	[2] 30,000	[2] 30,000	(1)	(1)	(1)	(1)
Mexico	619,792	762,398	816,584	815,734	906,577	854,264
Norway	154,192	207,667	138,000	(1)	(1)	(1)
Peru						[2] 2,000
Poland	124,461	182,591	(1)	(1)	(1)	(1)
South-West Africa [4]	132,763	259,133	82,155	39,634	[5] 179,497	(1)
U. S. S. R.	[2] 50,000	[2] 50,000	(1)	(1)	(1)	(1)
United Kingdom	124,142	124,898	(1)	(1)	(1)	(1)
United States:						
Metallic cadmium	1,935,003	1,849,722	2,001,026	2,791,484	3,146,976	3,321,797
Cadmium compounds (Cd content)	190,000	98,200	171,900	95,000	134,000	21,600
	3,972,300	3,858,500	4,300,000	4,800,000	(1)	(1)

[1] Data not available. [2] Estimated. [3] Exports.
[4] Cadmium content of flue dust exported for treatment elsewhere; represents in part shipments from stocks on hand. To avoid duplication of figures, the data are not included in the total.
[5] Figures cover January to June, inclusive.

Belgian Congo.—Production of cadmium was begun in November 1941 by Union Minière du Haut Katanga as a byproduct of the preliminary roasting of zinc concentrates from the Prince Leopold mine to obtain sulfuric acid. The metal was exported to the United States.

Canada.—The Dominion of Canada produces five or six times its cadmium requirements, and the surplus is exported to the United Kingdom.[3] The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, British Columbia, and Hudson Bay Mining & Smelting Co., Flin Flon, Manitoba,[4] are the two producers. The output of the latter company was increased in 1942, partly from a 10-ton pilot plant treating stock-piled zinc-copper-cadmium residues. Canadian cadmium consumption in 1940 was 142,019 pounds (64,419 kilograms), 85 percent of which was used in white-metal alloys. Primary cadmium may be bought and sold only under permit from the Metals Controller, according to an order effective June 1, 1942. Metallic cadmium was quoted at $1.30 a pound throughout 1942 by Canadian Metals and Metallurgical Industries.

[3] Northern Miner, vol. 28, No. 21, August 13, 1942, p. 14.
[4] Graham, G. T. E., The Removal of Copper and Cadmium in the Hydrometallurgy of Zinc: Canadian Jour. Research, vol. 20, No. 6, sec. B, June 1942, pp. 93–102.

PLATINUM AND ALLIED METALS

By H. W. Davis

SUMMARY OUTLINE

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SUMMARY

The great demand for platinum metals in the military program made 1942 the most important year in the history of the industry. Despite the unprecedented demand, supplies of platinum, palladium, ruthenium, and osmium were ample for both war and nonwar purposes; and with the use of iridium and rhodium in jewelry and other articles of personal adornment prohibited, the supply of those metals was sufficient for war needs. More platinum metals were refined, imported, and consumed in the United States in 1942 than in any other year. Compared with 1941, new platinum metals refined in 1942 (400,327 ounces) gained 162 percent, imports (335,954 ounces) 8 percent, and consumption (as measured by domestic sales—375,812 ounces) 30 percent. The electrical industry, which ranked third as a consumer of platinum metals in 1941, rose to first place in 1942; the chemical industry again was the second-largest consumer; and the jewelry industry, which in peacetime was the largest user of platinum metals, was third in 1942.

Salient statistics of platinum and allied metals in the United States, 1941–42, in troy ounces

	1941	1942		1941	1942
Production:			Stocks in hands of refiners, importers, and dealers, Dec. 31:		
Crude platinum from placers	26,221	[1] 23,213	Platinum	150,887	160,724
New metals:			Palladium	138,014	107,383
Platinum	[2] 98,376	[2] 244,226	Other	33,942	35,280
Palladium	49,812	140,262		322,843	303,387
Other	4,435	15,839			
	152,623	400,327	Imports for consumption:		
Secondary metals:			Platinum	254,714	[1] 317,195
Platinum	37,522	56,150	Palladium	46,099	[1] 9,984
Palladium	12,630	16,416	Other	9,182	[1] 8,775
Other	1,417	4,045		309,995	[1] 335,954
	51,569	76,611	Exports:		
			Ore and concentrates	244	159
			Refined metals and alloys, including scrap	15,405	102,460
			Manufactures (except jewelry)	3,204	1,246

[1] Subject to revision.

[2] In 1942 includes 25,403 ounces (17,027 in 1941) of new platinum from domestic sources, comprising 21,063 ounces (15,219 in 1941) derived from crude placer platium, 7 ounces (3 in 1941) from ore, and 4,333 ounces (1,805 in 1941) obtained from domestic gold and copper ores as a byproduct of refining.

Despite the greatly increased demand for platinum metals in 1942, prices remained level.

The use of rhodium in the manufacture of jewelry was prohibited by the War Production Board under Conservation Order M–95, effective March 11, 1942. This order was amended on April 1, 1942, to prohibit the use of rhodium alloys, as well as rhodium plating, in the manufacture of jewelry and other articles of personal adornment. Order M–162, as amended and effective October 31, 1942, prohibited the use of platinum and platinum alloys in the manufacture of jewelry.

Figure 1 shows graphically the trend in world production of platinum metals from 1914 to 1942.

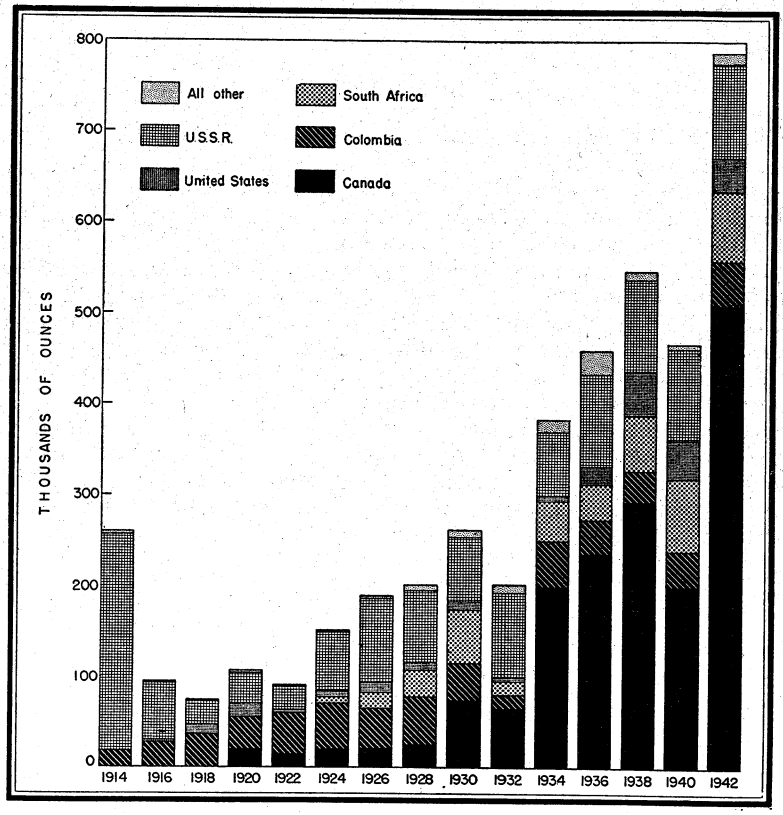

FIGURE 1.—Trend in world production of platinum metals, 1914–42.

CRUDE PLATINUM

Production.—Mine returns for 1942 indicate a production of 22,000 ounces of crude platinum (containing 19,360 ounces of platinum-group metals valued at $1,010,000) in Alaska,[1] 1,200 ounces in California, and 13 ounces in Oregon—a total of 23,213 ounces; comparable

[1] Figures and other information for Alaska from Geol. Survey, U. S. Dept. of Interior. Figures for 1942 subject to revision.

figures for 1941 are 24,800 ounces of crude platinum (containing 21,555 ounces of platinum-group metals valued at $1,078,000) in Alaska, 1,300 ounces in California, 41 ounces in Montana, and 80 ounces in Oregon—a total of 26,221 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 gold placers in Butte, Calaveras, Eldorado, Humboldt, Merced, Placer, Sacramento, San Joaquin, Siskiyou, Stanislaus, Trinity, and Yuba Counties. Production in Oregon came from Grant County.

Many gold and copper ores in the United States contain small quantities of platinum metals. In 1942, 9,805 ounces of platinum metals were recovered as a byproduct of refining gold and copper ores, compared with 6,494 ounces in 1941.

Purchases.—Buyers in the United States reported purchases of domestic crude platinum from the following sources in 1942: Alaska, 22,142 ounces; California, 961 ounces; Montana, 2 ounces; and Oregon, 42 ounces—a total of 23,147 ounces (27,017 ounces in 1941). Domestic buyers also reported purchases of 53,661 ounces (38,124 ounces in 1941) of foreign crude platinum or osmiridium in 1942—157 ounces from Australia, 1 ounce from Canada, 53,353 ounces from Colombia, 30 ounces from the Philippine Islands, and 120 ounces from the Union of South Africa.

Prices.—Buyers reported purchases at $28.79 to $75.38 an ounce for domestic crude platinum and $24.05 to $97.55 an ounce for foreign crude platinum or osmiridium in 1942.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, nickel, and copper indicate that 400,327 ounces (a new record) of platinum metals were recovered in the United States from such sources in 1942, an increase of 162 percent over 1941. Of the new metals recovered in 1942, 91 percent was chiefly from concentrates from Canada and crude from Colombia, 6 percent was from domestic crude (chiefly from Alaska), and 3 percent was a byproduct of domestic gold and copper ores.

New platinum metals recovered by refiners in the United States in 1942, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
Domestic from—							
Crude platinum	21,063	11	3,329	786	28	55	25,272
Ore	7	17	2				26
Gold and copper refining	4,333	5,432	35	5			9,805
	25,403	5,460	3,366	791	28	55	35,103
Foreign from—							
Crude platinum	42,581	246	221	98	41	25	43,212
Nickel and copper refining	176,242	134,556	1,515		5,962	3,737	322,012
	218,823	134,802	1,736	98	6,003	3,762	365,224
Total recovery	244,226	140,262	5,102	889	6,031	3,817	400,327

New platinum metals recovered by refiners in the United States, 1938–42, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1938	30,444	3,653	1,247	869	36,213
1939	36,033	3,491	1,051	866	41,441
1940	38,951	4,564	1,517	2,307	47,339
1941	98,376	49,812	1,392	3,043	152,623
1942	244,226	140,262	5,102	10,737	400,327

Secondary metals recovered.—In 1942, 76,611 ounces of secondary platinum metals were recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum metals, a 49-percent increase over 1941.

Secondary platinum metals recovered in the United States, 1938–42, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1938	44,654	13,489	1,253	4,895	64,291
1939	45,432	13,039	2,767	2,205	63,443
1940	47,657	14,773	1,365	2,635	66,430
1941	37,522	12,630	659	758	51,569
1942	56,150	16,416	1,552	2,493	76,611

Prices.—Quotations [2] on platinum metals remained level during 1942. Platinum was quoted at $36 an ounce, palladium $24, iridium $160 to $175, osmium $45 to $48, rhodium $125, and ruthenium $35 to $40. The quotations on palladium, rhodium, and ruthenium have prevailed for several years.

Properties and uses.—An excellent description of the properties and applications of the platinum metals, with particular reference to the war, has been presented by Wise,[3] from which the following has been drawn.

The chemical applications of the platinum metals, which rank high in immediate importance, are largely a consequence of their catalytic activity, resistance to corrosion, and resistance to oxidation at high temperatures, together with resistance to molten oxides and silicates. Of the catalytic uses, the production of nitric acid by the oxidation of a mixture of synthetic ammonia and air by passing it through a red-hot rhodium-platinum alloy gauze ranks first in wartime importance. The present demand for explosives naturally has led to a large expansion in output of nitric acid, which is used also in production of fertilizers, dyestuffs, photographic materials, plastics, and lacquer, and other chemical and metallurgical processes. Platinum is also used as a catalyst in the manufacture of sulfuric acid by oxidation of sulfur dioxide to sulfur trioxide. Palladium and platinum are excellent catalysts for hydrogenation as well as dehydrogenation. These metals are widely used in the laboratory and are being applied to larger-scale production in the manufacture of various special organic products, including vitamin adjuncts. Ruthenium also has been employed for certain rather special reactions in connection with the synthesis of long-chain hydrocarbons, and osmium tetroxide is an effective hydroxylation catalyst. Palladium has been utilized in supplying extremely pure hydrogen for furnace atmospheres.

[2] E & MJ Metal and Mineral Markets, vol. 13, 1942.
[3] Wise, E. M., Platinum at Work in 1942: Min. and Met., vol. 23, No. 428, August 1942, pp. 421–425.

Pure platinum is universally used as the anode in producing persulfuric acid, and hence hydrogen peroxide, and appears to be the most satisfactory for producing a variety of "per" salts and other highly oxidized materials. Platinum and iridium-platinum also are suitable for insoluble anodes in various electroplating and allied processes, including the recovery of metals from waste solutions. Platinum rupture disks are employed for safe handling of corrosive liquids and gases. Chemical laboratories have long used platinum for crucibles, electrodes, and other equipment, and with the use of microchemical technique many new pieces of platinum equipment have come into production. Use of platinum in plant-scale equipment has awaited the availability of platinum-clad sheets, pipe, rod, and lined reaction vessels, which can now be had in almost any desired size. One of the spectacular recent achievements in the ancient glass industry is the commercial production of fiber glass, which has provided a new and vastly superior insulation for copper wire, a chemically inert fabric, an excellent air-filter medium, and an improved storage-battery separator, as well as a versatile heat-insulation medium. Platinum, because of its resistance to attack by molten glass, made this possible, as the fiber is produced by permitting molten glass to pass through a bank of platinum nozzles from which it emerges in fine streams, which are stretched to produce the minute fibers required. The rayon industry utilizes platinum-gold and rhodium-platinum alloys in a somewhat similar way, as the viscose is forced through small spinnerets made of one of these alloys.

The numerous electrical applications of platinum, palladium, and the other platinum-group metals are based upon their resistance to tarnishing by oxidation or sulfidation, resistance to spark erosion, high melting temperatures, and good mechanical properties. Certain special applications also depend on their resistance vs. temperature relationships or on definite thermoelectric properties. Palladium is used most extensively in the contacts of telephone relays. Platinum, either pure or hardened with up to 10 percent ruthenium or 25 percent iridium, is employed for contacts in voltage regulators, thermostats, and relays, and the two alloys are used for contacts in high-tension magnetos, which are of particular importance in aircraft. Spark plugs equipped with small-diameter platinum-alloy electrodes have found extensive use in the present war owing to their long life and resistance to fouling. The ability to produce platinum wire as small as 40-millionths inch in diameter and its immunity to oxidation have made possible electrical fuses that will blow at a few thousandths of an ampere. Fuses of a different type, also using platinum and palladium alloys, are employed to detonate explosives. Platinum is also employed in resistance thermometers, in temperature-compensating networks of electrical instruments, and in electrical gas analyzers, and rhodium-platinum alloy is the standard high-temperature precision thermocouple. Some of the hard platinum alloys, somewhat similar to those used for tipping fountain pens, are used for special electrical contacts and for bearings in small instruments and magnetic compasses; and some related alloys are used for long-life needles for phonographs. The highly reflective rhodium has proved most satisfactory for surfacing the great searchlight reflectors that have become so important in the war.

Both palladium and platinum are used extensively in dental metallurgy in gold dental alloys to impart superior tarnish resistance,

strength, and response to age-hardening treatment. Platinum-base alloys are used in both wrought and cast form for dental restorations of the highest type; palladium-gold alloys are employed for producing the porcelain-to-metal junction in most artificial teeth; and soft platinum-foil matrices are used for producing porcelain crowns and inlays.

In the jewelry and decorative arts platinum is recognized as the ideal metal, particularly for gem-set jewelry. Ruthenium-palladium is now finding much broader application in jewelry. Iridium was formerly the favorite hardener for jewelry platinum but has been supplanted by ruthenium to conserve iridium for war requirements. Both platinum and palladium are beaten into foil in the same manner as gold and are used for about the same purposes.

Consumption.—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. Sales to consumers in the United States were 375,812 ounces in 1942, compared with 288,397 ounces in 1941.

The most widely used metal of the group is platinum, which constituted 269,176 ounces (71 percent) of the total platinum metals reported sold to consumers in the United States in 1942. The chemical industry, which advanced to first place as a consumer of platinum in 1941, maintained its rank in 1942, accounting for 35 percent (94,025 ounces) of the total sales. The largest outlet for platinum in the chemical industry in 1942 was as a catalyst to produce nitric and sulfuric acids. Important quantities were used also in laboratory ware, rayon spinnerets, and fiber glass. The electrical industry, which ranked third as a consumer of platinum in 1941, was a close second in 1942, taking 34 percent (92,961 ounces) of the total platinum sales. The largest use for platinum in the electrical industry in 1942 was as magneto and other contacts. Sales of platinum to the electrical industry were 228 percent greater than in 1941. The jewelry industry, which dropped to second place in 1941, fell to third place in 1942, taking 25 percent (66,518 ounces) of the total platinum sales. Despite the ban on the use of platinum in jewelry during the last 2 months of 1942, sales were about the same as in 1941. The dental industry purchased 5 percent (13,077 ounces) and miscellaneous uses accounted for the remainder (1 percent, or 2,595 ounces) of the platinum sold in 1942.

Next to platinum, palladium is the most extensively used metal of the group; it constituted 81,460 ounces (22 percent) of the total platinum metals sold to domestic consumers in 1942. The electrical industry was the chief consumer of palladium in 1942, buying 35 percent (28,452 ounces) of the total sold. However, sales of palladium to the electrical industry were 20 percent less than in 1941. A close second in magnitude of consumption of palladium in 1942 was the dental industry (34 percent, or 27,480 ounces), which was followed by the jewelry industry (24 percent, or 19,658 ounces). Sales of palladium to the dental industry declined 13 percent in 1942, but those to jewelers increased 146 percent. Comparatively small quantities were sold for use in the manufacture of chemical ware (5,480 ounces) and for miscellaneous purposes (390 ounces) in 1942.

The consumption of the other platinum metals—iridium, rhodium, osmium, and ruthenium—is comparatively small; it made up 7 percent (25,176 ounces) of the total for the group in 1942. Rhodium

and ruthenium (in almost equal quantities) were the most extensively used metals of this group, followed in order by iridium and osmium.

The following table shows sales of platinum metals by refiners, importers, and dealers to consumers in the United States in 1942.

Platinum metals sold to consuming industries in the United States in 1942, in troy ounces

Industry	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
Chemical	94,025	5,480	5,668	105,173
Electrical	92,961	28,452	12,446	133,859
Dental	13,077	27,480	106	40,663
Jewelry	66,518	19,658	4,275	90,451
Miscellaneous and undistributed	2,595	390	2,681	5,666
	269,176	81,460	25,176	375,812

Stocks.—Stocks of platinum metals in the hands of refiners, importers, and dealers were 303,387 ounces on December 31, 1942, compared with 322,843 ounces at the close of 1941.

Stocks of platinum metals held by refiners [1] in the United States, December 31, 1938–42, in troy ounces

Year	Platinum	Palladium	Iridium	Osmium, rhodium, and ruthenium	Total
1938	71,058	30,071	7,151	9,631	117,911
1939	71,393	29,273	7,000	9,884	117,550
1940 [1]	144,302	93,244	32,368		269,914
1941 [1]	150,887	138,014	33,942		322,843
1942 [1]	160,724	107,383	35,280		303,387

[1] In 1940 figures also include stocks held in the United States by importers from the United Kingdom; in 1941 and 1942 figures also include stocks held in the United States by all importers and dealers.

FOREIGN TRADE [4]

Imports.—Imports of platinum metals into the United States in 1942 established a new record and amounted to 335,954 ounces,[5] a gain of 8 percent over the previous peak year 1941. The principal sources of imported platinum metals in 1942 were Canada (222,685 ounces),[5] Colombia (46,714 ounces), United Kingdom (33,576 ounces), and U. S. S. R. (32,226 ounces). Imports of unrefined platinum (excluding scrap) increased in 1942 to 271,023 ounces (226,951 in 1941), and imports of refined platinum (including scrap) to 46,172 ounces (27,763 in 1941). Imports of refined palladium dropped in 1942 to 9,984 ounces (46,099 in 1941). Imports of refined iridium, osmium, and ruthenium also declined substantially in 1942, whereas there was a marked gain in imports of refined rhodium. Figures on imports in 1942 are subject to revision.

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

[5] The concentrates and residues imported from Canada contain, in addition to platinum, substantial quantities of palladium, iridium, rhodium, and ruthenium, but apparently only the platinum content is recorded by the Department of Commerce.

Platinum metals imported for consumption in the United States, 1938–42

Year	Troy ounces	Value	Year	Troy ounces	Value
1938	161,189	$4,366,912	1941	[1] 309,995	[1] $7,143,612
1939	306,627	9,881,531	1942 [2]	[1] 335,954	[1] 8,646,635
1940	[1] 195,645	[1] 5,748,005			

[1] The concentrates and residues imported from Canada contain also substantial quantities of palladium, iridium, rhodium, and ruthenium, but apparently only the platinum content is recorded by the Department of Commerce.
[2] Subject to revision.

Platinum metals (unmanufactured) imported for consumption in the United States, 1941–42, by metals

Metal	1941		1942 [1]	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores and concentrates of platinum metals (platinum [2] content)	175,810	$3,317,809	202,836	$4,300,690
Grain and nuggets (including crude, dust, and residues) (platinum [2] content)	51,141	1,300,601	68,187	2,006,500
Sponge and scrap (platinum content)	17,898	635,062	13,918	341,316
Ingots, bars, sheets, or plates not less than ⅛-inch thick (platinum content)	9,865	322,989	32,254	1,193,183
	254,714	5,576,461	317,195	7,841,689
Iridium	1,292	279,455	485	63,526
Osmiridium	266	23,851	276	23,367
Osmium	1,689	58,028	475	20,764
Palladium	46,099	851,174	9,984	190,892
Rhodium	2,780	271,809	4,609	430,055
Ruthenium	3,155	82,834	2,930	76,342
	309,995	7,143,612	335,954	8,646,635

[1] Subject to revision.
[2] The concentrates and residues imported from Canada contain also substantial quantities of palladium, iridium, rhodium, and ruthenium, but apparently only the platinum content is recorded by the Department of Commerce.

Platinum metals (unmanufactured) imported for consumption in the United States in 1942, by countries, in troy ounces [1]

Country	Platinum				Iridium	Osmium and osmiridium	Palladium	Rhodium and ruthenium	Total
	Ores and concentrates of platinum metals (platinum [2] content)	Grain and nuggets (including crude, dust, and residues) (platinum [2] content)	Sponge and scrap (platinum content)	Ingots, bars, sheets, or plates not less than ⅛-inch thick (platinum content)					
Canada	185,913	20,175	13,838	16	(3)	41	2	2,700	222,685
Colombia		46,711	3						46,714
United Kingdom	16,923	1,295	4		485	555	9,484	4,830	33,576
U. S. S. R.				32,226					32,226
Other countries		6	73	12	(3)	155	498	9	753
	202,836	68,187	13,918	32,254	485	751	9,984	7,539	335,954

[1] Subject to revision.
[2] The concentrates and residues imported from Canada contain also considerable quantities of palladium, iridium, rhodium, and ruthenium, but apparently only the platinum content is recorded by the Department of Commerce.
[3] Less than 1 ounce.

Exports.—Exports of refined platinum metals and alloys (including scrap) increased to 102,460 ounces in 1942 from 15,405 ounces in 1941. However, the 1942 exports included 97,800 ounces of refined palladium, which was shipped to Canada for storage. On the other hand, the 1941 figures included 8,100 ounces of refined platinum which was reexported to U. S. S. R. Deducting these items, exports of unmanufactured platinum metals in 1942 and 1941 were 4,660 and 7,305 ounces, respectively. Canada and Argentina were the chief foreign markets for platinum metals in 1942.

Platinum and allied metals exported from the United States, 1938–42

Year	Ore and concentrates		Platinum (bars, ingots, sheets, wire, sponge, and other forms, including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys, including scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1938	(1)	(1)	[2] 33,635	[2] $1,156,644	(2)	(2)	796	$31,111
1939	(1)	(1)	[2] 46,329	[2] 1,528,563	(2)	(2)	4,041	213,445
1940	(1)	(1)	[2] 55,027	[2] 2,280,339	(2)	(2)	1,800	96,703
1941	244	$11,713	[2] 15,405	[2] 607,333	(2)	(2)	3,204	160,674
1942	159	6,581	3,354	126,007	99,106	$2,301,953	1,246	61,088

[1] Not separately classified.
[2] Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium included with platinum; not separately classified before 1942.

Platinum and allied metals exported from the United States in 1942, by countries

Country	Ore and concentrates		Platinum (bars, ingots, sheets, wire, sponge, and other forms, including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys, including scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
Argentina			251	$9,991	462	$13,728	78	$5,107
Brazil	46	$1,573	290	10,884	93	2,912	75	7,192
Canada			1,733	73,148	98,376	2,279,737	640	24,147
Chile			234	9,291	57	2,648	39	2,087
Netherlands Indies			321	11,413			2	79
Other countries	113	5,008	525	11,280	118	2,928	412	22,476
	159	6,581	3,354	126,007	99,106	2,301,953	1,246	61,088

WORLD PRODUCTION

Because of restriction on the publication of statistics by certain governments, figures for many countries since 1939 have not been available.

Canada.—According to the Dominion Bureau of Statistics, recoveries of platinum metals from the nickel-copper ores of the Sudbury district, Ontario, were 298,400 ounces of platinum and 226,600 ounces of other platinum-group metals in 1942 (an all-time high), compared with 124,257 ounces of platinum and 97,432 ounces of other platinum-group metals in 1941. Placers in British Columbia yielded 30 ounces of platinum in 1942, compared with 60 ounces in 1941.

Colombia.—Colombia exported 49,163 ounces of crude platinum in 1942 (37,349 in 1941). The South American Gold & Platinum Co. produced 25,786 ounces of crude platinum metals in 1942 (30,548 in 1941) and 51,974 ounces of gold (72,582 in 1941). The figures for other operators are not available.

Union of South Africa.—Figures on output of platinum metals are not available for all of 1942, but it is reported that production to the full capacity of the plant proceeded uninterruptedly during the year. The output was shipped to England for refining.

World production of platinum and allied metals, 1937–42, in troy ounces

[Compiled by B. B. Waldbauer]

Country and product	1937	1938	1939	1940	1941	1942
Australia:						
New South Wales: Placer platinum	46	8	(1)	(1)	(1)	(1)
Tasmania: Placer osmiridium	586	191	283	(1)	(1)	(1)
Belgian Congo: From refineries:						
Palladium	12,507	1,575	3,312	(1)	(1)	(1)
Platinum	2,122	225	868	(1)	(1)	(1)
Canada:						
Placer platinum	22	16	25	24	60	30
From refineries: [2]						
Platinum	139,355	161,310	148,877	108,464	124,257	298,400
Other platinum metals	119,829	130,893	135,402	91,522	97,432	226,600
Colombia: Placer platinum (exports)	29,315	34,549	39,070	35,859	37,349	49,163
Ethiopia: Placer platinum	3,376	3,537	(1)	(1)	(1)	(1)
Italy: From refineries: Platinum	1,286	1,029	(1)	(1)	(1)	(1)
Japan: Placer platinum	(1)	(1)	(1)	(1)	(1)	(1)
Netherlands Indies (probably placer platinum)		21	28	34	(1)	(1)
New Zealand: Placer platinum	55	1	13		35	(1)
Panama: Placer platinum	267				(1)	(1)
Papua: [3]						
Placer platinum	20	41	2	(1)	(1)	(1)
Placer osmiridium	8	4	4	(1)	(1)	(1)
Sierra Leone: Placer platinum	308	180	83	135	(1)	(1)
Union of South Africa:						
Platinum (content of platinum metals) [4]	17,776	18,256	18,068	20,140	[5] 14,205	[6] 16,865
Concentrates (content of platinum metals) [4]	21,849	35,124	41,243	51,835	[5] 54,790	[6] 43,825
Osmiridium [7]	5,790	5,354	7,031	(1)	(1)	(1)
U. S. S. R.: Placer platinum [8]	100,000	100,000	100,000	100,000	100,000	100,000
United States:						
Placer platinum	10,803	40,932	32,460	33,800	26,221	[9] 23,213
Ore (content of platinum metals)	124	90	66		15	26
From refineries: [10]						
Platinum	4,761	3,761	5,270	4,470	1,805	4,333
Other platinum metals	5,817	3,486	3,364	3,304	4,689	5,472
	[11] 476,000	[11] 541,000	[11] 540,000	[11] 465,000	[11] 483,000	[11] 790,000

[1] Data not available.
[2] Recovered from nickel-copper mattes.
[3] Year ended June 30 of year stated.
[4] Produced from platinum ores.
[5] January to November, inclusive.
[6] January to October, inclusive.
[7] Produced from treatment of gold ores on the Rand.
[8] Estimated production.
[9] Subject to revision.
[10] New platinum metals recovered in gold and copper refining of domestic materials.
[11] Estimate.

TITANIUM

By Allan F. Matthews

SUMMARY OUTLINE

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GENERAL STATEMENT

The fading of summer in the Adirondack Mountains brought with it the first large-scale shipments of ilmenite from a mine near Tahawus, N. Y., which is to render the United States self-sufficient in ilmenite—principal ore of titanium. Domestic production of ilmenite tripled in 1942 compared with 1941, but rutile output was held somewhat below its normal level by a plant-expansion program at the Arkansas property. Mining of both titanium minerals is expected to increase greatly in 1943. Ilmenite imports, normally principally from India, slumped in 1942 to a fraction of their former volume, causing consumers to draw heavily on their stocks while awaiting domestic production to reach its stride. In contrast, rutile imports were able to increase in 1942 because of the smaller tonnages involved, a higher shipping priority rating, the relative proximity of Brazilian supplies, and the availability of cargo space on vessels returning from delivery of military supplies to Australia. White pigments and welding-rod coatings took the bulk of the ilmenite and rutile, respectively, consumed in 1942, but both minerals also were consumed in ferrotitanium.

GOVERNMENT CONTROL

Rutile was put under import control by the Office of Production Management, December 26, 1941 (Order M–63), and inventory restrictions on ilmenite were removed by the War Production Board, June 26, 1942 (Amendment 2, Order M–161). Producers of titanium pigments were directed to set aside a pool of 20 percent of their production for allocation by the Office of Production Management, effective December 1, 1941 (Order M–44). Subsequent amendments moved the effective date to January 1, 1942; clarified the original text; effective February 1 increased the allocation pool to 25 percent of the output; and December 9 revoked the entire order. Dealers were verbally requested by the War Production Board in the spring of 1942 to divert to welding-rod and alloy producers the quantities of rutile normally moving to ceramics manufacturers, although no formal order to that effect was promulgated.

Price action on titanium pigments first appeared January 3, 1942, when to stem a proposed advance the Office of Price Administration requested stabilization of prices at levels of October 1, 1941. The request was made mandatory March 1, 1942 (Price Schedule 98). Amendments allowed one producer to sell above the maximum price for 2 months, provided for additional means of enforcement, and after December 2 permitted adjustable pricing for long-term contracts.

DOMESTIC PRODUCTION

Ilmenite production in the United States tripled in 1942 compared with 1941 and set a new record, but rutile output decreased 15 percent. The decline was due primarily to a stoppage of Arkansas production during plant enlargement. Ilmenite concentrates shipped in 1942 contained 42 to 52 percent TiO_2, and rutile concentrates ranged from 90 to 94 percent TiO_2. Production and shipments, 1939–42, are shown in the following table. The Bureau of Mines is not at liberty to publish corresponding figures for 1929–38.

Production and mine shipments of titanium concentrates from domestic ores in the United States, 1939–42

Year	Ilmenite			Rutile		
	Production (short tons)	Shipments		Production (short tons)	Shipments	
		Short tons	Value [1]		Short tons	Value
1939	14,602	16,872	$137,042	(2)	(2)	(2)
1940	20,668	20,702	183,686	2,888	2,657	$393,243
1941	23,297	21,526	196,522	3,130	3,431	493,782
1942	(2)	(2)	(2)	2,648	2,649	410,956

[1] Represents cost of production for some producers whose product is consumed by affiliated companies.
[2] Bureau of Mines not at liberty to publish figures.

Arkansas.—The Titanium Corporation sold its rutile property at Malvern, Magnet Cove district, Hot Spring County, in March 1942 to the Titanium Alloy Co. of Arkansas, Inc., subsidiary of the Titanium Alloy Manufacturing Co. The property was inactive from January to September, during which time the concentrating plant was enlarged. In its decade (1932–42) of operation the Titanium Corporation produced 3,771 short tons of rutile averaging 93 percent TiO_2 and shipped 3,621 tons valued at $440,758. In addition, it produced 1,281 tons of rutile averaging 52 percent TiO_2 and shipped 29 tons valued at $583; the remainder was an inventory sold with the plant and will be brought up to commercial grade by the new operator.

Florida.—For 3 years the Riz Mineral Co. (formerly the Consolidated Operations Corporation) has been recovering rutile, ilmenite, and zircon from beach sands near Melbourne, Brevard County. Unworked since 1927, the beach deposits in Duval and St. Johns Counties near Jacksonville will yield large quantities of rutile in 1943, according to present plans of the Titanium Alloy Manufacturing Co.

New York.—The Sanford Lake titaniferous magnetite deposit near Tahawus, Essex County, was opened in 1942 by the Titanium Division of the National Lead Co., which granted a 25-percent interest in the

project to the Krebs Pigment & Chemical Division, E. I. du Pont de Nemours & Co., Inc. The mine is known as the MacIntyre Development.[1] Production began in August and by the end of the year was well on the way toward a daily output of 900 short tons of ilmenite concentrates (48 percent TiO_2) and 1,800 tons of magnetite concentrates (64 percent Fe, low P, 9 percent TiO_2, 0.35 percent V) derived from 4,500 tons of ore (16 percent TiO_2). Treatment of the ilmenite involves grinding to pass a 20-mesh screen and concentration by wet and dry magnetic separators. Proved ore reserves total 15 million tons, and probable reserves of the district are prodigious.

North Carolina.—Ilmenite production was begun in January 1942 at Finley, Caldwell County, by the Yadkin Valley Ilmenite Co., subsidiary of the Glidden Co. The feasibility of producing ilmenite from black sands of Albemarle Sound was investigated by the North Carolina State Board of Conservation and Development and E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., but results were not encouraging. A rutile deposit near Shooting Creek, Clay County, from which some shipments were made about 30 years ago, was under development in 1941 by the Southern Minerals Co., Asheville, but most of the property was condemned by the Tennessee Valley Authority for its Chatuge Dam project.

Virginia.—Rutile and ilmenite are produced near Roseland, Nelson County, by the American Rutile Corporation, subsidiary of the Metal & Thermit Corporation. Ilmenite is mined in the same district by the Southern Mineral Products Co., subsidiary of the Vanadium Corporation of America; this property is estimated to contain at least 4 million tons of titanium dioxide.[2]

FOREIGN TRADE[3]

Imports.—Ilmenite imports in 1942 comprised 4,540 short tons from Canada, 2,942 [4] from Australia, 1,287 from Brazil, and 1,165 from India compared with 1941 entries of 156,079 tons from India, 5,725 from Canada, 4,093 [4] from Australia, 3,709 from Brazil, and 969 from Portugal. Imports of rutile in 1942 comprised 4,967 short tons from Brazil, 4,661 [4] from Australia, 111 from French Equatorial Africa, and 35 from French Cameroun compared with 1941 entries of 3,752 [4] tons from Australia and 2,448 from Brazil. Australian concentrates classified as "Zirconium ore" by the Department of Commerce are about half zircon, and the remaining content is largely rutile and ilmenite with some gangue (magnetite, garnet, etc.); the rutile and ilmenite content of such concentrates is estimated and included in the preceding figures. After importation the mixed concentrates are separated into their component minerals by the International Titanium Corporation (subsidiary of the American Rutile Corporation and Ventures, Ltd.), Carteret, N. J.; Orefraction, Inc., Pittsburgh, Pa.; and Titanium Alloy Manufacturing Co., Niagara Falls, N. Y. There were no imports of ferrotitanium, 1941–42.

[1] Crockett, R. E., Eastern Magnetite: Min. and Met., vol. 24, No. 434, February 1943, p. 84.
Hagar, I. D., The MacIntyre Development—New Source of Titanium: Eng. and Min. Jour., vol. 143, No. 12, December 1942, pp. 47–49.
Hagar, I. D., Ilmenite and Magnetite Produced in Quantity at National Lead's New MacIntyre Development: Min. and Met., vol. 23, No. 432, December 1942, pp. 594–596.
Mining and Contracting Review, MacIntyre Development—Historic Mine Reopened: Vol. 44, No. 13, July 15, 1942, pp. 7 and 17.

[2] Bevan, Arthur, Virginia's War Mineral Resources: Virginia Geol. Survey Reprint Series 4, 1942, p. 5.

[3] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

[4] Partly estimated. See accompanying table, footnote 2.

Titanium concentrates [1] imported for consumption in the United States, 1938–42

Year	Ilmenite			Rutile		
	Short tons		Value of "As reported" [3]	Short tons		Value of "As reported" [3]
	As reported	Total [2]		As reported	Total [2]	
1938	234,275	234,141	$1,018,403	230	364	$26,533
1939	286,576	287,191	1,126,200	442	787	23,170
1940	221,641	223,891	750,590	156	2,164	14,849
1941	166,846	170,689	629,940	3,114	6,291	306,176
1942	7,115	10,369	56,694	6,479	10,465	626,375

[1] Classified as "Ore" by Department of Commerce.
[2] Includes Bureau of Mines estimate of ilmenite and rutile, respectively, contained in Australian zircon-rutile-ilmenite concentrates classified as "Zirconium ore" by Department of Commerce. Data for 1938 are adjusted to apportion Australian zircon-rutile-ilmenite concentrates classified as "Ilmenite" by Department of Commerce.
[3] Value pertains to "As reported" quantity only. Value of remainder included with "Zirconium ore." (See chapter of this volume on Minor Metals.)

Exports.—Exports in 1942 comprised 617 short tons ($117,886) of titanium concentrates, 491 tons ($61,909) of titanium ferro-alloys, 15 tons ($9,938) of titanium tetrachloride, and 9 tons ($3,728) of other titanium compounds.

STOCKS

Stocks of ilmenite were cut in half during 1942 as a result of virtual cessation of imports from India and consequent necessity for consumers to draw heavily on inventories. On the other hand, imports of rutile from Australia and Brazil were not only maintained but appreciably augmented in 1942 so that, even in the face of greatly increased consumption, total inventories of rutile climbed 56 percent. Industry stocks of rutile actually declined 3 percent, but that trend was offset by the stock-piling program of Government-owned Metals Reserve Co.

Stocks of titanium concentrates in the United States at end of year, 1941–42, in short tons

Stocks	1941				1942			
	Ilmenite		Rutile		Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
Mine	28,106	12,087	75	53	11,917	5,142	75	53
Distributors [1]	12,867	6,032	2,387	2,238	11,541	5,371	1,702	1,588
Consumers	311,087	178,258	1,144	1,072	149,153	81,735	1,707	1,589
Government			31	29			2,194	2,062
Total stocks	352,060	196,377	3,637	3,392	172,611	92,248	5,678	5,292

[1] Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.

CONSUMPTION AND USES

Consumption of ilmenite decreased 6 percent and that of rutile increased 67 percent in 1942 compared with 1941. Ilmenite was used

principally in pigments (95 percent) and alloys (5 percent) and rutile in welding-rod coatings (84 percent), alloys (15 percent), and ceramics (1 percent).

Consumption of ilmenite and rutile in the United States, 1941–42, in short tons

Product	Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
1941				
Pigments (manufactured titanium dioxide) [1 2]	267,944	147,905	----------	----------
Welding-rod coatings [1]	58	30	5,461	5,133
Alloys	7,104	3,031	709	673
Ceramics	----------	----------	172	162
Miscellaneous [3]	----------	----------	19	18
Total consumption	275,106	150,966	6,361	5,986
1942				
Pigments (manufactured titanium dioxide) [1 2]	244,465	134,964	----------	----------
Welding-rod coatings [1]	56	28	8,857	8,326
Alloys	11,802	5,899	1,652	1,526
Ceramics	----------	----------	92	86
Miscellaneous [3]	1,212	521	15	14
Total consumption	257,535	141,412	10,616	9,952

[1] "Pigments" include all manufactured titanium dioxide, consumption of which in welding-rod coatings was 1,700 short tons in 1941 and 4,900 tons in 1942.
[2] Partly estimated.
[3] Consists of ilmenite used as a steel flux and rutile used in lamp-electrode coatings and as a steel deoxidizer.

Titanium pigments.—Manufactured titanium dioxide obtained from ilmenite is used as a white pigment, principally in paint, varnish, and lacquer but also in paper, linoleum, rubber, coated textiles, leather, printing ink, soap, and cosmetics. Nonpigment applications of manufactured titanium dioxide include ceramics and welding-rod coatings. Domestic production of titanium pigments in 1942 receded from the high levels of 1941 at about the same rate as lead pigments and registered the second-best year to date. The output was double that of 1938 and was more in tonnage and twice as large in dollar volume as any other white pigment. Titanium white paints are noted for a high degree of opacity (covering power), reflectance (brightness), whiteness, and durability.

Welding-rod coatings.—Some 321,000 short tons of titanium-coated welding rods were produced in the United States in 1942 compared with 152,000 tons in 1941. According to Iron Age, the quantity of all types of welding rods produced in October 1942 was a little over 35,000 tons. Of this amount 60 to 70 percent was being used in shipbuilding to replace riveting with welding, thereby reducing steel requirements for cargo ships by 10 percent.[5] Titanium shields the arc from oxidation during welding and produces a brittle slag that protects the cooling weld deposit; it is usually added to coating compositions as rutile, manufactured titanium dioxide, or ilmenite.

Titanium alloys.—Ferrocarbontitanium (15–20 percent Ti, 3–8 percent C) is a powerful deoxidizer in steel melts, and ferrotitanium (18–45 percent Ti, 0.1 percent C max.) is added to steel to refine the grain, to

[5] Oliver, Frank J., Welding—Given Tremendous Impetus by War: Iron Age, vol. 151, No. 1, January 7, 1943, p. 127.

inhibit intergranular corrosion of stainless steels, and to prevent air-hardening of 5-percent chromium steels. Titanium is added to a number of nonferrous alloys, particularly to aluminum to increase strength and ductility, and is a constituent of a number of complex deoxidizers. The use of the pure metal is limited principally to radio tubes.

Other uses of titanium.—One hundred to two hundred short tons of ilmenite are consumed monthly by the Rustless Iron & Steel Corporation, Baltimore, Md., as a replacement for fluorspar (which, according to the company, emits fumes causing illness to workers) in making titanium-bearing stainless steel. Rutile and manufactured titanium dioxide are used in ceramics, principally to improve the acid resistance of porcelain enamels, to impart colors ranging from cream to brown in pottery bodies and glazes, and to make electric insulators. Consumption of rutile in ceramics was curtailed in 1942, and the quantities thus conserved were diverted to welding-rod coatings and alloys. Small quantities of rutile are used in lamp-electrode coatings of street lights and as a deoxidizer (with aluminum) in special alloy steels. Titanium carbide is a constituent of hard cutting alloys used in machine tools. Titanium tetrachloride is an important smoke-screen chemical.

PRICES

Titanium (in all forms) showed no price changes in 1942. Ilmenite, 60 percent TiO_2, was nominally quoted at \$28–\$30 a long ton, f. o. b. Atlantic seaboard, according to Metal and Mineral Markets. One consumer was paying \$31.50 a ton for Indian material early in the year. Rutile, 94 percent TiO_2, was listed at 8–10 cents a pound. Steel quoted ferrotitanium, ton lots, at \$1.23 per pound of contained Ti for 40- to 45-percent grade and \$1.35 for 20- to 25-percent grade; and ferrocarbontitanium, 15–20 percent Ti, at \$142.50 a short ton for 6- to 8-percent carbon and \$157.50 for 3- to 5-percent carbon. Titanium metal, 96–98 percent, was listed at \$5–\$5.50 a pound. The base price of manufactured titanium dioxide was fixed at 14½–16½ cents a pound by Office of Price Administration Schedule 98, noted under Government Control.

TECHNOLOGY

Titaniferous magnetite analyzing 18 percent TiO_2, from Poplar Lake, Minn., was crushed to minus-48-mesh and treated by hydraulic classification, tabling, and magnetic concentration to yield a product containing 43 percent TiO_2.[6] The effects of titanium in blast-furnace charges and the recovery of vanadium from Sanford Lake ilmenite tailings (titaniferous magnetite) were investigated by the Bureau of Mines, the University of Minnesota, and the National Lead Co.[7] An improved method of making powdered titanium metal was patented.[8]

[6] Minnesota Geological Survey, Notes on Titanium and Vanadium (mimeographed): 1942, 4 pp.

[7] Wood, C. E., Joseph, T. L., and Cole, S. S., Smelting of Vanadium-Bearing Titaniferous Sinter in an Experimental Blast Furnace: Bureau of Mines Rept. of Investigations 3679, 1943, 24 pp.

[8] Comstock, George F., and Efimoff, Viatcheslav V. (to Titanium Alloy Manufacturing Co.), Powdered Titanium Metal: U. S. Patent 2,273,834, February 24, 1942.

WORLD PRODUCTION

The United Nations controlled most of the known commercial deposits of titanium in 1942. The Axis countries had access only to mines in Norway and Malaya, unless in addition neutral Portugal sold ore to the Nazis or collaborationist Vichy France contributed material from Senegal. Cameroun concentrates, under protection of the Fighting Free French, were shipped to Great Britain and the United States. Available data on world production of ilmenite and rutile in recent years are shown in the following table.

World production of titanium concentrates (ilmenite and rutile), 1937–42, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942
Ilmenite:						
Australia:						
New South Wales	681	(1)	742	2,270	4,808	(1)
Queensland					254	(1)
Brazil (exports)	234	317	10	12	4,471	(1)
Canada	3,836	188	3,351	4,114	11,477	4,768
Egypt	317	90	(1)	(1)	2	(1)
Federated Malay States (exports)	6,290	6,462	11,098	2,596	(1)	(1)
India, British	182,142	256,268	(1)	[2] 243,850	(1)	(1)
Norway	84,209	62,724	55,027	(1)	(1)	[2] 60,000
Portugal	1,456	568	409	399	798	(1)
Senegal	3,075	8,436	(1)	5,798	895	(1)
United States	(3)	(3)	13,247	18,750	21,135	(3)
Rutile:						
Australia:						
New South Wales	[4] 1,141	[4] 460	790	2,044	4,440	(1)
Queensland					254	(1)
South Australia		8	2	2	(5)	(1)
Brazil (exports)	377	488	489	499	2,369	4,615
Cameroun (French)	103	118	[6] 159	(1)	(1)	(1)
Norway	187	124	166	(1)	(1)	(1)
South-West Africa	16				(1)	(1)
United States	(3)	(3)	(3)	2,620	2,839	2,402

[1] Data not available.
[2] Subject to revision.
[3] Bureau of Mines not at liberty to publish figures.
[4] In addition, zircon-rutile-ilmenite concentrates were produced as follows—1937: 73 tons; 1938: 98 tons.
[5] Less than 1 ton.
[6] Exports.

Algeria.—The Keddaradans mine, Palestro district, produced 1,475 metric tons of titanium-zirconium concentrates in the first 4 months of 1942.

Australia.—Mixed rutile-ilmenite-zircon concentrates are produced in New South Wales by Porter & Derrick at Cudgen Headlands, by Metal Recoveries Pty., Ltd., at New Brighton, and by Zircon Rutile, Ltd., at Byron Bay; and in Queensland by Minerals Deposit Syndicate at Little Burleigh. Most of the concentrates are exported in mixed form to the United States; the output of the first-named company goes to the Titanium Alloy Manufacturing Co., of the second to International Titanium Corporation, and of the other two largely to Orefraction, Inc. A little rutile is also produced at Williamstown, South Australia. Some titanium concentrates are consumed in Australia by the Broken Hill Proprietary Co., Ltd., in making ferrotitanium.

Brazil.—Production of rutile in Brazil in 1941 was estimated at 2,500 metric tons, principally from Goyaz, Ceara, and Minas Gerais. Concentrates average 70 to 95 percent TiO_2, the higher grades bringing $170 a ton, f. o. b. shipping port.[9] Mining conditions were described.[10]

Cameroun (French).—Rutile exports from French Cameroun in January 1940 were 51 metric tons.

Canada.—Ilmenite is produced at St. Urbain, Quebec. Following an announcement by the Quebec Bureau of Mines that field work indicated favorable opportunities for ilmenite in the Romaine River area, Saguenay County,[11] a massive deposit of ilmenite containing about 37 percent TiO_2 and 53 percent FeO was discovered at Allard Lake, southwest of Havre-St. Pierre, by the Vital Metals Prospecting Syndicate.[12]

India.—Sands of the Malabar coast, State of Travancore, have been the world's principal source of ilmenite; they also yield rutile, zircon, and monazite. Ilmenite production was about 5,100 metric tons in August 1942, compared with a monthly capacity of 32,000 tons, and stocks on hand were 93,400 tons—due primarily to unavailability of cargo space to the United States. There were no inventories of rutile at that time, and the monthly output of 230 metric tons was expected by March 1943 to reach 380 tons, most of which was under contract to the British Ministry of Supply. Ilmenite cost about $5 a long ton, f. o. b. Cochin, but the freight rate to the United States was $28. The three companies that produce titanium concentrates from beach sands are the Travancore Minerals Co., Ltd., Hopkins & Williams (Travancore), Ltd., and F. X. Pereira & Sons (Travancore), Ltd.

Spain.—Plans have been made for the erection of a plant near Gijon, Asturias District, to produce ferrotitanium and other ferroalloys.[13] Workable beach deposits of ilmenite occur in the nearby Districts of Galicia and Coruna and also in the Balearic and Canary Islands.[14]

United Kingdom.—Sales of rutile were subjected to official control May 1, 1942, but legitimate consumers were permitted to order as much as 3 months' requirements at a time.[15] Prices of rutile, f. o. b. consumers' works, were fixed at £54 a long ton for Cameroun concentrates, £42–£50 for Indian concentrates, and £45 for Australian concentrates, according to Metal Bulletin. Indian ilmenite, 52–54 percent TiO_2, was quoted at 28–30 s. per long ton, f. a. s., at the end of 1942.

[9] Wright, Charles Will, Brazil's Strategic Mineral Resources: Min. Cong. Jour., vol. 28, No. 10, October 1942, pp. 38–43.
[10] Foote-Prints, Brazilian Rutile Goes to War: Vol. 15, No. 1, August 1942, pp. 2–8.
[11] Canadian Mining Journal, vol. 63, No. 4, April 1942, p. 272.
[12] Northern Miner, New Ilmenite Show Looks Big: Vol. 28, No. 27, September 24, 1942, p. 9.
[13] Metal Bulletin (London), No. 2709, July 14, 1942, p. 12.
[14] Mining Journal (London), vol. 218, No. 5578, July 18, 1942, p. 29.
Metal Bulletin (London), No. 2710, July 17, 1942, p. 3.
[15] Metal Bulletin (London), No. 2690, May 5, 1942, p. 9.

MINOR METALS

By Allan F. Matthews[1]

SUMMARY OUTLINE

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Beryllium	819	Indium	825
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Columbium and tantalum	823	Thallium	829
Germanium	825	Zirconium	829

BERYLLIUM

Beryl requirements for 1943 were estimated at 7,000 short tons by the War Production Board and at 5,000 tons by the Army and Navy Munitions Board. Beryllium in all forms was placed under import control May 4, 1942 (amendment to Order M–63), by the War Production Board and under complete allocation June 1, 1942 (Order M–160). Copper scrap containing 0.1 percent or more Be was directed to be delivered only to companies specifically authorized by the War Production Board, effective March 1, 1943 (Order M–9–b).

Domestic mine production.—Mine shipments of beryl (beryllium concentrates) increased 70 percent in 1942 compared with 1941 and were the largest on record. Beryl is produced in several Western and New England States as a byproduct in mining feldspar, mica, and other pegmatite minerals. Pennington and Custer Counties in the Black Hills of South Dakota furnished 76 percent of the United States total in 1942 compared with 96 percent in 1941.

Beryl (beryllium concentrates) shipped from mines in the United States, 1938–42

Year	State	Mine shipments		
		Short tons	Value	
			Total	Average per ton
1938	Maine	25	$770	$30.80
1939	Colorado, Maine, South Dakota	95	2,720	28.62
1940	do	121	3,721	30.75
1941	Maine, New Hampshire, South Dakota, Wyoming	158	7,300	46.20
1942	Colorado, Maine, New Hampshire, South Dakota	269	24,188	89.92

Prospecting for beryllium ore was very active in 1942. Most promising is a deposit of helvite (sulfosilicate of manganese, iron, and beryllium) at Iron Mountain, Sierra and Socorro Counties, N. Mex., which was examined in some detail by the Bureau of Mines and Geological Survey and found to contain about a million tons of ore averaging 0.4 percent BeO. This quantity is equivalent to some 35,000 tons of beryl, but its availability depends upon development of suitable concentration methods—a problem now being investigated by the Bureau of

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

Mines and private interests. During 1942 the Bureau of Mines and the Geological Survey examined beryl deposits in Colorado, Connecticut, Idaho, Maine, New Hampshire, South Dakota, and Virginia. Of 131 pegmatites studied in New Hampshire, 61 were found to contain some beryl.[2] A search for additional sources of beryl in the Black Hills was begun by the South Dakota School of Mines under sponsorship of the General Electric Co., Schenectady, N. Y.

Domestic alloy and compound production.—Beryllium-copper master alloys are made by the Beryllium Corporation of Pennsylvania, Reading, Pa., and by the Brush Beryllium Co., Cleveland, Ohio. Clifton Products, Inc., Painesville, Ohio, a producer of oxide, will enter the alloy field in 1943. The facilities of these three companies are being expanded by commitments of $1,900,000, $615,000, and $200,000, respectively, by the Government-owned Defense Plant Corporation. In addition, the Reconstruction Finance Corporation is loaning $500,000 to the Beryllium Corporation of Pennsylvania. Metallic beryllium and beryllium compounds are produced by the Brush Beryllium Co. The Calloy Co., Harbor City, Calif., made some test runs on beryllium oxide early in 1942 but had no commercial output during the year. Recent patents on beryllium production have been summarized.[3]

Foreign trade.—Beryl imports declined 27 percent in 1942 compared with 1941, primarily as a result of an Argentine embargo in effect most of the year. Two-thirds of the 1942 imports were entered in January and December. Exports in 1942 comprised 1,531 pounds of beryllium concentrates, 25,256 pounds ($24,882) of alloys and metal, and 4,778 pounds ($9,274) of compounds.

Beryl imported for consumption in the United States, 1938–42, by countries, in short tons

Country of origin	1938	1939	1940	1941	1942
Argentina	78	384	422	861	701
Brazil		75	377	1,805	915
India and Dependencies (British India)	58				282
Union of South Africa	10		6		38
Total:					
Short tons	146	459	805	2,666	1,936
Value	$5,990	$14,574	$23,865	$143,992	(1)
Average per ton	$41.03	$31.75	$29.65	$54.01	(1)

[1] Data not available.

Stocks.—Inventories of beryl held by the principal miners, dealers, and consumers in 1942 declined from 2,200 short tons January 1 to 1,400 tons December 31. In addition, the Government-owned Metals Reserve Co. began stock-piling beryl in the third quarter and had 725 tons on hand at the end of the year.

Prices.—Beryl prices continued to climb in 1942, and 10- to 12-percent material brought $75–$100 a short ton. Beryllium-copper master alloy (4 percent Be) continued to be quoted at $15 per pound of contained Be by one producer but was listed at $17 by the other. Beryllium metal, 96 percent, was quoted at $47 a pound and beryllium-aluminum at $40 per pound of contained Be, according to American Metal Market.

[2] Olson, J. C., Mica-Bearing Pegmatites of New Hampshire: Geol. Survey Bull. 931–P, 1942, pp. 363–403.

[3] Light Metals (London), Recent Inventions Relating to Beryllium Alloys: Vol. 5, No. 56, September 1942, pp. 361–363.

Uses.—The principal application of beryllium is in beryllium-copper alloys (0.1–3.5 percent Be; 0–2.6 percent Co, Cr, or Ag; remainder Cu) fabricated into instrument springs, diaphragms, motor parts subject to wear, and low-sparking tools. Beryllium hardens copper and increases its tensile properties without greatly decreasing electrical conductivity. Beryllium-copper springs have a large amplitude of movement combined with remarkable freedom from elastic drift—properties that enable them to retain stable springiness to a much greater degree than springs made of any other available corrosion-resistant material.[4] Beryllium oxide is used in white fluorescent lamps and special refractories and the metal[5] as windows in X-ray tubes. Interest in beryllium-aluminum continues, but certain fabricating difficulties remain to be solved. Some raw beryl is ground for use in ceramics.

Foreign production.—Argentine beryl output comes from the Provinces of Córdoba and San Luis, but the reserves of the largest producer (Las Tapias mine in Córdoba) are approaching exhaustion. To assure an adequate ore supply for the beryllium oxide-carbonate plant of Sociedad Anonima Berilo Argentina, Juan Ortiz, Province of Santa Fé, an embargo was placed on beryl early in 1942, but the plant experienced operational difficulties and consumed little ore, so the embargo was lifted October 7. Brazilian beryl comes principally from the States of Paraiba and Rio Grande do Norte. A beryl deposit in the Karibib area of South-West Africa was opened in March 1941 by Jooste Lithium Mines, Ltd. Occurrences of beryl in South Africa and Canada have been described.[6] The Beryllium Smelting Co., Ltd., London, was formed in June 1942 "to carry on business of refiners and smelters of beryllium and beryllium compounds."

World production of beryl, 1936–42, by countries, in metric tons [1]

Country [1]	1936	1937	1938	1939	1940	1941	1942
Argentina	300	260	753	299	520	1,986	[2] 784
Australia, Western				6	2	[3]	[3]
Brazil (exports)	4		203	276	1,472	1,703	[4] 963
Canada (estimate)	18	18	9	161	[3]	[3]	[3]
India, British	89	24	15	9	[3]	[3]	[3]
Madagascar (estimated exports)	10	2	2	[3]	[3]	[3]	[3]
Portugal	2	21	[2] 265	[3]	[3]	[3]	[3]
South-West Africa	[3]	[3]	[3]	[3]	[3]	20	[3]
Union of South Africa (estimate)	5	[3]	[3]	[3]	[3]	[3]	[3]
United States (mine shipments)	[3]	68	23	86	110	143	244

[1] In addition to countries listed, beryl may also be produced in France, Italy, Norway, Portuguese East Africa, Rumania, and U. S. S. R.
[2] Exports.
[3] Data not available.
[4] January to September, inclusive.

BORON

Boron was a metallurgical hit of 1942, virtually assuring itself high rank in future among the conventional ferro-alloy elements. The effect of boron on steel is to increase hardenability (depth of hardness); greater ultimate strength and elastic limit are also ob-

[4] Carson, Robert W., Springs of Beryllium Copper: Aero Digest, vol. 41, No. 1, July 1942, pp. 150, 153, 272–273.
[5] Claussen, G. E., and Skehan, J. W., Malleable Beryllium: Metals and Alloys, vol. 15, No. 4, April 1942, pp. 599–603.
[6] Chubb, W. F., Beryllium—Its Economics and Technology: Light Metals (London), vol. 5, No. 52, May 1942, pp 156–164.

tained.[7] Boron additions of 0.003 percent can substitute for 1 percent nickel, 0.3 percent chromium, 0.2 percent manganese, 0.12 percent vanadium, or 0.1 percent molybdenum.[8] Thus, the incorporation of boron in NE (National Emergency) steels enables the quantities of strategic metals used to be reduced without impairing quality. Not a new discovery, boron in steel has been adopted as a result of fuller realization that only quantities as small as 0.001 to 0.003 percent give optimum results and that much excess causes hot shortness and produces brittle steel. Boron is introduced as ferroboron (10–20 percent B), boron-silicon (Borosil), or one of a series of complex alloys (0.2–2 percent B) such as Grainal, Bortam, Carbortam, Silvaz, or Silcaz.

In cast iron 0.02–0.12 percent boron reportedly increases hardness, refines the grain, and improves wearing qualities, although it also reduces malleability. Boron is a strong deoxidizer, and its use to remove oxygen and nitrogen from copper alloys is said to increase the mechanical soundness and electrical conductivity of castings.

Salts of boron are discussed in the Magnesium Compounds and Miscellaneous Salines chapter of this volume.

CALCIUM

Production of calcium metal was increased in 1942 by the principal producer—the Electro Metallurgical Co., Sault Ste. Marie, Mich. The metal was informally placed under Government allocation control at the beginning of 1943, and a conventional War Production Board order was expected by the middle of the year. Calcium-silicon was subjected to direct allocation by the Office of Production Management July 29, 1941 (Order M–20), which was revised November 29, 1941 (Order M–20–a), and extended indefinitely May 30, 1942 (Amendment 1). Calcium-silicon was imported from Canada in 1942 and from France in 1941. Calcium metal, 97–98 percent, ton lots, continued to be quoted at $1.25 a pound in 1942. According to Canadian Metals & Metallurgical Industries, calcium-silicon, ton lots, was 16½ cents a pound, f. o. b. Welland, Ontario. Metallic calcium, calcium-silicon, and other calcium alloys are used primarily in deoxidizing steel.[9] Additions of up to 0.25 percent calcium in some magnesium castings reduce the heat-treating time and result in an improved surface.

Calcium metal and calcium-silicon imported for consumption in the United States, 1938–42

Commodity	1938		1939		1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Calcium metal	41,299	$16,144	41,718	$17,758	11,900	$6,518				
Calcium-silicon	1,402,314	77,003	3,972,571	225,312	2,131,758	154,424	111,994	$8,337	60,300	$10,144

[7] Comstock, George F., Effects of Eight Complex Deoxidizers on Some 0.40-Percent Carbon Forging Steels: Trans. Am. Inst. Min. and Met. Eng., vol. 150, 1942, pp. 408–420. Metals Technol., vol. 9, No. 1, January 1942, Tech. Pub. 1417, 13 pp.
Lippert, T. W., Boron: Iron Age, vol. 150, No. 21, November 19, 1942, pp. 41–44.
Tisdale, Norman F., Boron—A New Vitamin for Steel and Cast Iron: Metal Progress, vol. 41, No. 3, March 1942, pp. 330–331.

[8] Tisdale, Norman F., Boron Steels Increasingly Favored: Iron Age, vol. 151, No. 5, February 4, 1943, pp. 40–44.

[9] Einerl, Otto, and Neurath, Frederic, The Alkaline Earth Metals and Their Alloys—Increasing Technical Importance: Chem. Age (London), vol. 47, No. 1205, August 1, 1942, pp. 107–111.
Sanderson, L., Calcium: Canadian Min. Jour., vol. 63, No. 12, December 1942, pp. 779–780.

CERIUM

Ferrocerium, the principal pyrophoric (sparking) alloy, was in strong demand during 1941 and 1942 as a constituent of cigarette lighters for our armed forces and particularly for export to the United Kingdom under Lend-Lease agreement. The supply was provided by the Cerium Metals Corporation (formerly American Treibach Chemical Works), Niagara Falls, N. Y., and by Shawinigan Chemicals, Ltd., Shawinigan Falls, Quebec, Canada. Imports of cerium alloys from Canada, only foreign source since the outbreak of war, totaled 11,573 pounds ($65,549) in 1942 compared with 20,190 pounds ($90,948) in 1941 and 462 pounds ($1,611) in 1940. Exports of cerium alloys and metal were 26,016 pounds ($84,739) in 1942. Cerium metal was quoted by Metal Bulletin (London) at £7 5s. a pound and the 52-percent alloy at 35s. a pound at the close of 1942. Ferrocerium is used in cigarette lighters and acetylene-welding torches and as a metallurgical refining agent. Cerium metal finds application in the evacuation of radio tubes. The principal ore of cerium is monazite, described in the Minor Nonmetals chapter of this volume.

COLUMBIUM AND TANTALUM

Columbium (niobium) and tantalum ores were placed under import control by the War Production Board April 9, 1942 (Amendment 4, Order M–63). Full allocation control of tantalum in all forms was instituted May 22, 1942 (Order M–156), and of ferrocolumbium March 25, 1943 (Order M–296). Columbium and tantalum ores (columbite and tantalite) are invariably mixtures, designated one or the other depending on the relative content of Cb_2O_5 and Ta_2O_5. The Government stock pile held by the Metals Reserve Co. included no columbite but 427,756 pounds of tantalite at the end of 1942 and 1,016 pounds of columbite and 321,867 pounds of tantalite March 8, 1943.

Domestic production.—Some 1,000 pounds of tantalite-columbite was produced in South Dakota and Wyoming in 1941–42, but only 200 to 250 pounds was shipped each year. The sole domestic producer of ferrocolumbium is the Electro Metallurgical Co., Niagara Falls, N. Y., and the principal producer of tantalum metal and compounds is the Fansteel Metallurgical Corporation, North Chicago, Ill. Adjunctive to its original plant, the latter company in the name of its subsidiary—the Tantalum Defense Corporation—is erecting facilities for which the Government-owned Defense Plant Corporation has provided $4,225,000.

Tantalite shipped from mines and columbite and tantalite imported for consumption in the United States, 1938–42

Year	Mine shipments of tantalite [1]		Imports			
			Columbite		Tantalite	
	Pounds	Value	Pounds	Value	Pounds	Value
1938	36,189	$35,127	645,141	$228,078	41,706	$80,092
1939	340	200	109,132	37,062	56,561	82,990
1940			595,220	210,526	490,460	258,514
1941	250	[2] 219	1,440,455	504,537	403,464	188,936
1942	[2] 200	[2] 175	1,762,355	608,917	575,799	481,230

[1] Includes some columbite. [2] Revised estimate. [3] Subject to revision.

Foreign trade.—Columbite imports comprised 1,724,800 pounds from Nigeria, 36,422 from Belgian Congo, and 1,133 from Brazil in 1942; and 1,435,312 pounds from Nigeria, 2,914 from Argentina, and 2,229 from Brazil in 1941. Tantalite imports included 309,843 pounds from Belgian Congo, 224,835 from Brazil, 18,971 from Southern Rhodesia, 17,380 from India, and 3,300 from Canada in 1942; they totaled 161,996 pounds from Brazil, 146,904 from Belgian Congo, 64,773 from South-West Africa, 29,574 from Australia, and 217 from the Union of South Africa in 1941. Exports in 1942 comprised 200 pounds ($277) of ferrocolumbium, 266 pounds ($18,475) of tantalum metal and alloys, and 179 pounds ($2,595) of tantalum compounds.

Prices.—Columbite (about 65 percent) was selling at 50–56 cents per pound of contained Cb_2O_5 early in 1943. The Metals Reserve Co. purchased tantalite during 1942 at $1.25 per pound of contained Ta_2O_5 for 40-percent material, $1.75 for 50-percent, $2.15 for 60-percent, and $2.60 for 70-percent material. Ferrocolumbium, 50–55 percent, was quoted by Metal and Mineral Markets at $2.25–$2.30 per pound of contained Cb, f. o. b. Niagara Falls. Columbium metal continued to be listed at $227–$254 a pound and tantalum metal at $65–$73 a pound.

Uses.—The addition of 0.5 to 0.8 percent columbium to stainless steels[10] has been found to improve weldability, creep strength, and impact strength. One application is aircraft exhaust stacks, manifolds, and collector rings. Tantalum is used principally in electronic tubes and carbide tools and as a catalyst in producing butadiene synthetic rubber. Smaller quantities go into corrosion-resistant equipment for chemical plants and into aerial camera lenses. The glass for these lenses is a mixture of tantalum, tungsten, lanthanum, and boron oxides without silica and combines high refractivity and low dispersion, resulting in a lense that can be used at high altitudes with no loss of definition or coverage. Tantalum metal is recommended for skull plates.[11]

Foreign production.—Nigeria produced 623 metric tons of columbite and exported 862 tons in the first 9 months of 1942, according to the War Production Board. The Jantar Nigeria Co., Ltd., principal producer, mined 424 metric tons of columbite and shipped 711 tons during the year ended September 30, 1942; proved ore reserves at that time were 4,800 tons, and the expected output for the 1943 fiscal year was 500 tons, all under contract to American buyers.[12] A pilot plant for producing columbium oxide has been built in England.[13] Belgian Congo was producing about 11 metric tons of tantalite monthly in mid-1942, according to the War Production Board. Brazilian exports of tantalite-columbite were stated by the Board of Economic Warfare to be 94 tons in 1941. Moneta Mines, Ltd., opened a tantalite deposit in 1942 between Malartic and Amos, Quebec, Canada.[14]

[10] Clark, C. L., Influence of Columbium or Titanium Additions to 5 Cr-Mo Steel: Oil and Gas Jour., vol. 40, No. 27, April 2, 1942, pp. 39–41; No. 50, April 23, 1942, p. 72.
Riegel, Emil Raymond, Industrial Chemistry: Reinhold Publishing Corporation, New York, 4th ed., 1942, pp. 799, 818–819.

[11] Pudenz, Lieut. (j.g.) Robert H., The Repair of Cranial Defects with Tantalum: Jour. Am. Med. Assoc., vol. 121, No. 7, February 13, 1943, pp. 478–481.

[12] Metal Bulletin (London), No. 2755, December 29, 1942, p. 12.

[13] Horne, W. P., A Note on the Experimental Production of Mixed Oxides of Tantalum and Niobium from Nigerian Columbite: Bull. Inst. Min. and Met. (London), No. 458, January 11, 1943, 5 pp.

[14] Canadian Min. Jour., vol. 63, No. 9, September 1942, p. 614.

GERMANIUM

Germanium in small quantities (often about 0.01 percent) occurs in zinc and copper ores, but it has never been recovered on a commercial scale in the United States. A pilot plant erected by the Eagle-Picher Mining & Smelting Co., Henryetta, Okla., to treat cadmium by-products yielded small quantities of germanium metal, oxide, and chloride during 1942. Uses for germanium are reported occasionally, but none have appeared sufficiently promising to induce the War Production Board to stimulate domestic production or importation from South-West Africa of a quantity of germanium residue obtained as a byproduct of smelting Tsumeb copper-lead-zinc ores. Germanium metal was quoted by suppliers of rare metals at $3–$5 a gram in New York and 19s. 6d. a gram in London at the close of 1942, but commercial grades were available at lower prices.

INDIUM

Domestic production.—Indium metal production in the United States in 1942 increased several-fold over 1941. Virtually the entire 1942 output—byproduct of zinc and lead operations—was produced by the Anaconda Copper Mining Co., although the Eagle-Picher Mining & Smelting Co. had a small pilot-plant yield. Some indium has been produced in past years by the American Metal Co., Ltd., American Smelting & Refining Co., and National Zinc Co., Inc., and these companies marketed some metal from stock during 1942. The Indium Corporation of America, principal distributor, owns a property near Kingman, Mohave County, Ariz., where there is reputedly blocked out 50,000 tons of zinc ore averaging about 2 troy ounces of indium per ton. The increasing demand for indium is expected to result in early exploitation of this deposit.[15]

Prices.—The price of indium metal, commercial grade (98 percent), according to Metal and Mineral Markets was $12.50 a troy ounce during most of 1942 but was reduced to $10 an ounce ($146 an avoirdupois pound), effective December 23. Electrolytic-grade indium (99.9 percent) was reduced on the same date from $30 to $15 an ounce.

Uses.—Cadmium-nickel and copper-lead bearings for aircraft, truck, and marine engines are coated with indium to resist the corrosive action of acids in lubricants, and this application absorbed most of the indium consumed in 1942. The life of bronze bearings in a certain heavy-duty screw machine was lengthened greatly by indium treatment. Additions of 1 to 2 percent indium to lead-silver solders improve coverage, spreadability, and bonding strength.[16] In general, indium coatings 0.0005 to 0.001 inch thick on nonferrous metals improve resistance to corrosion and abrasion and present a lustrous finish.

Foreign production.—The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, British Columbia, began to produce indium in 1941. Indium has also been produced commercially in Germany, Belgium, and possibly Japan and U. S. S. R.

LITHIUM

Production facilities for lithium metal were greatly expanded during 1942. Nevertheless, supply could not pace demand, so the War

[15] Ludwick, M. T., Indium: Steel, vol. 111, No. 19, November 9, 1942, pp. 80–81, 122–124.
[16] Metal Finishing, Indium Solders: Vol. 40, No. 11, November 1942, pp. 594, 596.

Production Board instituted allocation control of the metal and compounds September 1 (Order M–191) and of the ores December 5 (Order M–253). Lithium ores are discussed in the Minor Nonmetals chapter of this volume. Lithium has a strong affinity for gases and impurities in molten metal, and its addition to copper-base alloy melts in the form of lithium-copper (2 percent Li), lithium-zinc (2 percent Li), or lithium-calcium (50 percent Li) results in sounder castings and higher conductivity. The use of lithium as a scavenger in cast iron and steel is also developing. Lithium in small quantities (0.04–0.1 percent) is reported to improve the physical properties of various lead, zinc, aluminum, and magnesium alloys. Addition of 0.12 percent lithium to a silver brazing solder increased fluidity, strength, and melting properties.[17] Lithium metal, 98–99 percent, 100-pound lots, was quoted at $15 a pound throughout 1942, according to Metal and Mineral Markets.

RADIUM AND URANIUM

Industrial radiography absorbed over half of the new supply of radium in 1942, and most of the rest went into luminescent paints. There were virtually no Government controls on the delivery, price, or use of radium and uranium in the United States in 1942; but effective January 26, 1943, the War Production Board prohibited the use of uranium in ceramics (Order M–285). Research on uranium progressed appreciably in 1941–42, and in the interest of secrecy the War Production Board relinquished to the War Department the supervision of supply and distribution.

Domestic production.—Carnotite is mined in Arizona, Colorado, and Utah for recovery of vanadium, radium, and uranium.[18] Grinding tests on these ores were conducted recently by the Bureau of Mines.[19] Increased production of vanadium has yielded large quantities of uranium in concentrates and tailings, but it is not known to what extent these have been processed. The domestic output of radium in 1942 was 2.6 grams, all refined by the Vitro Manufacturing Co., Pittsburgh, Pa. The S. W. Shattuck Chemical Co., Denver, Colo., devoted its facilities principally to molybdenum compounds and thus produced no radium. The two companies had material in stock at the end of 1942 containing about 1 gram of radium each. These companies and the Vanadium Corporation of America (Naturita, Colo.) are producers of uranium compounds.

Foreign trade.—All the radium, radioactive substitutes, and uranium imported in 1941–42 came from Canada, except entries of 100 milligrams of radium from Belgium (originally) and 525,559 pounds of uranium ore from Belgian Congo in 1942 and 53,090 pounds of uranium compounds from Belgian Congo in 1941. Exports in 1942 comprised 1,245 grams ($58,997) of radium-bearing compounds, 2 milligrams ($8) of mesothorium compounds, 543 grams ($1,076) of uranium concentrates, and 426 pounds ($1,827) of uranium compounds.

[17] Hensel, F. R., Larsen, E. I., and Swazy, E. F., A Lithium-Bearing Silver Solder: Metals and Alloys, vol. 15, No. 6, June 1942, pp. 962–965.

[18] Fischer, Richard P., Vanadium Deposits of Colorado and Utah—A Preliminary Report: Geol. Survey Bull. 936–P, 1942, pp. 363–394.
Kelly, Sherwin F., Geological Studies of Vanadium-Uranium Deposits by Geophysical Exploration Methods: Min. Cong. Jour., vol. 27, No. 8, August 1941, pp. 27–35.

[19] Shelton, S. M., and Engel, A. L., Progress Reports—Metallurgical Division. 55. Dry Differential Grinding Tests of Carnotite Ores: Bureau of Mines Rept. of Investigations 3636, 1942, 32 pp.

Radium salts, radioactive substitutes, and uranium ore and compounds imported for consumption in the United States, 1938–42

Year	Radium salts			Radioactive substitutes (value)	Uranium ore		Uranium oxide and salts	
	Grams	Value			Pounds	Value	Pounds	Value
		Total	Average per gram					
1938	38.75	$787,025	$20,300	$5,746	----------	----------	376,708	$520,540
1939	78.631	1,953,820	24,800	966	5	$10	1,439,324	1,197,786
1940	30.311	748,097	24,700	5,650	2,400,198	2,110,927	240,199	388,355
1941	4.412	110,202	25,000	13	----------	----------	387,505	501,370
1942	23.043	377,326	16,400	50	541,307	806,919	377,398	851,098

Prices.—Radium was nominally quoted at $25 a milligram during 1942. Some sales at $25–$27.50 were reported, but probably most were nearer $20 a milligram. Orange or yellow uranium oxide and sodium uranate were listed by Glass Industry unchanged at $1.65 a pound during 1942; black uranium oxide was quoted at $2.55 a pound until December, when the price was reduced to $2.15.

Uses of radium.—Most of the radium in current use is for the treatment of cancer and skin diseases. However, over half of the new supply is employed in radiographic inspection of castings, forgings, and welds. In many instances of both medical and industrial radiography, radium emanations and X-rays can be utilized interchangeably. Radium coatings on watches, gun sights, compasses, and other instrument dials permit observation in the dark. Radium and beryllium mixtures project neutrons for petroleum exploration [20] and scientific research. The number of radioactive specimens tested annually by the National Bureau of Standards gives some index as to demand. Such specimens contained 16,408 milligrams of radium and 2,139 milligrams of mesothorium in 1942 compared with 19,928 and 1,451 milligrams, respectively, in 1941. Mesothorium is a radium substitute obtained from monazite residues. The National Bureau of Standards recently outlined safe practices in handling radioactive compounds in the dial-painting industry (Handbook 27) and gave suggestions for the protection of radium during air raids (Handbook 38). Polonium, a byproduct of radium, is a radioactive element used in spark plugs.[21]

Uses of uranium.—The principal peacetime outlet for uranium is as a colorant in ceramics, but this use was prohibited in January 1943 to assure ample supplies for research on uranium isotope 235 as a source of energy [22] and for consumption in special steels, luminescent paints, photographic reagents, and other chemicals.

Foreign production.—Eldorado Gold Mines, Ltd., reopened its pitchblende mine at Great Bear Lake, Northwest Territories, Canada,[23] in 1942 after a 2-year shut-down. Its refinery at Port Hope, Ontario, continued to operate during the interim on accumulated concentrates and in 1942 reportedly ran close to its capacity of 8 or 9

[20] Pontecorvo, Bruno, Neutron Well Logging—A New Geological Method Based on Nuclear Physics: Oil and Gas Jour., vol. 40, No. 18, September 11, 1941, pp. 32–33.
[21] Dillon, J. H., and Street, J. W., Large-Scale Extraction of Polonium from Active Lead and Formation of Radioactive Electrode Alloys: Jour. Appl. Physics, vol. 13, No. 3, March 1942, pp. 189–198.
[22] De Ment, Jack, and Dake, H. C., Uranium and Atomic Power: Chemical Publishing Co., Inc., Brooklyn, 1941, 335 pp.
[23] Camsell, Charles, Discovery and Development of Radium at Great Bear Lake: Jour. Franklin Inst., vol. 233, No. 6, June 1942, pp. 545–557.

grams of radium and 40 short tons of uranium compounds monthly. The radium-uranium mine in Belgian Congo, owned by Union Minière du Haut Katanga, remained inoperative in 1942, although a few hundred tons of ore were shipped from stock to the United States. British-owned Urgeirica Radium, Consolidated, produced all of Portugal's output in 1941—330 metric tons of uranium ore (1–1.8 percent U_3O_8) and 772 kilograms of radioactive barium sulfate containing 5.8 grams of radium.

SELENIUM AND TELLURIUM

Domestic production.—Selenium and tellurium production declined 18 and 0.2 percent, respectively, in 1942 compared with 1941, and producers' shipments slumped more than 50 percent. Thus, in 1942 producers maintained their output relatively close to the 1941 peak even in face of a drastic decline in demand, hoping, apparently, that current uses would expand or that the shortage of common metals would promote development of new uses for selenium and tellurium and thereby provide an outlet for their mounting stocks. Some tellurium is a byproduct of lead, but all the selenium and most of the tellurium recovered come from the tank slimes of electrolytic copper refineries. Annual plant capacity for selenium and tellurium production is approximately 750,000 and 300,000 pounds, respectively, but actual capacity for the former is limited by the availability of selenium slimes.

Salient statistics of elemental selenium and tellurium in the United States, 1938–42

Year	Selenium					Tellurium [1]		
	Production (pounds)	Producers' sales [2] (pounds)	Producers' stocks at end of year (pounds)	Imports [3]		Production (pounds)	Producers' sales [2] (pounds)	Producers' stocks at end of year (pounds)
				Pounds	Value			
1938	225,674	166,494	365,400	101,034	$163,598	11,076	26,944	77,300
1939	227,131	345,726	246,800	124,830	193,168	25,234	63,431	39,100
1940	328,731	368,709	206,800	134,429	198,163	85,622	88,996	35,700
1941	620,493	681,650	146,000	197,873	288,161	224,639	239,983	20,400
1942	506,426	316,613	341,900	83,666	127,004	224,132	98,798	145,700

[1] Includes tellurium content of small quantity of oxide.
[2] Bureau of Mines not at liberty to publish value. Quantities for 1942 represent producers' shipments.
[3] Includes selenium salts.

Foreign trade.—Except for an unspecified quantity valued at $5 from the United Kingdom in 1942, all selenium imports in 1941–42 came from Canada. Tellurium is not shown in import statistics, except in combination with other commodities. Producers reported exporting 5,550 pounds of selenium (including Se content of compounds) and 150 pounds of tellurium in 1942 compared with 23,169 pounds of selenium and no tellurium in 1941. Dealers doubtless exported additional quantities.

Prices.—The base price of selenium (black powdered, 99.5 percent) and of tellurium continued to be $1.75 a pound throughout 1942. Glass Industry quoted barium selenite and sodium selenite at $1.40–$1.65 a pound.

Uses.—The largest consumer of selenium is the glass industry, which uses it as a red colorant and (in smaller additions) as a

decolorizer. Most of the tellurium supply and some selenium are added to rubber cable coverings to promote resistance to heat, oxidation, and abrasion and to increase resilience. Additions of selenium and tellurium improve the machinability of stainless steels and copper alloys.[24] Formerly made of silver-plated brass, cable connectors of tellurium-copper (combining high machinability and electrical conductivity) are going into aircraft, torpedo boats, tanks, and trucks.[25] Coatings of red selenium on magnesium alloys to resist attack by sea water have found considerable application in Europe. Cadmium sulfoselenide pigments (red, maroon, and orange) were in wide use until the cadmium shortage. Tellurium toughens lead and is now substituting for chromium in the development of wear-resistant surfaces on gears, wheels, and other cast-iron products. Uses of selenium and tellurium are described in a comprehensive paper by several research men at Battelle Memorial Institute.[26]

THALLIUM

Thallium output was stepped up in 1942 by the sole domestic producer, the American Smelting & Refining Co., which recovers the metal as a byproduct of zinc-cadmium operations at its Globe refinery, Denver, Colo. Thallium has been produced in Belgium, France, Germany, and Poland, and cessation of imports from these countries has resulted in a shortage of thallium in the United States. Thallium metal is quoted at $10 a pound by Metal and Mineral Markets and sulfate at $5–$7 a pound by Oil, Paint and Drug Reporter. Most of the thallium supply is consumed in the form of sulfate, an odorless, tasteless poison used in rodent and ant control. Consumption of thallium sulfate was 3,500 pounds in 1942, according to an estimate by the Department of Agriculture. Thallium oxysulfide is sensitive to wave lengths in the infrared and is therefore useful in "dark signaling." Thallium-lead alloys containing 3–65 percent Tl are among the most insoluble alloys known.

ZIRCONIUM

No use or price control was imposed on zirconium in 1942, but the War Production Board placed the concentrates under import control December 27, 1941 (Order M–63). The Government-owned Metals Reserve Co. began stock-piling zirconium concentrates in 1942 and by the end of the year had on hand 4,590 short tons of zircon and 4,156 tons of baddeleyite. The Government purchased zircon only as an inducement to processors to increase the supply of rutile obtained from Australian mixed zircon-rutile concentrates.

Domestic production.—Zircon production in the United States amounted to a few hundred tons in 1942 compared with somewhat smaller quantities in 1941 and 1940, no output in 1929–39, and 3,646 short tons in 1927. The only domestic producer at present is the Riz Mineral Co., which recovers zircon as an accessory of rutile and ilmenite from beach sands near Melbourne, Fla. At the beginning of

[24] Bailey, G. L., and Hallowes, A. P. C., The Properties of Commercial Coppers Containing Selenium, Tellurium, and Bismuth: Metal Ind., vol. 62, No. 1, January 1, 1943, pp. 6–9; No. 2, January 8, 1943, pp. 18–20.
[25] Butzner, J. I., Nonferrous Metals: Iron Age, vol. 151, No. 1, January 7, 1943, pp. 141–142.
[26] Waitkins, G. R., Bearse, A. E., and Shutt, R., Industrial Utilization of Selenium and Tellurium: Ind. and Eng. Chem., ind. ed., vol. 34, No. 8, August 1942, pp. 899–910.

1942 E. S. Curtis set up a pilot plant on the Fay Placers Mining Co. property, Lincoln, Calif., to determine the feasibility of producing zircon as a byproduct of gold dredging, but the results indicated that such production was not economical at current price levels and the plant was dismantled in May. Tests on concentration of zircon from Oregon beach sands were conducted by the Bureau of Mines.[27]

Foreign trade.—Imports of zirconium concentrates included 18,259 short tons from Australia, 15,283 from Brazil, and 196 from India in 1942 compared with a total of 21,709 from Australia, 5,002 from Brazil, and 963 from India in 1941. The Australian concentrates are nearly half zircon and also contain appreciable quantities of rutile and ilmenite. (See Titanium chapter of this volume for details.) The Brazilian zirconium concentrates are essentially baddeleyite containing 70 to 85 percent ZrO_2. Exports in 1942 comprised 30 tons ($2,104) of zirconium concentrates, 166 tons ($169,729) of zirconium alloys and metal, and 201 tons ($65,975) of zirconium compounds.

Zirconium concentrates and zirconium ferro-alloys imported for consumption in the United States, 1938–42

Year	Zirconium concentrates [1]		Zirconium ferro-alloys	
	Short tons	Value	Pounds	Value
1938	2,093	$62,138	244,126	$13,520
1939	3,433	49,919	799,269	50,169
1940	16,845	252,749	533,055	37,126
1941	27,674	604,744	----------	----------
1942	33,962	817,702	----------	----------

[1] Classified as "Ore" by Department of Commerce. Includes zircon-rutile-ilmenite concentrates from Australia.

Prices.—Metal and Mineral Markets continued to quote zirconium ore, 55 percent ZrO_2, at $60–$70 a short ton, f. o. b. Atlantic seaboard; zirconium ferrosilicon at $102.50–$107.50 a long ton for 12- to 15-percent Zr content and 14–16 cents a pound for 35–40 percent Zr; and powdered zirconium metal at $7 a pound.

Uses.—Most of the zirconium supply goes into ceramics, chiefly as an opacifier in porcelain enamels and pottery glazes but also as a constituent of refractories, electrical and chemical porcelains, grinding balls, and glasses resistant to heat and chemicals. Metallurgically zirconium is a deoxidizer and scavenger; and small additions to certain steels are said to improve hot-working properties, surface characteristics, and impact strength. Zirconium-copper is a promising alloy that combines high heat conductivity and tensile strength.[28] Ductile zirconium metal is used in electronic tubes, lamp filaments, and welding rods, and the metal powder in flares, photoflash bulbs, and blasting caps. In addition to ceramics, zirconium compounds go into white leather, resins, dye extenders, water repellents, and catalysts.

[27] Dasher, John, Fraas, Foster, and Gabriel, Alton, Mineral Dressing of Oregon Beach Sands. 1. Concentration of Chromite, Zircon, Garnet, and Ilmenite: Bureau of Mines Rept. of Investigations 3668, 1942, 19 pp.

[28] Metal Industry (London), Copper-Zirconium: Vol. 61, No. 4, July 24, 1942, p. 49.

PART III. NONMETALS

BITUMINOUS COAL AND LIGNITE [1]

SUMMARY OUTLINE

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SURVEY OF THE BITUMINOUS-COAL AND LIGNITE INDUSTRY IN 1942

In response to the increased need for coal to keep the war economy moving, the production of soft coal was pushed to an all-time high in 1942 estimated at 580,000,000 net tons, which surpassed the previous peak of 579,385,820 net tons mined in 1918. Owing to the Government program to encourage summer storage of coal, there was less seasonal decline than for any year on record. The regularity of production in 1942 was in striking contrast with 1941. During the first quarter of 1941 production was high to fill orders purchased for storage by consumers in anticipation of possible suspension of mining when the wage contract expired on March 31. Output was largely at a standstill in April pending the signing of a new wage contract.

Production.—The 1942 output—580,000,000 net tons—was a 13-percent increase over 1941. An outstanding feature related to this production was the elimination of seasonal declines, due largely to the Government program urging consumers to build up stocks during the summer. Throughout most of the year production remained well above 11,000,000 net tons per week.

Consumption.—Each of the major classes of consumers except steel and rolling mills used more coal in 1942 than in 1941; the increase

[1] Data for 1942 are preliminary; detailed statistics with final revisions will be released later. Data for 1941 are final.

The collection of statistics on the bituminous-coal industry which before 1937 was conducted by the Bureau of Mines is now performed by the Bituminous Coal Division, U. S. Department of the Interior, Dan H. Wheeler, Director.

Material in this chapter was prepared in the Division's Economics Branch under the supervision of G. A. Lamb, chief. It was completed under the immediate direction of W. H. Young, in collaboration with R. L. Anderson, M. E. McMillan, and R. M. McKinney.

ranged from 23 percent for beehive coke ovens to 4 percent for coal-gas retorts. Consumption by steel and rolling mills, for uses other than making coke, declined 4 percent in 1942 compared with 1941.

Changes in stocks.—The reserve supply of coal in the hands of industrial consumers and retail coal yards rose from a total of 62,737,000 net tons at the beginning of 1942 to 85,889,000 net tons at the close. The days' supply of stocks advanced from 40 to 51. Between the same periods stocks on the upper Lake docks declined 1,418,621 net tons, while unbilled coal in cars at the mines or classification yards fell 780,000 net tons.

Distribution.—Shipments of bituminous coal and lignite during 1942 rose substantially above the 1941 level in each of the primary channels of distribution except in Lake Erie loadings, which decreased slightly. Table 9 shows trends in distribution of bituminous coal for

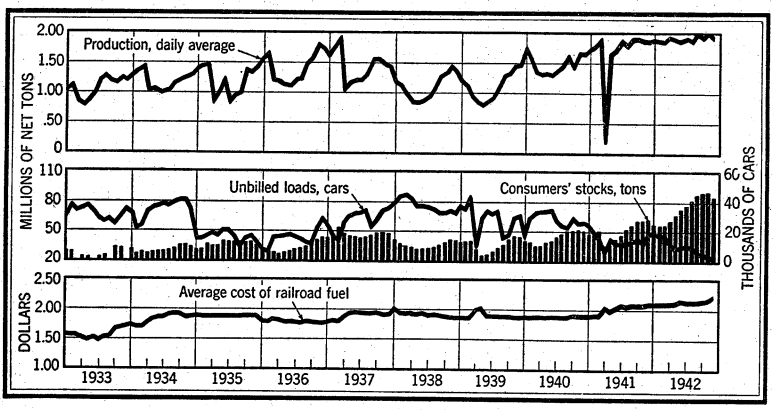

FIGURE 1.—Trends of production, stocks, and prices of bituminous coal and lignite in the United States, 1933–42.

1937–42. Changes in the monthly volume of the more important movements are shown in figure 7.

Mechanization.—Coal loaded mechanically at underground mines in the United States continued to advance sharply during 1941. The quantity of soft coal mechanically loaded expanded from 147,870,252 net tons in 1940 to 186,667,250 in 1941, an increase of 26 percent. The percentage of total underground bituminous and lignite production mechanically loaded increased from 35 in 1940 to 41 in 1941.

Mechanical cleaning.—Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States (exclusive of Alaska) rose from 102,205,186 net tons in 1940 to 117,469,857 in 1941, an increase of 15 percent. There are no mechanical cleaning plants at lignite mines.

Trend of employment.—An estimate of the average number of men employed at bituminous-coal and lignite mines in 1942 indicates a slight rise to 460,000 men from 456,981 in 1941. The estimate is based largely on monthly indexes of employment compiled by the Bureau of Labor Statistics.

Index to capacity.—The potential output upon a 308-day basis was 733,000,000 net tons in 1941. Under the 5-day week, full-time operation is limited to approximately 261 days. The average output per working day was 2,380,321 tons during 1941, which (if applied to 261

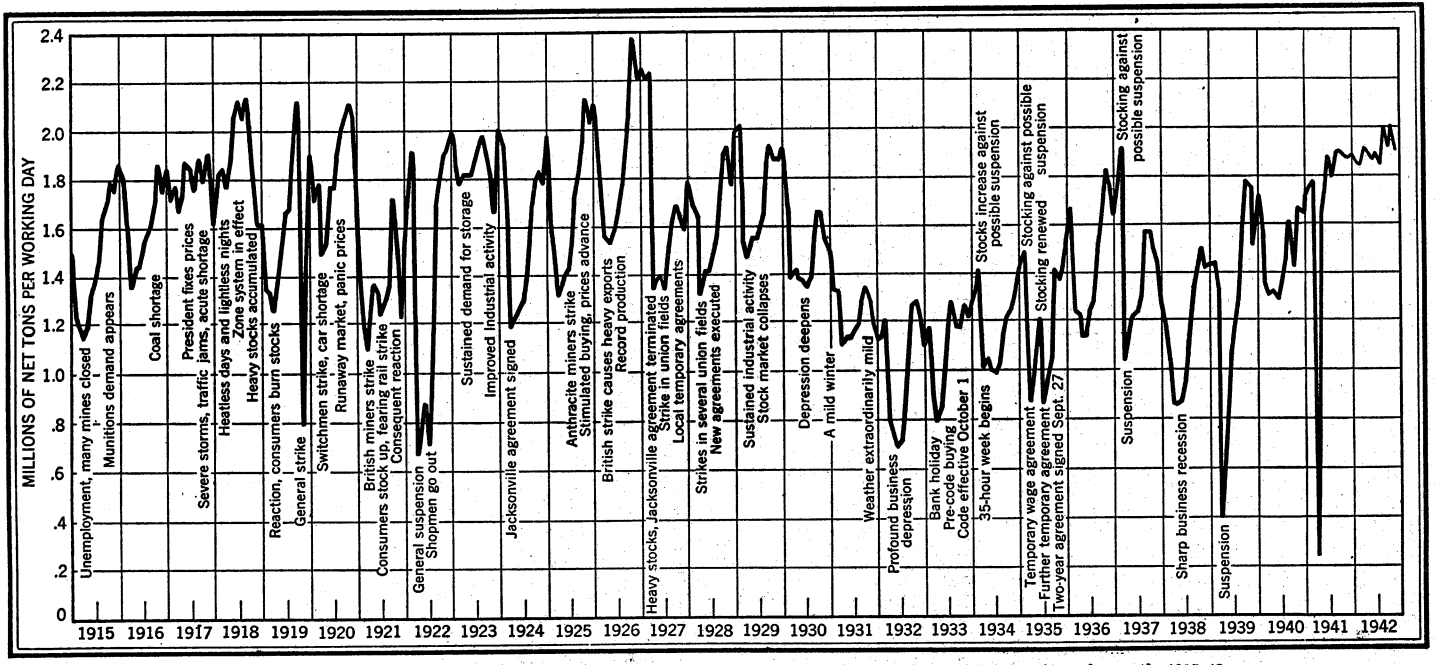

FIGURE 2.—Average production of bituminous coal and lignite in the United States per working day in each month, 1915–42.

days) gives an annual potential output of 621,000,000 tons compared with the actual total production of 514,149,245 tons.

Trend of fuel efficiency.—For many years before 1942 there was a steady trend toward increased fuel efficiency. During 1942 this trend was arrested or reversed, and some industries exhibited decreased fuel efficiency (see table 5).

Competition of oil and gas.—Competition of coal with oil and gas in 1942 was overshadowed by the necessity of making the best possible use of the fuels available and satisfying the unprecedented fuel requirements of a war economy. Rationing of fuel oil in the Eastern States was accompanied by extensive conversion from oil to coal, particularly with respect to industrial fuel-burning facilities.

Electric power utilities consumed 6 percent more bituminous coal and 14 percent more gas in 1942 than in 1941, while decreasing their use of fuel oil by 24 percent.

The consumption of coal in 1942 by class I line-haul railroads increased 19 percent over 1941, and fuel-oil consumption by class I line-haul, switching, and terminal railroads increased 23 percent.

In domestic heating the effect of curtailment of the manufacture and sale of certain types of fuel-burning equipment is shown by Bureau of the Census data. Sales of domestic stokers dropped from 158,734 in 1941 to 62,753 in 1942, a decrease of 60 percent; and shipments of domestic oil-burners, boiler-burner units, and furnace-burner units fell from 271,673 to 82,357, a decrease of 70 percent.

SOURCES OF DATA

Bituminous-coal and lignite production statistics for 1942 are preliminary estimates based upon (1) weekly or monthly reports of railroad carloadings of coal and beehive coke by all the important carriers, (2) shipments by river as reported by the United States Army Engineers, (3) direct reports from a number of mining companies, and (4) monthly production statements compiled by a number of local operators' associations and State mine departments. In the estimates for 1942, 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.

The 1941 bituminous-coal statistics were compiled by the Bituminous Coal Division, and 1941 statistics on lignite and certain semianthracite mines in Montgomery and Pulaski Counties, Va., were compiled by the Bureau of Mines. Data for 1941 are final and are based upon detailed annual reports of production and mine operation furnished by the producers. As in previous years, all but a small percentage of the output was covered by the reports submitted. For the remaining output not directly reported, consisting chiefly of small mines, it has been possible to obtain reasonably accurate data from the records of the State mine departments, which have statutory authority to require such reports or, in a few instances, from railroad carloadings.

Final production of bituminous coal and lignite for 1941 was 514,149,245 net tons. This differ slightly from 515,769,248 net tons, as published in May 1943 in Mineral Industry Surveys HSS 309 by

the Bureau of Mines. These two figures differ largely because the annual canvass of the Bituminous Coal Division includes only mines with 1,000 tons or more yearly production, whereas the Bureau of Mines canvass is concerned with the production of all mines in which men are employed and hence are exposed to accident hazards incident to mining.

SALIENT STATISTICS

TABLE 1.—*Salient statistics of the bituminous-coal and lignite industry in the United States, 1940–42*

[All tonnage figures represent net tons]

	1940	1941	1942 (preliminary)
Production	460,771,500	514,149,245	580,000,000
Consumption in the United States [1]	431,331,000	492,445,000	540,726,000
Stocks at end of year:			
Industrial consumers and retail yards	50,998,000	62,737,000	85,889,000
Stocks on upper Lake docks	6,998,258	7,777,446	6,358,825
Unbilled loads, at mines or in classification yards [2]	1,298,300	919,700	139,700
Price indicators (average per net ton):			
Average cost of railroad fuel purchased, f. o. b. mines [3]	$1.88	$2.02	$2.13
Average cost of coking coal at merchant byproduct ovens [4]	$4.40	$4.69	$4.97
Average retail price—38 cities [5]	$8.60	$9.15	$9.53
Average railroad freight charge per net ton [6]	$2.22	$2.22	$2.31
Underground loading machinery sold: [7]			
Mobile loading machines (number)	233	367	352
Scrapers (number)	36	8	15
Conveyors, including those with duckbills (units)	1,573	1,800	[8] 1,167
Pit-car loaders (units)	3	10	2
Average number of men employed at mines operating [9]	439,075	456,981	460,000
Fuel-efficiency indicators:			
Pounds of coal per kw.-hr. at electric power plants [10]	1.35	1.34	1.34
Pounds per 1,000 gross ton-miles—railroads [11]	113	111	111

[1] Represents certain classes of consumers only. See table 4 for consumers included.
[2] Association of American Railroads.
[3] Interstate Commerce Commission (class I steam railways, including class I switching and terminal companies) Excludes freight charges.
[4] As reported by coke operators to the Bureau of Mines.
[5] Bureau of Labor Statistics.
[6] Average receipts per net ton of revenue bituminous coal and lignite originated, as reported by the Interstate Commerce Commission.
[7] Young, W. H., Anderson, R. L., Lamb, G. A., and Buch, J. W., Mechanization Sales: Coal Age, February 1943, pp. 86–88; and Min. Cong. Jour., February 1943, pp. 68–70.
[8] Not comparable with previous years; in 1942, loading heads were not counted as a separate unit.
[9] The figures for 1940 and 1941 are based upon reports of mine operators producing over 1,000 tons. The figure for 1942 is estimated from various sources, including the employment index of the Bureau of Labor Statistics.
[10] Federal Power Commission.
[11] Interstate Commerce Commission; includes coal equivalent of fuel oil consumed.

PRODUCTION BY WEEKS AND MONTHS

The following tables summarize the preliminary statistics of weekly and monthly production of bituminous coal and lignite in 1942. The figures are estimates based upon daily and weekly statements of cars of coal and beehive coke loaded by the principal railroads and of shipments over the more important originating rivers. Allowance has been made for commercial truck shipments, local sales, and colliery fuel. The estimates given are based upon the latest information available and differ in some instances from the current figures previously published in the Bituminous Coal Division's Weekly Coal Reports.

For the method used in counting holidays, see the chapter on Coal in Mineral Resources of the United States, 1930, p. 631.

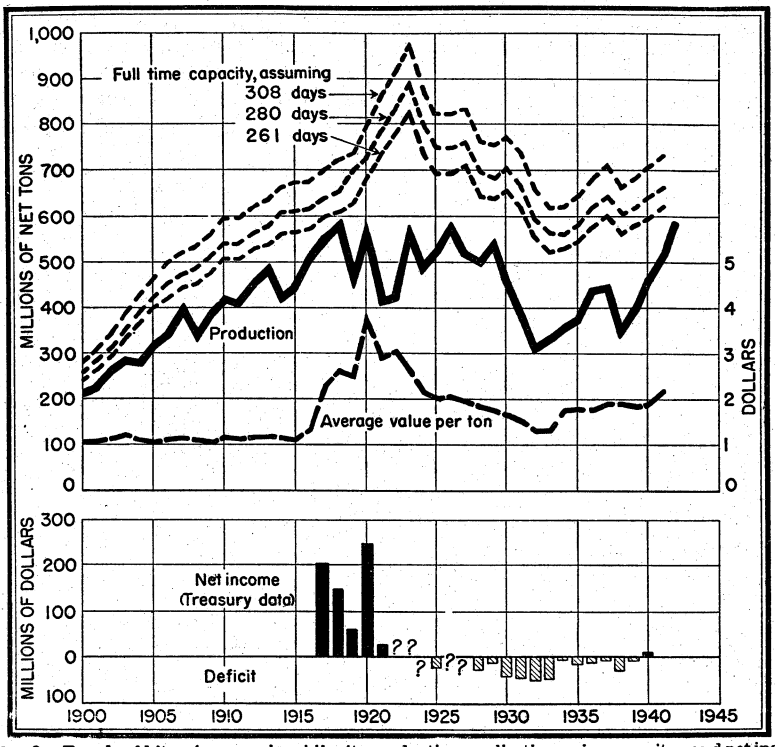

FIGURE 3.—Trends of bituminous coal and lignite production, realization, mine capacity, and net income or deficit in the United States, 1900–1942.

TABLE 2.—*Estimated weekly production of bituminous coal and lignite in the United States in 1942*

Week ended—	Production (net tons)	Number of working days	Average net tons per working day	Week ended—	Production (net tons)	Number of working days	Average net tons per working day
Jan. 3	[1] 3,726,000	[1] 2	[2] 2,021,000	July 18	11,139,000	6	1,857,000
Jan. 10	11,227,000	6	1,871,000	July 25	11,055,000	6	1,843,000
Jan. 17	11,507,000	6	1,918,000	Aug. 1	11,232,000	6	1,872,000
Jan. 24	11,332,000	6	1,889,000	Aug. 8	11,090,000	6	1,848,000
Jan. 31	11,240,000	6	1,873,000	Aug. 15	11,374,000	6	1,896,000
Feb. 7	10,912,000	6	1,819,000	Aug. 22	11,062,000	6	1,844,000
Feb. 14	11,039,000	6	1,840,000	Aug. 29	11,505,000	6	1,918,000
Feb. 21	10,971,000	6	1,829,000	Sept. 5	11,453,000	6	1,909,000
Feb. 28	11,452,000	6	1,909,000	Sept. 12	10,683,000	5	2,137,000
Mar. 7	10,263,000	6	1,711,000	Sept. 19	11,704,000	6	1,951,000
Mar. 14	11,049,000	6	1,842,000	Sept. 26	11,577,000	6	1,930,000
Mar. 21	11,075,000	6	1,846,000	Oct. 3	11,604,000	6	1,934,000
Mar. 28	11,311,000	6	1,885,000	Oct. 10	11,658,000	6	1,943,000
Apr. 4	10,458,000	5.2	2,011,000	Oct. 17	11,555,000	6	1,926,000
Apr. 11	11,112,000	6	1,852,000	Oct. 24	11,547,000	6	1,925,000
Apr. 18	11,327,000	6	1,888,000	Oct. 31	11,776,000	6	1,963,000
Apr. 25	11,335,000	6	1,889,000	Nov. 7	11,379,000	6	1,897,000
May 2	11,134,000	6	1,856,000	Nov. 14	11,453,000	5.7	2,009,000
May 9	11,271,000	6	1,879,000	Nov. 21	11,721,000	6	1,954,000
May 16	11,329,000	6	1,888,000	Nov. 28	10,866,000	5	2,173,000
May 23	11,266,000	6	1,878,000	Dec. 5	11,331,000	6	1,889,000
May 30	11,058,000	5.3	2,086,000	Dec. 12	12,031,000	6	2,005,000
June 6	11,034,000	6	1,839,000	Dec. 19	11,815,000	6	1,969,000
June 13	11,204,000	6	1,867,000	Dec. 26	8,738,000	5	1,748,000
June 20	11,006,000	6	1,834,000	Jan. 2, 1943	[1] 7,735,000	[1] 4	[2] 1,896,000
June 27	11,328,000	6	1,888,000				
July 4	8,172,000	4	2,043,000		580,000,000	305.2	1,900,000
July 11	10,779,000	6	1,797,000				

[1] Figures represent output and number of working days in that part of the week included in the calendar year shown. Total production for the week of Jan. 2, 1943, was 9,479,000 net tons, and for the week of Jan. 3, 1942, 10,104,000 net tons.

[2] 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, in thousands of net tons, in 1942*

[Bituminous and lignite figures 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 the State in which the tipple is located. The estimates here given differ in a few cases from the current figures previously published in the Weekly Coal Reports]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,575	1,460	1,608	1,614	1,610	1,625	1,590	1,560	1,583	1,616	1,454	1,575	18,870
Alaska	25	22	23	24	21	22	22	22	23	25	24	27	280
Arkansas and Oklahoma	422	271	211	223	290	344	386	375	410	427	380	407	4,146
Colorado	866	715	685	515	550	514	507	596	695	750	752	845	7,990
Georgia and North Carolina	3	3	3	4	4	3	4	4	4	4	4	4	44
Illinois	5,852	5,340	5,250	4,925	4,983	5,124	4,820	4,850	5,455	5,900	5,290	5,961	63,750
Indiana	2,440	2,166	2,160	1,964	1,855	1,625	2,090	2,012	2,215	2,330	2,220	2,393	25,470
Iowa	348	308	268	218	180	185	190	182	214	290	296	311	2,990
Kansas and Missouri	861	684	676	607	623	590	636	718	726	755	703	761	8,340
Kentucky:													
Eastern	3,588	3,120	3,517	4,164	4,230	4,105	3,921	4,042	4,110	4,204	3,930	3,796	46,727
Western	1,210	1,108	1,045	935	1,005	1,058	978	985	1,145	1,302	1,197	1,272	13,240
Maryland	168	157	175	187	175	175	162	158	146	149	126	120	1,898
Michigan	44	39	29	19	20	22	16	18	27	27	26	33	320
Montana (bituminous and lignite)	365	257	300	258	213	244	293	322	356	412	388	450	3,858
New Mexico	155	123	138	125	125	137	143	144	150	162	143	151	1,696
North and South Dakota (lignite)	270	219	172	134	100	97	89	107	219	367	374	340	2,488
Ohio	2,745	2,580	2,920	2,970	2,920	3,140	2,952	2,940	2,910	3,100	2,753	2,670	34,600
Pennsylvania (bituminous)	11,973	11,360	12,365	12,202	12,074	12,285	12,118	11,945	12,068	12,326	11,010	11,448	143,174
Tennessee	526	581	644	664	652	652	611	620	636	655	596	588	7,425
Texas (bituminous and lignite)	28	21	22	22	24	27	36	34	35	33	32	28	342
Utah	547	376	434	364	433	482	480	502	495	520	493	544	5,670
Virginia	1,736	1,396	1,520	1,762	1,755	1,718	1,720	1,595	1,733	1,764	1,614	1,587	19,900
Washington	193	166	164	182	171	171	150	144	171	166	150	160	1,988
West Virginia	12,338	11,308	12,855	13,714	13,296	13,334	13,357	13,320	13,587	13,674	12,720	13,247	156,750
Wyoming	752	592	610	535	550	540	560	655	728	831	797	875	8,025
Other Western States	2	2	2	1	1	1	1	1	2	2	2	2	19
Total bituminous coal and lignite	49,032	44,374	47,796	48,332	47,860	48,220	47,832	47,851	49,843	51,791	47,474	49,595	580,000
Pennsylvania anthracite [1]	4,532	4,772	5,085	5,153	4,843	5,122	5,341	5,180	5,426	5,101	4,795	4,611	59,961
Grand total	53,564	49,146	52,881	53,485	52,703	53,342	53,173	53,031	55,269	56,892	52,269	54,206	639,961

[1] Pennsylvania anthracite figures from Bureau of Mines and subject to revision. Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations.

CONSUMPTION

TABLE 4.—*Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1934–42, in thousands of net tons* [1]

Year	Colliery fuel	Electric power utilities [2]	Railroads (class I) [3]	Coke [4]		Steel and rolling mills	Coal-gas retorts	Cement mills [4]	Other industrials [5]	Retail-dealer deliveries	Total of classes shown
				Beehive ovens	By-product ovens						
1934	3,175	31,835	76,037	1,635	44,343	10,898	2,475	3,500	83,798	86,925	344,621
1935	3,103	33,013	77,109	1,469	49,046	11,747	2,245	3,516	91,589	83,990	356,827
1936	3,227	40,029	86,391	2,698	63,244	13,471	1,945	4,771	108,620	84,200	408,596
1937	3,052	42,871	88,080	4,927	69,575	12,853	1,680	5,247	122,410	80,076	430,771
1938	2,493	38,245	73,921	1,360	45,266	8,412	1,644	4,483	92,390	68,520	336,734
1939	2,565	43,979	79,072	2,298	61,216	9,808	1,614	5,274	98,900	71,570	376,296
1940	2,443	50,973	85,130	4,803	76,583	10,040	1,746	5,633	106,280	87,700	431,331
1941	2,489	61,861	97,384	10,529	82,609	10,902	1,659	6,832	120,720	97,460	492,445
1942 [6]	2,807	65,634	115,410	12,907	88,014	10,434	1,721	7,499	131,550	104,750	540,726

[1] These data have been assembled to show changes in consumption of bituminous coal and lignite by such classes of consumers as report currently. The total, including retail deliveries, does not represent grand total consumption in the United States. Bunker-fuel statistics are not available for publication at present. The "total of classes shown" for each year in the above table cannot be reconciled with the calculated consumption obtained by the formula: "Production plus imports minus exports plus or minus net changes in consumers' stocks" due to the omission of bunker fuel; to revisions in data covering production, exports, and imports; and to unavoidable irregularities that occur in reports from respondents who are unable to require that definitions applied and closing dates observed by their accountants are identical with those generally used in the surveys of bituminous-coal and lignite consumption.

[2] Geological Survey and Federal Power Commission. Represents bituminous coal and lignite consumed by public utility power plants in power generation, including a small quantity of coke amounting to approximately 100,000 tons annually.

[3] Association of American Railroads. Represents the consumption of bituminous coal and lignite by class I railways for all uses, including locomotive, powerhouse, shop, and station fuel. The Interstate Commerce Commission reports that in 1941 the consumption for all uses by class I line-haul railways plus the purchases for class II and class III railways, plus purchases by all switching and terminal companies combined, was 103,228,446 net tons of bituminous coal and lignite. Similar data from the Interstate Commerce Commission are not yet available for 1942.

[4] Bureau of Mines.

[5] Estimates based upon reports collected jointly by the National Association of Purchasing Agents and the Bituminous Coal Division from a selected list of representative manufacturing plants.

[6] Subject to revision.

FUEL EFFICIENCY

TABLE 5.—*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	
1941	111	34.7
1942	111	34.7
Pounds per passenger-train car-mile:		
Average:		
1919–20	18.5	
1941	14.9	19.5
1942	15.1	18.4
Electric public utility power plants:		
Pounds per kilowatt-hour:		
1919	3.2	
1941	1.3	59.4
1942	1.3	59.4
Iron and steel—pounds coking coal per net ton of pig: [1]		
1918	3,194	
1941	2,525	20.9
1942	2,604	18.5
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913–42, expressed as percent of coal used for all coke in 1942 [2]		18.5

[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 covered in next item.

[2] These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and coking, and to a small extent for automotive fuel.

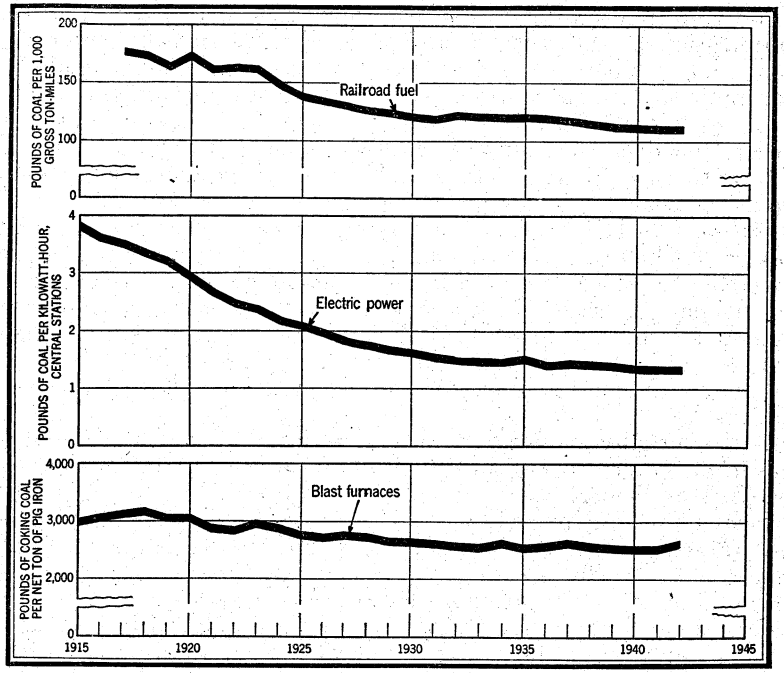

FIGURE 4.—Trends of fuel efficiency in the United States, 1915–42.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1889–1942

According to preliminary data, the total supply of available energy in the form of coal, oil, natural gas, and water power in 1942 was 31,785 trillion B. t. u.—an 8.7-percent increase over 1941 (see fig. 5).

The figures are expressed in British thermal units because some common denominator is necessary for such unlike quantities as tons of coal, barrels of oil, and cubic feet of gas. Table 6 summarizes the equivalent of each of the fuels in 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 1942. 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 1.34 pounds in 1942. (The *prevailing* factor is thus much above the *constant* factor in 1899 and much below it in 1942.) 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 1942 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, kerosine, and lubricants, for which purposes coal cannot well compete, except at very much higher levels of oil prices. Even these refined products, however, involve a certain measure of indirect competition with coal, for the energy market of the country is becoming more fluid and competitive and a demand that cannot be met by one source of supply tends to fall back on the others.

The subject of interfuel competition is exceedingly complex, and an elaborate analysis and the accumulation of data not now available would be required to determine even approximately how much of any one fuel actually has been displaced either by other fuels or by water power. The present tables do not permit determination of such displacement; their purpose is rather to measure the long-time trends in the total demand for energy.

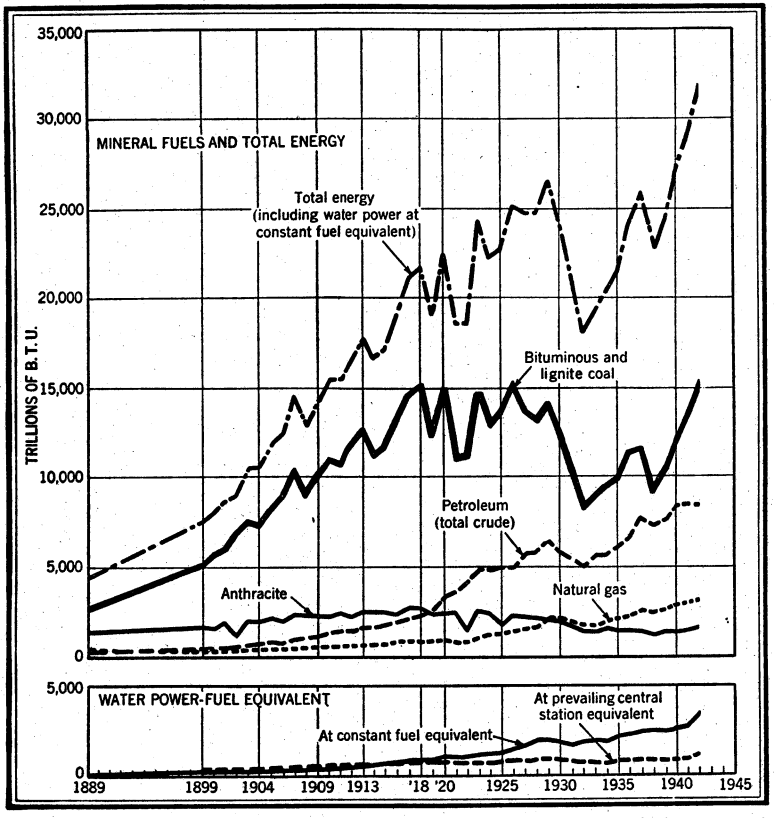

FIGURE 5.—Annual supply of energy from mineral fuels and water power in the United States, 1889–1942.

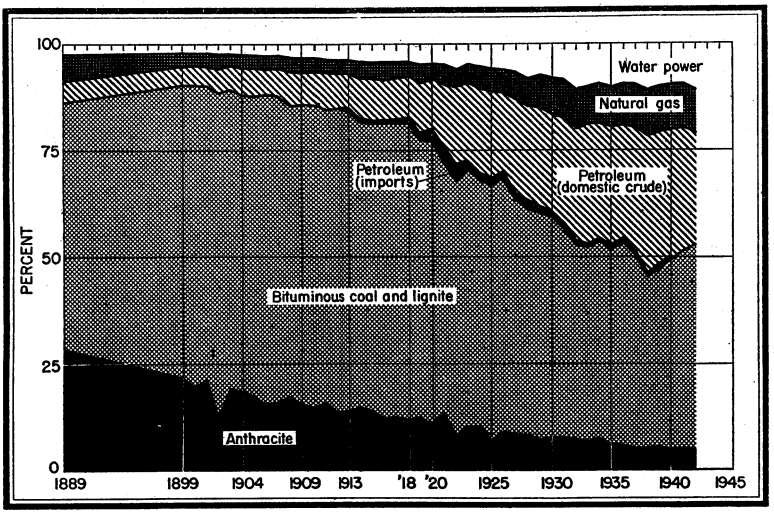

FIGURE 6.—Percentage of total B. t. u. equivalent contributed by the several sources of energy in the United States, counting water power at *constant* fuel equivalent, 1889–1942. If water power is counted at the *prevailing* fuel equivalent of central stations in each year, its proportion is 3.2 percent in 1899 and 3.9 percent in 1942, and the proportions of the other sources of energy are affected accordingly.

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TABLE 6.—*Annual supply of energy from mineral fuels and water power in the United States, 1933–42,*[1] *in trillions of B. t. u.*[2]

Year	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	
	Pennsylvania anthracite	Bituminous coal and lignite	Total	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	1,485	11,504	12,989	6,598	194	2,330	9,122	22,111	2,256	812	24,367	22,923
1937	1,410	11,673	13,083	7,675	165	2,588	10,428	23,511	2,446	871	25,957	24,382
1938	1,255	9,132	10,387	7,286	158	2,468	9,912	20,299	2,466	866	22,765	21,165
1939	1,400	10,345	11,745	7,590	199	2,663	10,452	22,197	2,423	838	24,620	23,035
1940	1,400	12,072	13,472	8,119	256	2,860	11,235	24,707	2,620	880	27,327	25,587
1941 [5]	1,533	13,471	15,004	8,413	(6)	3,024	[6] 11,437	[6] 26,441	2,804	934	[6] 29,245	[6] 27,375
1942 [5]	1,631	15,196	16,827	8,313	(6)	3,171	[6] 11,484	[6] 28,311	3,474	1,157	[6] 31,785	[6] 29,468

[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 and lignite, 13,100 B. t. u. per pound; petroleum, 6,000,000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of water power is calculated from the kilowatt-hours of power produced wherever available, as 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 average of central-electric-station practice in 1913, the base period used.
[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 1.34 pounds in 1942.
[5] Subject to revision.
[6] Excludes imports of crude petroleum. Figures not available for publication.

TABLE 7.—*Index numbers for relative rate of growth of coal, oil, and water power in the United States, 1933–42* [1]

[The figures are expressed as a percentage of the 1918 rate]

Year	Coal			Petroleum (total crude)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (at constant fuel equivalent)	Grand total	
	Pennsylvania anthracite	Bituminous coal and lignite	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	52	77	73	359	73	334	332	112	292	119	112
1938	47	60	58	341	70	318	316	97	295	104	98
1939	52	68	66	335	88	344	333	106	289	113	106
1940	52	80	75	380	113	369	358	118	313	125	118
1941 [2]	57	89	84	394	(3)	390	[3] 365	[3] 126	335	[3] 134	[3] 126
1942 [2]	61	100	94	389	(3)	409	[3] 366	[3] 135	415	[3] 146	[3] 136

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 809.
[2] Subject to revision.
[3] Excludes imports of crude petroleum. Figures not available for publication.

TABLE 8.—*Percentage of total B. t. u. equivalent contributed by the several mineral fuels and water power in the United States, 1933–42* [1]

Year	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
	Pennsylvania anthracite	Bituminous coal and lignite	Total	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	5.4	45.0	50.4	29.6	.6	10.0	40.2	90.6	9.4	100.0
1938	5.5	40.1	45.6	32.0	.7	10.8	43.5	89.1	10.9	100.0
1939	5.7	42.0	47.7	30.8	.8	10.8	42.4	90.1	9.9	100.0
1940	5.1	44.2	49.3	29.7	.9	10.5	41.1	90.4	9.6	100.0
1941 [2]	5.2	46.1	51.3	28.8	[3]	10.3	39.1	90.4	9.6	100.0
1942 [2]	5.1	47.8	52.9	26.2	[3]	10.0	36.2	89.1	10.9	100.0
	Water power counted at *prevailing* central-station equivalent for year									
1933	7.4	48.4	55.8	30.0	1.1	9.2	40.3	96.1	3.9	100.0
1934	8.1	49.0	57.1	28.3	1.1	9.9	39.3	96.4	3.6	100.0
1935	7.0	48.3	55.3	29.5	1.0	10.2	40.7	96.0	4.0	100.0
1936	6.5	50.2	56.7	28.8	.8	10.2	39.8	96.5	3.5	100.0
1937	5.8	47.8	53.6	31.5	.7	10.6	42.8	96.4	3.6	100.0
1938	5.9	43.2	49.1	34.4	.7	11.7	46.8	95.9	4.1	100.0
1939	6.1	44.9	51.0	32.9	.9	11.6	45.4	96.4	3.6	100.0
1940	5.5	47.2	52.7	31.7	1.0	11.2	43.9	96.6	3.4	100.0
1941 [2]	5.6	49.2	54.8	30.7	[3]	11.1	41.8	96.6	3.4	100.0
1942 [2]	5.5	51.6	57.1	28.2	[3]	10.8	39.0	96.1	3.9	100.0

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 810.
[2] Subject to revision. Percentages based upon figures in table 6.
[3] Figures not available for publication.

DISTRIBUTION

TABLE 9.—*Trends in distribution of bituminous coal and lignite in the United States, 1937–42*

[For details and sources of data, see Monthly Report on Distribution of Coal Shipments. Tonnage figures shown in thousands of net tons]

	1937		1938		1939		1940		1941		1942 (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
New England receipts:												
Via rail across the Hudson	4,885		4,104		4,626		4,892		6,385		9,938	
Lake Erie loadings (cargo and fuel):												
By fields of origin:												
From Ohio	3,231	7.1	2,390	6.8	2,356	5.7	2,646	5.5	3,947	7.7	4,171	8.5
From Pittsburgh and Other Pennsylvania	11,763	26.0	8,019	22.8	9,259	22.5	11,578	24.1	11,612	22.6	9,305	18.8
From Moundsville, Fairmont, and Cumberland-Piedmont	2,319	5.1	1,389	4.0	1,963	4.8	2,357	4.9	2,963	5.8	2,778	5.6
From Southern West Virginia:												
High volatile	10,975	24.3	8,329	23.7	10,883	26.5	12,025	25.0	14,277	27.8	14,746	29.8
Low volatile	8,428	18.6	7,612	21.7	8,665	21.1	10,372	21.6	9,010	17.5	9,160	18.5
From Eastern Kentucky, Tennessee, and Virginia	8,530	18.9	7,392	21.0	7,998	19.4	9,133	18.9	9,585	18.6	9,295	18.8
Total	45,246	100.0	35,131	100.0	41,124	100.0	48,111	100.0	51,394	100.0	49,455	100.0
By destinations (cargo only):												
To American points	35,123	80.6	27,656	80.9	33,188	83.3	37,804	81.2	38,823	78.1	36,267	75.9
To Canadian points	8,479	19.4	6,510	19.1	6,672	16.7	8,778	18.8	10,886	21.9	11,544	24.1
Total	43,602	100.0	34,166	100.0	39,860	100.0	46,582	100.0	49,709	100.0	47,811	100.0
Across Lake Michigan car ferry	650		588		592		612		627		740	
West-bound rail to Mississippi Valley (revenue all-rail shipments, excluding railroad fuel, Lake coal, and movements to Kentucky points):												
From Ohio fields	11,861	9.5	8,042	8.7	9,052	8.4	9,807	8.0	10,846	7.9	11,719	7.4
From Pennsylvania fields	15,091	12.1	9,620	10.4	12,200	11.4	15,195	12.4	16,663	12.1	18,141	11.5
From Northern West Virginia and Cumberland-Piedmont	3,521	2.8	2,615	2.8	3,227	3.0	3,467	2.8	4,728	3.4	5,201	3.3
From Southern West Virginia:												
High volatile	17,293	13.9	13,668	14.8	15,099	14.0	16,943	13.8	18,275	13.3	21,500	13.6
Low volatile	19,575	15.8	13,335	14.5	15,946	14.8	19,536	15.9	22,773	16.6	25,005	15.9

From Eastern Kentucky, Tennessee, and Virginia	17,953	14.5	14,120	15.3	15,749	14.7	18,340	14.9	18,980	13.8	22,770	14.4
Total from Appalachian fields	85,294	68.6	61,400	66.5	71,273	66.3	83,288	67.8	92,265	67.1	104,336	66.1
From Illinois	26,625	21.4	20,719	22.5	24,879	23.1	27,618	22.5	30,100	21.9	36,992	23.4
From Indiana	10,594	8.5	8,501	9.2	9,455	8.8	10,223	8.3	12,499	9.0	14,031	8.9
From Western Kentucky	1,859	1.5	1,661	1.8	1,917	1.8	1,758	1.4	2,735	2.0	2,556	1.6
Total from middle western fields	39,078	31.4	30,881	33.5	36,251	33.7	39,599	32.2	45,334	32.9	53,579	33.9
Grand total	124,372	100.0	92,281	100.0	107,524	100.0	122,887	100.0	137,599	100.0	157,915	100.0
Total shipments from other groups (all shipments, including, in this case, nonrevenue railroad fuel):[1]												
From Michigan fields	181	([2] [3])	166	([2] [3])	122	([2] [3])	103	([2] [3])	120	([2] [3])	71	([2] [3])
From upper Lake commercial docks, all deliveries	13,518	[2] 3.1	10,845	[2] 3.1	11,111	[2] 2.8	12,054	[2] 2.6	12,473	[2] 2.4	14,036	[2] 2.4
From Iowa, Missouri, Kansas	7,202	[2] 1.6	6,528	[2] 1.9	6,088	[2] 1.5	6,411	[2] 1.4	6,731	[2] 1.3	8,147	[2] 1.4
From Arkansas, Oklahoma, Texas	3,739	[2] .8	3,126	[2] .9	2,946	[2] .7	3,394	[2] .7	3,411	[2] .7	4,152	[2] .7
From far western fields	21,867	[2] 4.9	17,612	[2] 5.1	18,442	[2] 4.7	19,658	[2] 4.3	22,009	[2] 4.3	26,265	[2] 4.5
From Alabama field	11,771	[2] 2.7	10,382	[2] 3.0	11,233	[2] 2.8	14,288	[2] 3.1	14,310	[2] 2.8	17,777	[2] 3.1

[1] Excluding commercial sales by truck and wagon, except from upper Lake docks.
[2] Percent of total national shipments from all mines, all destinations.
[3] Less than 0.1 percent.

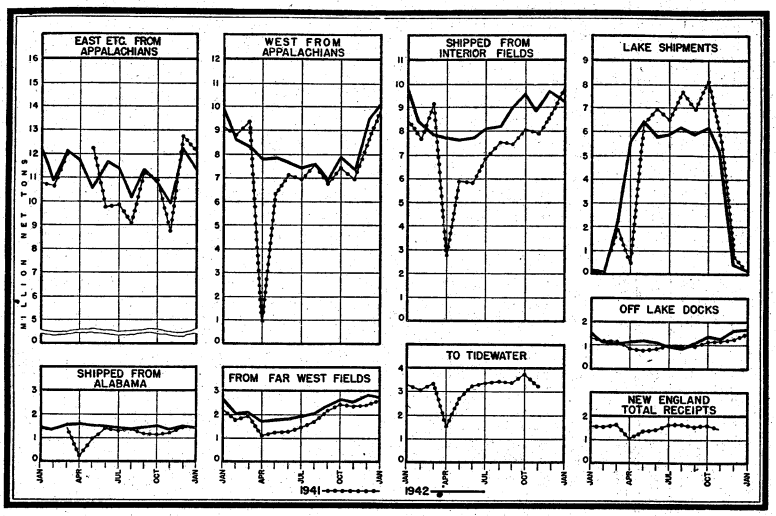

FIGURE 7.—Monthly movement of bituminous coal and lignite in the United States in the major channels of distribution, 1941–42.

STOCKS HELD BY CONSUMERS

TABLE 10.—*Stocks of bituminous coal and lignite in hands of commercial consumers and in retail dealers' yards in the United States, 1941–42*

Date	Total stock (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	Railroads	Cement mills	Total
1941										
Jan. 1	50,998,000	45	26	42	51	74	28	23	27	38
Feb. 1	48,702,000	43	28	37	53	72	19	24	31	34
Mar. 1	48,518,000	43	30	35	50	69	16	26	33	32
Apr. 1	50,690,000	43	39	38	51	74	14	32	37	35
May 1 [1]	35,971,000	23	23	34	41	65	26	24	24	32
June 1	37,483,000	21	27	38	37	57	32	25	25	32
July 1	42,929,000	26	26	45	53	58	32	26	27	35
Aug. 1	47,051,000	27	27	53	69	62	34	28	30	38
Sept. 1	52,801,000	31	28	59	70	60	31	31	31	40
Oct. 1	56,994,000	32	31	61	79	63	33	33	34	42
Nov. 1	61,401,000	37	32	58	79	62	36	34	33	43
Dec. 1	61,763,000	36	30	54	78	67	34	33	34	43
Dec. 31	62,737,000	38	30	50	76	67	27	34	37	40
1942										
Jan. 1	62,737,000	38	30	50	76	67	27	34	37	40
Feb. 1	58,681,000	34	30	45	72	66	17	31	36	34
Mar. 1	56,885,000	33	30	42	66	73	15	30	37	34
Apr. 1	57,221,000	33	33	48	59	86	17	32	42	38
May 1	61,836,000	35	37	54	63	94	21	35	43	43
June 1	67,418,000	38	42	69	71	96	26	38	42	49
July 1	73,271,000	41	45	78	80	98	33	41	46	54
Aug. 1	77,583,000	41	48	87	96	94	48	44	49	60
Sept. 1	82,686,000	42	50	94	90	99	53	45	50	63
Oct. 1	87,311,000	44	48	92	89	105	42	43	48	61
Nov. 1	89,937,000	45	46	85	86	110	44	41	47	61
Dec. 1	90,874,000	46	42	80	89	111	45	39	47	59
Dec. 31	85,889,000	44	34	69	88	101	28	35	48	51

[1] Unadjusted for coal in transit during suspension of mining in April 1941.

FINAL BITUMINOUS-COAL AND LIGNITE STATISTICS FOR 1941

Tables 11 to 45 give the final detailed statistics of bituminous-coal and lignite mine operations in 1941. The subjects covered include production, number and size of mines, employment, value, mechanization, and world production.

In accordance with the practice followed by the Bureau of Mines in previous years, the statistics in this report relate to mines having an

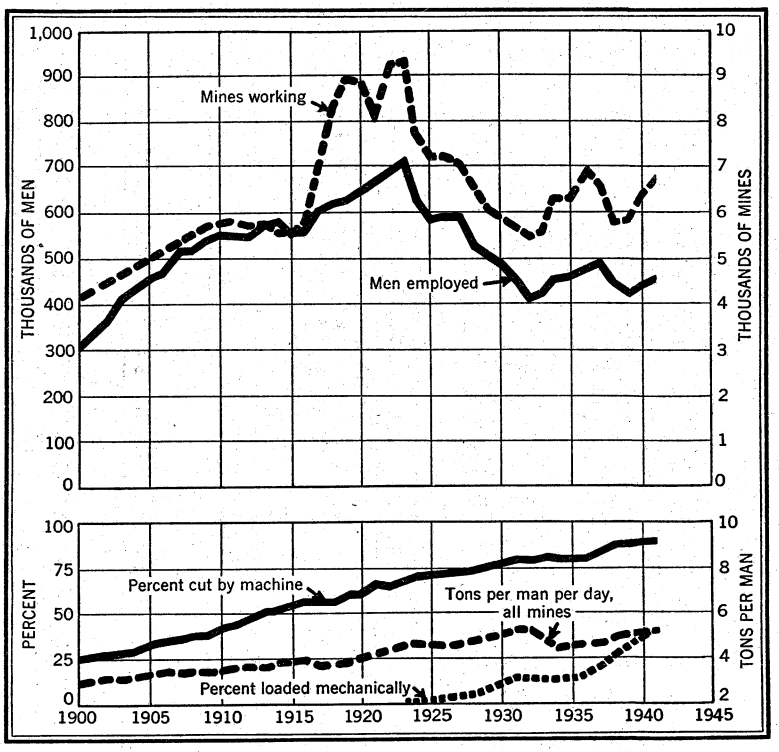

FIGURE 8.—Trends of employment, mechanization, and output per man at bituminous-coal and lignite mines in the United States, 1900–1941.

output of 1,000 tons a year or more and do not attempt to include many small mines producing less than 1,000 tons a year that sell their output by wagon or truck.

These statistics include, for convenience and historical comparison, the small output of anthracite and semianthracite produced outside Pennsylvania and the production of lignite.

SALIENT TRENDS

TABLE 11.—*Growth of bituminous-coal and lignite mining industry in the United States, 1890–1941*

Year	Production	Value [1]	Value per ton [1]	Men employed	Number of mines	Calculated capacity (millions of net tons)		
						At 308 days	At 280 days	At 261 days
1890	111,302,322	$110,420,801	$0.99	192,204	(2)	152	137	129
1891	117,901,238	117,188,400	.99	205,803	(2)	163	148	138
1892	126,856,567	125,124,381	.99	212,893	(2)	178	162	151
1893	128,385,231	122,751,618	.96	230,365	(2)	194	174	164
1894	118,820,405	107,653,501	.91	244,603	(2)	214	196	181
1895	135,118,193	115,779,771	.86	239,962	2,555	215	196	182
1896	137,640,276	114,891,515	.83	244,171	2,599	221	202	187
1897	147,617,519	119,595,224	.81	247,817	2,454	232	213	197
1898	166,593,623	132,608,713	.80	255,717	2,862	243	221	206
1899	193,323,187	167,952,104	.87	271,027	3,245	254	230	216
1900	212,316,112	220,930,313	1.04	304,375	(2)	279	255	237
1901	225,828,149	236,422,049	1.05	340,235	(2)	309	281	262
1902	260,216,844	290,858,483	1.12	370,056	(2)	348	316	295
1903	282,749,348	351,687,933	1.24	415,777	(2)	387	350	328
1904	278,659,689	305,397,001	1.10	437,832	4,650	425	386	360
1905	315,062,785	334,658,294	1.06	460,629	5,060	460	417	390
1906	342,874,867	381,162,115	1.11	478,425	4,430	496	451	420
1907	394,759,112	451,214,842	1.14	513,258	4,550	520	473	440
1908	332,573,944	374,135,268	1.12	516,264	4,730	531	482	450
1909	379,744,257	405,486,777	1.07	543,152	5,775	560	510	474
1910	417,111,142	469,281,719	1.12	555,533	5,818	592	538	502
1911	405,907,059	451,375,819	1.11	549,775	5,887	593	538	502
1912	450,104,982	517,983,445	1.15	548,632	5,747	622	566	527
1913	478,435,297	565,234,952	1.18	571,882	5,776	635	577	538
1914	422,703,970	493,309,244	1.17	583,506	5,592	668	608	566
1915	442,624,426	502,037,688	1.13	557,456	5,502	672	610	569
1916	502,519,682	665,116,077	1.32	561,102	5,726	673	613	570
1917	551,790,563	1,249,272,837	2.26	603,143	6,939	699	636	593
1918	579,385,820	1,491,809,940	2.58	615,305	8,319	717	650	607
1919	465,860,058	1,160,616,013	2.49	621,998	8,994	736	669	624
1920	568,666,683	2,129,933,000	3.75	639,547	8,921	796	725	675
1921	415,921,950	1,199,983,600	2.89	663,754	8,038	860	781	729
1922	422,268,099	1,274,820,000	3.02	687,958	9,299	916	832	776
1923	564,564,662	1,514,621,000	2.68	704,793	9,331	970	885	823
1924	483,686,538	1,062,626,000	2.20	619,604	7,586	871	792	738
1925	520,052,741	1,060,402,000	2.04	588,493	7,144	822	748	696
1926	573,366,985	1,183,412,000	2.06	593,647	7,177	821	747	696
1927	517,763,352	1,029,657,000	1.99	593,918	7,011	835	759	708
1928	500,744,970	933,774,000	1.86	522,150	6,450	760	691	644
1929	534,988,593	952,781,000	1.78	502,993	6,057	752	679	638
1930	467,526,299	795,483,000	1.70	493,202	5,891	770	700	653
1931	382,089,396	588,895,000	1.54	450,213	5,642	736	669	623
1932	309,709,872	406,677,000	1.31	406,380	5,427	653	594	554
1933	333,630,533	445,788,000	1.34	418,703	5,555	615	559	521
1934	359,368,022	628,383,000	1.75	458,011	6,258	622	565	527
1935	372,373,122	658,063,000	1.77	462,403	6,315	640	582	543
1936	439,087,903	770,955,000	1.76	477,204	6,875	680	618	576
1937	445,531,449	864,042,000	1.94	491,864	6,548	710	646	601
1938	348,544,764	678,653,000	1.95	441,333	5,777	663	602	562
1939	394,855,325	728,348,366	1.84	421,788	5,820	683	621	579
1940	460,771,500	879,327,227	1.91	439,075	6,324	703	639	595
1941	514,149,245	1,125,362,836	2.19	456,981	6,822	733	666	621

[1] Figures on value and value per ton for the years 1890 to 1936, inclusive, and 1939 exclude selling expense. Figures for other years include selling expense.
[2] Data not available.

TABLE 11.—*Growth of bituminous-coal and lignite mining industry in the United States, 1890–1941*—Continued

Year	Average number of days worked	Average number of days lost on account of strikes		Net tons per man		Percent of underground production		Percent of total production	
		Per man employed	Per man on strike	Per day	Per year	Cut by machines [1]	Mechanically loaded	Mechanically cleaned [2]	Mined by stripping
1890	226	[3]	[3]	2.56	579	[3]	[3]	[3]	[3]
1891	223	[3]	[3]	2.57	573	5.3	[3]	[3]	[3]
1892	219	[3]	[3]	2.72	596	[3]	[3]	[3]	[3]
1893	204	[3]	[3]	2.73	557	[3]	[3]	[3]	[3]
1894	171	[3]	[3]	2.84	486	[3]	[3]	[3]	[3]
1895	194	[3]	[3]	2.90	563	[3]	[3]	[3]	[3]
1896	192	[3]	[3]	2.94	564	11.9	[3]	[3]	[3]
1897	196	[3]	[3]	3.04	596	15.3	[3]	[3]	[3]
1898	211	[3]	[3]	3.09	651	19.5	[3]	[3]	[3]
1899	234	8	46	3.05	713	22.7	[3]	[3]	[3]
1900	234	5	43	2.98	697	24.9	[3]	[3]	[3]
1901	225	2	35	2.94	664	25.6	[3]	[3]	[3]
1902	230	7	44	3.06	703	26.8	[3]	[3]	[3]
1903	225	3	28	3.02	680	27.6	[3]	[3]	[3]
1904	202	8	44	3.15	637	28.2	[3]	[3]	[3]
1905	211	2	23	3.24	684	32.8	[3]	[3]	[3]
1906	213	28	63	3.36	717	34.7	[3]	2.7	[3]
1907	234	1	14	3.29	769	35.1	[3]	2.9	[3]
1908	193	11	38	3.34	644	37.0	[3]	3.6	[3]
1909	209	1	29	3.34	699	37.5	[3]	3.8	[3]
1910	217	35	89	3.46	751	41.7	[3]	3.8	[3]
1911	211	2	27	3.50	738	43.9	[3]	[3]	[3]
1912	223	10	35	3.68	820	46.8	[3]	3.9	[3]
1913	232	4	36	3.61	837	50.7	[3]	4.6	[3]
1914	195	19	80	3.71	724	51.8	[3]	4.8	0.3
1915	203	4	61	3.91	794	55.3	[3]	4.7	.6
1916	230	4	26	3.90	896	56.9	[3]	4.6	.8
1917	243	4	17	3.77	915	56.1	[3]	4.6	1.0
1918	249	1	7	3.78	942	56.7	[3]	3.8	1.4
1919	195	25	37	3.84	749	60.0	[3]	3.6	1.2
1920	220	6	22	4.00	881	60.7	[3]	3.3	1.5
1921	149	3	23	4.20	627	66.4	[3]	3.4	1.2
1922	142	78	117	4.28	609	64.8	[3]	[3]	2.4
1923	179	2	20	4.47	801	68.3	0.3	3.8	2.1
1924	171	7	73	4.56	781	71.5	.7	[3]	2.8
1925	195	2	30	4.52	884	72.9	1.2	[3]	3.2
1926	215	1	24	4.50	966	73.8	1.8	[3]	3.0
1927	191	45	153	4.55	872	74.9	[3]	5.3	3.6
1928	203	8	83	4.73	959	76.9	4.5	5.7	4.0
1929	219	[4]	11	4.85	1,064	78.4	7.4	6.9	3.8
1930	187	2	43	5.06	948	81.0	10.5	8.3	4.3
1931	160	3	35	5.30	849	83.2	13.1	9.5	5.0
1932	146	19	120	5.22	762	84.1	12.3	9.8	6.3
1933	167	9	30	4.78	797	84.7	12.0	10.4	5.5
1934	178	3	15	4.40	785	84.1	12.2	11.1	5.8
1935	179	[3]	[3]	4.50	805	84.2	13.5	12.2	6.4
1936	199	2	21	4.62	920	84.8	16.3	13.9	6.4
1937	193	[3]	[3]	4.69	906	[3]	20.2	14.6	7.1
1938	162	1	13	4.89	790	87.5	26.7	18.2	8.7
1939	178	25	36	5.25	936	87.9	31.0	20.1	9.6
1940	202	1	8	5.19	1,049	88.4	35.4	22.2	9.4
1941	216	20	27	5.20	1,125	89.0	40.7	22.9	10.7

[1] Percentages for the years 1890 to 1913, inclusive, are of total production, as a separation of strip mine and underground production is not available for these years.

[2] For the years 1906 to 1926, inclusive, these percentages are exclusive of coal cleaned at central washeries operated by consumers; after 1926, when data became available on the tonnage cleaned by consumer-operated plants, the percentages include the total tons cleaned at the mines and at consumer-operated washeries.

[3] Data not available.

[4] One-half day or less.

TABLE 12.—*Salient trends in bituminous-coal and lignite mining industry in the United States, 1934–41*

	1934	1935	1936	1937	1938	1939	1940	1941
Production:								
Loaded at mine for shipment by rail—net tons	313,303,729	319,741,376	370,762,901	[1] 399,237,575	295,336,027	331,189,620	380,387,674	425,184,319
Loaded at mine for shipment by water—do	15,127,968	18,327,282	24,867,683	(1)	16,902,969	22,229,364	29,493,058	30,240,489
Shipped by truck or wagon—do	18,739,320	21,960,252	27,929,298	[2] 37,762,612	25,592,058	29,533,824	35,540,476	40,055,638
Taken by locomotive tenders at tipple—do	(3)	(3)	(3)	(3)	606,857	826,556	939,058	1,099,582
Shipped by conveyor or tram to point of consumption—do	(3)	(3)	(3)	(3)	4,221,671	4,317,465	5,887,994	6,067,697
Used by mine employees—do	[3] 7,374,143	[3] 7,773,619	[3] 9,571,997	(3)	2,032,289	1,901,408	2,035,201	1,872,026
Used at mines for power and heat—do	3,175,057	3,102,691	3,227,447	3,052,095	2,493,017	2,565,276	2,442,989	2,488,950
Made into beehive coke at mines—do	1,647,805	1,467,902	2,728,577	4,884,054	1,359,876	2,089,475	4,045,050	7,140,544
Total production—do	359,368,022	372,373,122	439,087,903	[4] 445,531,449	348,544,764	[5] 394,855,325	460,771,500	514,149,245
Number of active mines of commercial size:								
Class 1 (200,000 tons or more)	551	561	660	661	526	577	636	730
Class 2 (100,000 to 200,000 tons)	485	479	452	469	402	404	432	437
Class 3 (50,000 to 100,000 tons)	479	503	460	448	415	387	371	402
Class 4 (10,000 to 50,000 tons)	1,072	1,056	1,085	1,117	1,042	1,065	1,157	1,305
Class 5 (1,000 to 10,000 tons)	3,671	3,716	4,218	3,853	3,392	3,387	3,728	3,948
Total number over 1,000 tons	6,258	6,315	6,875	6,548	5,777	5,820	6,324	6,822
Average number of men employed at mines active:								
Underground	384,947	389,942	399,367	(6)	370,004	353,476	365,013	376,765
Surface:								
In strip pits	7,652	8,533	8,043	(6)	7,877	8,791	8,983	10,861
All others	65,412	63,928	69,794	(6)	63,452	59,521	65,079	69,355
Total	458,011	462,403	477,204	491,864	441,333	421,788	439,075	456,981
Average number of days mines operated	178	179	199	193	162	178	202	216
Capacity of active mines with existing labor force:								
Per year of 308 days—net tons	622,000,000	640,000,000	680,000,000	710,000,000	663,000,000	683,000,000	703,000,000	733,000,000
Per year of 280 days—do	565,000,000	582,000,000	618,000,000	646,000,000	602,000,000	621,000,000	639,000,000	666,000,000
Per year of 261 days—do	527,000,000	543,000,000	576,000,000	601,000,000	562,000,000	579,000,000	595,000,000	621,000,000
Output per man per day—do	4.40	4.50	4.62	4.69	4.89	5.25	5.19	5.20
Output per man per year—do	785	805	920	906	790	936	1,049	1,125
Underground output cut by machine—do	284,676,715	293,664,208	348,332,330	(6)	278,315,365	313,969,394	369,227,277	408,510,296
Percent of underground output cut by machine	84.1	84.2	84.8	(6)	87.5	87.9	88.4	89.0
Underground output mechanically loaded—net tons	41,432,735	47,177,224	66,976,872	83,500,000	85,092,836	110,711,970	147,870,252	186,667,250
Percent of underground output mechanically loaded	12.2	13.5	16.3	20.2	26.7	31.0	35.4	40.7
Quantity mined by stripping—net tons	20,789,641	23,647,292	28,125,857	31,750,853	30,406,855	37,722,583	43,167,336	55,071,609
Percent mined by stripping	5.8	6.4	6.4	7.1	8.7	9.6	9.4	10.7
Quantity cleaned by wet or pneumatic processes [7]—net tons	39,826,559	45,361,021	61,094,976	65,000,000	63,454,588	79,376,672	102,205,186	117,469,857
Percent cleaned by wet or pneumatic processes [7]	11.1	12.2	13.9	14.6	18.2	20.1	22.2	22.9

[1] In 1937, coal loaded at mine for shipment by water is included with "loaded at mine for shipment by rail."
[2] In 1937, coal "taken by locomotive tenders at tipple," "shipped by conveyor or tram to point of consumption," and "used by mine employees" included with "shipped by truck or wagon."
[3] In 1934, 1935, and 1936, data were not collected in such form as to permit a separation of coal "taken by locomotive tenders at tipple," "shipped by conveyor or tram to point of consumption," and "used by mine employees." They are all included here under "used by mine employees."
[4] Total production differs from sum of items shown by amount of changes in inventory and tonnage not accounted for in distribution analysis. This tonnage amounted to 595,113 net tons.
[5] Includes 202,337 tons of coal reported as net changes in stocks at mines, January 1, 1939, to January 1, 1940.
[6] Data not available.
[7] Includes central washeries operated by consumers.

TABLE 13.—*Coal produced in the United States, by States, 1931–41, with production of maximum year and cumulative production from earliest record to end of 1941, in thousands of net tons*

State	Maximum production		Production by years											Total production from earliest record to end of 1941
	Year	Quantity	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	
Alabama	1926	21,001	11,999	7,857	8,760	9,142	8,505	12,229	12,440	11,062	12,047	15,324	15,464	681,863
Arkansas	1907	2,670	1,154	1,033	883	857	1,133	1,623	1,511	1,197	1,152	1,454	1,574	77,721
Colorado	1917	12,483	6,604	5,599	5,230	5,211	5,911	6,812	7,187	5,663	5,923	6,589	6,949	416,383
Georgia	1903	416	22	27	41	33	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	1918	89,291	44,303	33,475	37,413	41,272	44,525	50,927	51,602	41,912	46,783	50,610	54,703	2,599,899
Indiana	1918	30,679	14,295	13,324	13,761	14,794	15,754	17,822	17,765	14,759	16,943	18,869	22,484	794,145
Iowa	1917	8,966	3,388	3,862	3,195	3,367	3,650	3,961	3,637	3,103	2,948	3,231	2,939	320,960
Kansas	1918	7,562	1,987	1,953	2,218	2,508	2,686	2,944	2,893	2,654	2,675	3,579	4,008	241,980
Kentucky	1927	69,124	39,964	35,300	36,100	38,525	40,761	47,522	47,086	38,545	42,557	49,141	53,710	1,393,922
Maryland	1907	5,533	2,006	1,429	1,531	1,627	1,678	1,704	1,549	1,281	1,443	1,503	1,701	245,875
Michigan	1907	2,036	359	446	407	622	628	626	562	494	457	410	311	45,588
Missouri	1917	5,671	3,621	4,070	3,432	3,352	3,646	3,985	4,091	3,436	3,273	3,097	3,145	225,237
Montana (bituminous coal and lignite)	1918	4,533	2,378	2,125	2,152	2,566	2,759	2,988	2,965	2,732	2,804	2,867	3,254	126,725
New Mexico	1918	4,023	1,553	1,263	1,226	1,259	1,389	1,597	1,715	1,239	1,230	1,111	1,251	109,601
North Carolina	1922	79	2	2	2	3	(1)	(1)						(1)
North Dakota (lignite)	1941	2,309	1,519	1,740	1,782	1,754	1,956	2,215	2,251	2,050	2,072	2,218	2,309	46,472
Ohio	1920	45,878	20,411	13,909	19,589	20,691	21,153	24,110	25,178	18,591	20,289	22,772	29,319	1,426,518
Oklahoma	1920	4,849	1,908	1,255	1,238	1,208	1,229	1,540	1,600	1,245	1,188	1,646	1,771	134,880
Pennsylvania (bituminous)	1918	178,551	97,659	74,776	79,296	89,826	91,405	109,887	111,002	77,705	92,584	116,603	130,240	6,305,318
Tennessee	1910	7,121	4,721	3,538	3,775	4,136	4,138	5,108	5,213	4,472	5,185	6,008	7,045	272,907
Texas (bituminous coal and lignite)	1913	2,429	716	637	822	759	758	843	910	879	826	621	353	60,042
Utah	1920	6,005	3,350	2,852	2,675	2,406	2,947	3,247	3,810	2,947	3,285	3,576	4,077	145,489
Virginia	1941	18,441	9,699	7,692	8,179	9,377	9,667	11,662	13,795	12,283	13,531	15,348	18,441	408,677
Washington	1918	4,082	1,846	1,591	1,394	1,383	1,559	1,812	2,002	1,567	1,690	1,650	1,841	131,859
West Virginia	1927	145,122	101,473	85,609	94,344	98,134	99,179	117,926	118,646	93,288	108,362	126,438	140,250	3,718,669
Wyoming	1920	9,630	4,994	4,171	4,013	4,368	5,177	5,781	5,918	5,204	5,373	5,808	6,646	298,687
Other States			158	175	173	188	180	217	203	237	235	299	364	62,593
Total bituminous coal and lignite			382,089	309,710	333,631	359,368	372,373	439,088	445,531	348,545	394,855	460,772	514,149	20,292,010
Pennsylvania anthracite	1917	99,612	59,646	49,855	49,541	57,168	52,159	54,580	51,856	46,099	51,487	51,485	56,368	4,441,797
Grand total			441,735	359,565	383,172	416,536	424,532	493,668	497,387	394,644	446,342	512,257	570,517	24,733,807

[1] Included under "Other States."

SUMMARY BY STATES

TABLE 14.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States, in 1941*

[Exclusive of mines producing less than 1,000 tons]

State	Disposition of coal produced (net tons)					Average value per ton [4]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mines for power and heat and made into beehive coke at mines [3]	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
Alabama	14,276,483	964,368	118,576	[3] 105,096	15,464,523	$2.71	21,572	141	3,222	24,935	216	5,384,901	2.87
Alaska	235,230			3,730	238,960	3.95	110		43	153	311	47,617	5.02
Arizona, Georgia, Idaho, and Oregon	33,598	19,468	1,071	680	54,817	2.74	136		52	188	222	41,659	1.32
Arkansas	1,499,049	62,615	4,180	8,328	1,574,172	3.74	3,267	120	601	3,988	134	534,791	2.94
Colorado	4,958,827	1,640,814	112,190	[3] 236,701	6,948,532	2.83	6,345	16	1,389	7,750	213	1,647,015	4.22
Illinois	46,246,919	7,314,004	370,449	771,912	54,703,284	1.81	25,396	1,751	6,920	34,067	186	6,343,392	8.62
Indiana	19,718,097	2,258,093	380,731	127,008	22,483,929	1.70	5,186	1,885	3,194	10,265	200	2,050,613	10.96
Iowa	1,290,173	1,593,009	39,240	16,204	2,938,626	2.74	4,544	331	718	5,593	158	882,343	3.33
Kansas	3,643,928	343,747	9,799	10,098	4,007,572	1.98	1,514	525	723	2,762	201	555,831	7.21
Kentucky	50,882,955	2,052,833	620,169	[3] 154,389	53,710,346	2.17	48,780	159	7,857	56,796	215	12,213,755	4.40
Maryland	1,427,209	252,095	13,884	7,386	1,700,574	2.40	1,957	8	266	2,231	216	481,198	3.53
Michigan	119,645	173,168	6,765	11,197	310,775	4.22	672		85	757	162	122,619	2.53
Missouri	1,797,266	1,304,795	18,365	24,862	3,145,288	2.23	2,856	653	679	4,188	169	707,194	4.45
Montana:													
Bituminous coal	3,034,147	147,578	9,000	4,206	3,194,931	1.48	886	47	350	1,283	197	252,817	12.64
Lignite	4,483	54,042	228	40	58,793	1.79	68	8	22	98	174	17,083	3.44
Total Montana	3,038,630	201,620	9,228	4,246	3,253,724	1.48	954	55	372	1,381	195	269,900	12.06
New Mexico	1,067,092	133,190	11,180	39,658	1,251,120	3.03	1,427		396	1,823	219	399,462	3.13
North Dakota (lignite)	1,709,100	411,880	163,515	24,393	2,308,888	1.27	562	444	269	1,275	177	225,657	10.23
Ohio	22,329,298	6,833,165	83,401	72,979	29,318,843	1.99	16,734	1,685	3,741	22,160	223	4,936,786	5.94
Oklahoma	1,572,187	187,371	3,029	8,521	1,771,108	2.65	1,540	183	415	2,138	171	365,841	4.84
Pennsylvania	109,081,289	10,562,884	4,077,713	[3] 6,517,797	130,239,683	2.28	105,899	2,514	15,075	123,488	224	27,605,388	4.72
South Dakota (lignite)	37,338	33,364	[5] 123	(3)	70,825	1.52	15	44	10	69	174	12,001	5.90
Tennessee	6,411,829	525,255	69,327	[3] 38,860	7,045,271	2.34	7,926	3	1,243	9,172	218	1,997,557	3.53

See footnotes at end of table.

TABLE 14.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States, in 1941*—Continued

State	Disposition of coal produced (net tons)					Average value per ton	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine	Used at mines for power and heat and made into beehive coke at mines	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
Texas:													
Bituminous coal	10,074	5,282	126	----------	15,482	$3.41	57	----------	11	68	94	6,405	2.42
Lignite	329,947	[5] 7,379	----------	([6])	337,326	.84	154	30	18	202	180	36,301	9.29
Total Texas	340,021	[5] 12,661	126	([6])	352,808	.95	211	30	29	270	158	42,706	8.26
Utah	3,543,114	478,271	23,115	[3] 32,279	4,076,779	2.33	1,926	----------	719	2,645	207	546,872	7.45
Virginia	17,412,546	376,955	99,276	[3] 552,169	18,440,946	2.33	16,407	4	2,257	18,668	226	4,223,273	4.37
Washington	1,339,501	400,717	85,984	15,092	1,841,274	3.52	1,712	6	442	2,160	223	482,129	3.82
West Virginia	135,098,222	1,717,762	2,681,535	[3] 752,729	140,250,248	2.23	95,710	248	17,791	113,749	228	25,907,185	5.41
Wyoming	6,315,262	201,534	36,354	93,180	6,646,330	2.09	3,407	56	847	4,310	203	874,568	7.60
Total United States	455,424,808	40,055,638	9,039,305	[3] 9,629,494	514,149,245	2.19	376,765	10,861	69,355	456,981	216	98,902,253	5.20

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water.

[2] Includes coal transported from mines to points of use by conveyor, chute, or aerial tramway.

[3] Includes coal made into beehive coke at mines in the following States: Alabama, 4,830 tons; Colorado, 124,198 tons; Kentucky, 3,424 tons; Pennsylvania, 6,037,747 tons; Tennessee, 11,920 tons; Utah, 20,106 tons; Virginia, 525,067 tons; and West Virginia, 413,252 tons; a grand total of 7,140,544 tons.

[4] Value received or charged for coal f. o. b. the mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by the producer at average prices that might have been received if such coal had been sold commercially.)

[5] Since it is necessary to conceal certain items in the lignite break-down of disposition of coal, the figures are included here in the column where the greater part of the concealed tonnage would appear.

PRODUCTION BY WEEKS AND MONTHS

TABLE 15.—*Final bituminous-coal and lignite production in the United States, with estimates by weeks, in 1941*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 4	[1] 5,169,000	[1] 3	[2] 1,799,000	July 19	10,814,000	6	1,802,000
Jan. 11	10,371,000	6	1,729,000	July 26	10,937,000	6	1,823,000
Jan. 18	9,880,000	6	1,647,000	Aug. 2	10,734,000	6	1,789,000
Jan. 25	10,165,000	6	1,694,000	Aug. 9	10,783,000	6	1,797,000
Feb. 1	10,329,000	6	1,722,000	Aug. 16	11,062,000	6	1,844,000
Feb. 8	10,318,000	6	1,720,000	Aug. 23	11,062,000	6	1,844,000
Feb. 15	10,642,000	6	1,774,000	Aug. 30	11,307,000	6	1,885,000
Feb. 22	10,641,000	6	1,774,000	Sept. 6	10,050,000	5	2,010,000
Mar. 1	11,096,000	6	1,849,000	Sept. 13	11,536,000	6	1,923,000
Mar. 8	10,947,000	6	1,825,000	Sept. 20	10,459,000	6	1,743,000
Mar. 15	11,288,000	6	1,881,000	Sept. 27	11,417,000	6	1,903,000
Mar. 22	11,493,000	6	1,916,000	Oct. 4	11,627,000	6	1,938,000
Mar. 29	11,931,000	6	1,989,000	Oct. 11	11,606,000	6	1,934,000
Apr. 5	3,380,000	5	676,000	Oct. 18	11,463,000	6	1,911,000
Apr. 12	1,089,000	6	182,000	Oct. 25	11,256,000	6	1,876,000
Apr. 19	1,305,000	6	218,000	Nov. 1	10,963,000	6	1,827,000
Apr. 26	1,612,000	6	269,000	Nov. 8	11,398,000	6	1,900,000
May 3	5,117,000	6	853,000	Nov. 15	11,666,000	5.6	2,083,000
May 10	9,368,000	6	1,561,000	Nov. 22	9,006,000	5.2	1,732,000
May 17	10,089,000	6	1,682,000	Nov. 29	11,695,000	5.8	2,016,000
May 24	10,475,000	6	1,746,000	Dec. 6	11,415,000	6	1,903,000
May 31	9,627,000	5.4	1,783,000	Dec. 13	11,457,000	6	1,910,000
June 7	9,591,000	6	1,599,000	Dec. 20	11,224,000	6	1,871,000
June 14	10,186,000	6	1,698,000	Dec. 27	8,469,000	5	1,694,000
June 21	10,364,000	6	1,727,000	Jan. 3, 1942	[1] 6,378,000	[1] 3	[2] 2,021,000
June 28	11,322,000	6	1,887,000				
July 5	6,863,000	3.4	2,019,000		514,149,000	303.4	1,695,000
July 12	9,707,000	5	1,941,000				

[1] Figures represent output and number of working days in that part of the week included in the calendar year shown. Total production for the week of January 4, 1941, was 8,994,000 net tons and for January 3, 1942, was 10,104,000 net tons.

[2] Average daily production for the entire week and not for the working days in the calendar year shown.

TABLE 16.—*Final coal production in the United States, by States, with estimates by months, in thousands of net tons, in 1941*

[The toals for the year are based upon final complete returns to the Bituminous Coal Division from all operators known to have produced more than 1,000 tons a year. The apportionment of the known yearly total among the 12 months is based upon the best information available—in some States upon direct tonnage reports by operators to the State mine department, in most cases upon current records of railway carloadings and waterway shipments]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,444	1,409	1,591	191	1,083	1,488	1,404	1,463	1,286	1,244	1,315	1,546	15,464
Alaska	21	14	17	19	19	15	22	22	20	23	22	25	239
Arkansas	205	147	132	19	25	31	85	178	207	210	175	160	1,574
Colorado	768	624	689	306	368	375	446	491	676	702	719	785	6,949
Illinois	5,493	5,125	5,862	968	3,905	3,764	4,538	4,750	4,677	5,063	4,980	5,578	54,703
Indiana	2,153	1,924	2,468	194	1,766	1,627	1,666	1,888	2,009	2,259	2,218	2,312	22,484
Iowa	343	291	351	130	167	167	167	176	231	277	299	340	2,939
Kansas	416	381	441	249	202	243	275	327	342	353	365	414	4,008
Kentucky:													
Eastern	3,577	3,416	3,901	162	3,731	3,994	3,922	3,993	4,181	4,474	3,404	3,375	42,130
Western	952	960	1,073	1,398	866	711	829	886	872	942	1,004	1,087	11,580
Total Kentucky	4,529	4,376	4,974	1,560	4,597	4,705	4,751	4,879	5,053	5,416	4,408	4,462	53,710
Maryland	153	149	167	14	131	151	146	152	163	162	142	171	1,701
Michigan	44	39	38	17	6	2	7	28	30	34	32	34	311
Missouri	327	298	347	195	158	191	215	256	269	276	287	326	3,145
Montana:													
Bituminous coal	299	256	224	181	184	184	220	238	289	372	369	379	3,195
Lignite	6	5	5	3	3	3	3	3	5	8	9	6	59
Total Montana	305	261	229	184	187	187	223	241	294	380	378	385	3,254
New Mexico	113	106	122	85	76	99	95	90	103	112	115	135	1,251
North Dakota (lignite)	289	237	197	87	77	88	83	100	177	306	382	286	2,309
Ohio	2,230	2,298	2,676	269	2,431	2,533	2,592	2,739	2,893	3,068	2,805	2,785	29,319
Oklahoma	231	166	147	21	29	34	96	201	233	238	196	179	1,771
Pennsylvania (bituminous)	11,607	10,962	12,380	242	11,930	11,711	11,500	12,135	11,832	12,949	10,412	12,580	130,240
South Dakota (lignite)	11	9	6	3	1	1	1	1	5	12	12	9	71
Tennessee	595	596	668	107	591	632	614	627	651	715	614	635	7,045
Texas:													
Bituminous coal	2	2	1	1	1	1	1	1	1	1	2	2	16
Lignite	30	27	31	28	26	29	28	29	25	34	29	21	337
Total Texas	32	29	32	29	27	30	29	30	26	35	31	23	353
Utah	431	356	351	61	237	209	242	388	457	472	406	467	4,077
Virginia	1,461	1,385	1,619	234	1,714	1,691	1,696	1,733	1,770	1,906	1,637	1,595	18,441

Washington	164	150	165	134	124	124	118	146	173	186	174	183	1,841
West Virginia	11,129	10,779	12,682	349	13,365	12,976	12,773	13,431	13,434	14,555	11,956	12,821	140,250
Wyoming	587	490	571	440	382	377	477	538	676	745	663	700	6,646
Other States [1]	6	5	4	3	5	4	3	3	4	5	5	7	54
Total bituminous coal and lignite	45,087	42,606	48,926	6,110	43,603	43,455	44,264	47,013	47,691	51,703	44,748	48,943	514,149
Pennsylvania anthracite [2]	5,162	4,596	4,765	3,317	4,001	5,072	4,855	5,441	5,334	5,580	3,974	4,271	56,368
Grand total	50,249	47,202	53,691	9,427	47,604	48,527	49,119	52,454	53,025	57,283	48,722	53,214	570,517

[1] Includes Arizona, Georgia, Idaho, and Oregon.
[2] Pennsylvania anthracite figures from Bureau of Mines. Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations; also includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

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NUMBER AND SIZE OF MINES

TABLE 17.—*Number and production of bituminous-coal and lignite mines in the United States, classified by size of output in each State, in 1941*

[Exclusive of mines producing less than 1,000 tons]

State	Class 1A, more than 500,000 tons					Class 1B, 200,000 to 500,000 tons					Class 2, 100,000 to 200,000 tons				
	Mines		Production			Mines		Production			Mines		Production		
	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent
Alabama	7	2.3	4,772,359	681,766	30.9	14	4.5	4,941,533	352,967	32.0	22	7.1	3,301,638	150,074	21.3
Alaska											(1)	(1)	(1)	(1)	(1)
Arizona, Georgia, Idaho, and Oregon															
Arkansas											1	1.2	113,606	113,606	7.2
Colorado	1	.5	657,043	657,043	9.5	5	2.4	1,229,953	245,991	17.7	15	7.2	2,143,199	142,880	30.8
Illinois	45	9.1	38,100,812	846,685	69.7	24	4.8	8,497,011	354,042	15.5	17	3.4	2,667,784	156,928	4.8
Indiana	13	4.5	10,650,663	819,282	47.4	23	7.9	7,239,806	314,774	32.2	9	3.1	1,218,440	135,382	5.4
Iowa						1	.4	214,241	214,241	7.3	4	1.5	490,174	122,544	16.7
Kansas	1	1.1	735,514	735,514	18.4	7	7.5	2,243,317	320,474	56.0	3	3.2	390,036	130,012	9.7
Kentucky	17	2.4	14,701,638	864,802	27.4	71	9.9	22,121,434	311,569	41.2	63	8.8	9,100,416	144,451	16.9
Maryland						1	1.1	236,417	236,417	13.9	2	2.2	340,945	170,473	20.0
Michigan											1	10.0	168,945	168,945	54.4
Missouri						3	1.5	1,155,199	385,066	36.7	2	1.0	317,368	158,684	10.1
Montana (bituminous coal)	1	2.0	1,395,943	1,395,943	43.7	3	5.9	1,303,249	434,416	40.8	2	3.9	281,335	140,668	8.8
Montana, North Dakota, South Dakota, and Texas (lignite)															
New Mexico						6	3.1	1,710,669	285,112	61.6	1	.5	177,624	177,624	6.4
Ohio	17	2.3	13,608,069	800,475	46.4	3	7.1	818,583	272,861	65.4					
Oklahoma						13	1.7	4,364,844	335,757	14.9	29	3.9	4,405,675	151,920	15.0
Pennsylvania	80	5.0	71,711,679	896,396	55.1	1	1.0	390,491	390,491	22.1	3	3.0	387,706	129,235	21.9
Tennessee						77	4.8	24,029,757	312,075	18.4	105	6.5	15,206,470	144,824	11.7
Texas (bituminous coal)						12	8.2	3,555,987	296,332	50.5	12	8.2	1,738,807	144,901	24.7
Utah	3	5.7	1,827,351	609,117	44.8	2	3.8	746,016	373,008	18.3	6	11.3	881,009	146,835	21.6
Virginia	8	5.2	7,254,283	906,785	39.3	24	15.5	7,904,846	329,369	42.9	13	8.4	1,932,663	148,666	10.5
Washington						2	4.9	614,614	307,307	33.4	5	12.2	736,389	147,278	40.0
West Virginia	79	9.5	64,651,065	818,368	46.1	155	18.7	48,530,086	313,420	34.6	116	13.9	17,525,852	151,085	12.5
Wyoming	4	6.0	2,622,368	655,592	39.5	7	10.4	2,548,928	364,133	38.3	6	9.0	993,849	165,642	15.0
Total United States	276	4.1	232,688,787	843,075	45.3	454	6.6	144,446,981	318,165	28.1	437	6.4	64,519,930	147,643	12.5

TABLE 17.—*Number and production of bituminous-coal and lignite mines in the United States, classified by size of output in each State, in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

State	Class 3, 50,000 to 100,000 tons					Class 4, 10,000 to 50,000 tons					Class 5, less than 10,000 tons					Total		
	Mines		Production			Mines		Production			Mines		Production			Mines	Production (net tons)	
	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent		Total	Average per mine
Alabama	15	4.8	1,134,570	75,638	7.3	32	10.3	676,049	21,127	4.4	220	71.0	638,374	2,902	4.1	310	15,464,523	49,886
Alaska	[1] 3	[1] 100.0	[1] 238,960	[1] 79,653	[1] 100.0	(1)	(1)	(1)	(1)	(1)						3	238,960	79,653
Arizona, Georgia, Idaho, and Oregon						1	11.1	35,674	35,674	65.1	8	88.9	19,143	2,393	34.9	9	54,817	6,091
Arkansas	8	9.5	591,413	73,927	37.6	32	38.1	724,622	22,644	46.0	43	51.2	144,531	3,361	9.2	84	1,574,172	18,740
Colorado	20	9.6	1,414,683	70,734	20.4	45	21.6	1,078,323	23,963	15.5	122	58.7	425,331	3,486	6.1	208	6,948,532	33,406
Illinois	24	4.9	1,575,245	65,635	2.9	125	25.3	2,833,540	22,668	5.2	260	52.5	1,028,892	3,957	1.9	495	54,703,284	110,512
Indiana	19	6.5	1,380,243	72,644	6.1	64	21.9	1,401,142	21,893	6.2	164	56.1	593,635	3,620	2.7	292	22,483,929	77,000
Iowa	6	2.2	462,693	77,116	15.7	56	20.9	1,032,891	18,444	35.2	201	75.0	738,627	3,675	25.1	268	2,938,626	10,965
Kansas	1	1.1	58,421	58,421	1.4	20	21.5	345,568	17,278	8.6	61	65.6	234,716	3,848	5.9	93	4,007,572	43,092
Kentucky	55	7.7	4,216,876	76,670	7.8	97	13.5	2,294,190	23,651	4.3	414	57.7	1,275,792	3,082	2.4	717	53,710,346	74,910
Maryland	6	6.8	423,318	70,553	24.9	20	22.5	528,287	26,414	31.1	60	67.4	171,607	2,860	10.1	89	1,700,574	19,108
Michigan						6	60.0	127,819	21,303	41.1	3	30.0	14,011	4,670	4.5	10	310,775	31,078
Missouri	2	1.0	167,596	83,798	5.3	42	20.9	1,008,541	24,013	32.1	152	75.6	496,584	3,267	15.8	201	3,145,288	15,648
Montana (bituminous coal)	1	2.0	53,497	53,497	1.7	2	3.9	39,208	19,604	1.2	42	82.3	121,699	2,898	3.8	51	3,194,931	62,646
Montana, North Dakota, South Dakota, and Texas (lignite)	5	2.6	358,414	71,683	12.9	12	6.1	219,442	18,287	7.9	171	87.7	309,683	1,811	11.2	195	2,775,832	14,235
New Mexico	2	4.8	180,811	90,406	14.5	9	21.4	176,169	19,574	14.1	28	66.7	75,557	2,698	6.0	42	1,251,120	29,789
Ohio	25	3.3	1,828,708	73,148	6.2	143	19.2	3,424,332	23,946	11.7	519	69.6	1,687,215	3,251	5.8	746	29,318,843	39,301
Oklahoma	4	3.9	239,967	59,992	13.5	24	23.5	503,323	20,972	28.4	70	68.6	249,621	3,566	14.1	102	1,771,108	17,364
Pennsylvania	104	6.4	7,513,875	72,249	5.8	372	23.1	8,632,384	23,205	6.6	873	54.2	3,145,518	3,603	2.4	1,611	130,239,683	80,844
Tennessee	13	8.9	913,041	70,234	13.0	25	17.1	580,512	23,220	8.2	84	57.6	256,924	3,059	3.6	146	7,045,271	48,255
Texas (bituminous coal)						1	33.3	11,382	11,382	73.5	2	66.7	4,100	2,050	26.5	3	15,482	5,161
Utah	3	5.7	220,755	73,585	5.4	12	22.6	287,553	23,963	7.1	27	50.9	114,095	4,226	2.8	53	4,076,779	76,920
Virginia	10	6.4	740,050	74,005	4.0	15	9.7	359,488	23,966	1.9	85	54.8	249,616	2,937	1.4	155	18,440,946	118,974
Washington	1	2.4	61,397	61,397	3.3	15	36.6	362,140	24,143	19.7	18	43.9	66,734	3,707	3.6	41	1,841,274	44,909
West Virginia	74	8.9	5,605,991	75,757	4.0	121	14.6	2,954,696	24,419	2.1	286	34.4	932,558	3,261	.7	831	140,250,248	168,773
Wyoming	1	1.5	67,187	67,187	1.0	14	20.9	309,075	22,077	4.6	35	52.2	104,923	2,998	1.6	67	6,646,330	99,199
Total United States	402	5.9	29,447,711	73,253	5.7	1,305	19.1	29,946,350	22,947	5.8	3,948	57.9	13,099,486	3,318	2.6	6,822	514,149,245	75,366

[1] In Alaska, 1 mine that should be included in class 2 and 1 mine that should be included in class 4 are included in class 3 to avoid disclosure of individual operations.

AVERAGE VALUE

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 it covered all coal (other than Pennsylvania anthracite) produced in the United States. It represented the bituminous-coal industry as the term ordinarily was used in the trade and included the lignite of the Dakotas, Texas, and Montana, as well as any small tonnages of hard coal produced outside of Pennsylvania.

With the passage of the Coal Act, the Bureau of Mines relinquished the collection of statistics relating to bituminous coal, effective June 30, 1937, though continuing to compile data regarding lignite and Pennsylvania anthracite. Effective the same date, the Coal Commission became responsible for the compilation of data on bituminous coal, though not attempting to collect data regarding lignite, which was specifically exempted by the act. The records of the Commission (now Bituminous Coal Division, United States Department of the Interior) relate to all coal other than Pennsylvania anthracite, Virginia semianthracite, and lignite.

To permit comparison of the old and new series, therefore, it is necessary to separate the lignites 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 18.)

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. Reporting operators were 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 reporting operators were instructed that the "value of coal not sold but used by producer, also mine fuel and coal made into coke should be estimated at average prices that might have been received." The instructions of the Coal Commission regarding such items were in effect similar, though given in greater detail.

A comparison of the two series is possible for 1936. In that year the average value per ton on the old (Bureau of Mines) basis amounted to $1.761 per ton for bituminous coal, excluding lignite. The aver-

age gross realization, according to data 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 18.—*Trend of average value in the United States of bituminous coal and lignite per ton, f. o. b. mines, 1929–41*

Year	Bituminous coal (subject to regulation under 1937 act) [1]	Lignite [2]	Total
Average value per ton less selling cost (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 cost (Bituminous Coal Division 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]	1.850	1.158	1.845
1940	1.913	[3] 1.156	1.908
1941	2.194	[3] 1.237	2.189

[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 from the Bureau of Mines. Data on sales realization were not collected from lignite mines by the Bituminous Coal Division. Figures for 1936–38 and 1940 exclude selling cost as before. Figure for 1941 includes selling cost.
[4] Producers were asked to exclude selling cost in reporting value, but a number of them included such costs.

LABOR STATISTICS

Men employed.—An average of 456,981 men was employed at bituminous-coal mines in 1941, a 4.1-percent increase over the total of 439,075 for 1940 (see fig. 8). Statistics on men employed in 1941 represent annual averages of the number of workers on the rolls on the days when the mines were in operation.

The method used here in calculating employment gives an accurate measure of the working force in the coal industry, but it does not consider the time lost by men on the rolls through intermittent operations. To measure the influence of intermittency upon employment the factor of mine activity as indicated by the average number of days of

plant operation was recorded separately. The average number of men employed when the mines were in operation was then used, in conjunction with the average number of days of operation, as a measure of the total volume of employment in the industry.

Days operated.—The average number of days of operation at bituminous-coal mines in 1941 was 216. This represents an increase over the average of 202 days for 1940. All statistics on days of mine operation included in this report are weighted averages, in which the operating time of each mine has been weighted by the number of its employees. Several coal-mining States publish series on the number of days worked that are simple averages of the figures for each reporting mine, regardless of size. As these unweighted averages are likely to be unduly depressed by small mines, which generally operate fewer days than the larger ones, they tend to understate the working time of a typical mine employee.

Man-days of labor.—Only a small proportion of the bituminous-coal-mine operations, however, keep an accurate record of man-days or man-hours worked. Consequently, man-days have been computed by multiplying the number of workers employed by the number of operating days. Although these computations were made for each individual mine, the combined total is necessarily only an approximation.

Until the American coal industry arranges to keep an accurate record of man-days or man-hours of employment all computations of accident rates, daily earnings, and output per man will remain subject to qualification. Meanwhile, the method of multiplying men by days must be accepted as the best available procedure.

Data for 1941 indicate that bituminous-coal-mine employees performed 98,902,253 man-days of labor during the year. Table 14 gives a summary record of men employed, days operated, and output per man per day at bituminous-coal mines, by States, in 1941. Details by counties for 1941 are shown in table 40.

Length of working day.—Table 19 summarizes the replies of mine operators to the question, "Number of hours operated per shift."

The reports of more than 7 hours of work per shift in 1941 consist partly of (1) work for which the operator has included time when the men are entering or leaving the mine, (2) work for which the operator has reported the time of certain employees who work longer than other employees, as in stripping overburden, or (3) operations where work is staggered and two crews of men overlap. There were, however, a number of mines in 1941 where the established day was 8 hours. As shown by the table, most of these were very small. Numerous mines, especially the smaller ones, failed to answer the question.

It was found that 92.6 percent of the men employed were in 7-hour mines and that the weighted average working shift was 7.03 hours.

The established working day does not of itself measure the length of time that men actually work or the time that they are underground, because of the possibility of overtime, because the mine may sometimes shut down before the full day is over, because the miner may go home before the mine stops, and because he spends a considerable time going to and from his place of work underground.

As interpreted in the wage agreements, the 7-hour day means 7 hours of labor at the usual working place, exclusive of any time for

lunch and exclusive of the time spent in going from the entrance of the mine to the working place and back again. As noted, these figures represent the operator's statement of the nominal operating day for the mine. They do not purport to represent the time actually worked by the men. On the one hand, they make no allowance for tonnage or piece workers who leave early; on the other hand, they make no allowance for tonnage men who continue at work after the mine as a whole is shut down, or who go into the mine to work on days when the tipple is idle.

TABLE 19.—*Number of bituminous-coal and lignite mines in the United States having established working shift of certain length and number of men employed therein, in 1941*

State	7 hours		8 hours		9 hours		All others [1]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Alabama	293	24,424	12	159			5	352	310	24,935
Alaska			3	153					3	153
Arizona, Georgia, Idaho, and Oregon			8	182			1	6	9	188
Arkansas	73	3,882	5	47	1	2	5	57	84	3,988
Colorado	151	7,214	23	177			34	359	208	7,750
Illinois	380	30,534	62	778			53	2,755	495	34,067
Indiana	146	6,039	60	473	2	12	84	3,741	292	10,265
Iowa	164	4,417	85	915	5	59	14	202	268	5,593
Kansas	35	1,393	40	443	1	7	17	919	93	2,762
Kentucky:										
Eastern	360	44,238	116	3,033			14	701	490	47,972
Western	173	7,729	47	684			7	411	227	8,824
Total Kentucky	533	51,967	163	3,717			21	1,112	717	56,796
Maryland	78	2,052	11	179					89	2,231
Michigan	8	682					2	75	10	757
Missouri	73	1,906	103	1,607	5	56	20	619	201	4,188
Montana:										
Bituminous coal	35	1,146	16	137					51	1,283
Lignite	6	44	8	35			6	19	20	98
Total Montana	41	1,190	24	172			6	19	71	1,381
New Mexico	24	1,661	16	135			2	27	42	1,823
North Dakota (lignite)	10	167	96	874	5	32	44	202	155	1,275
Ohio	546	19,832	158	1,667	3	70	39	591	746	22,160
Oklahoma	83	1,771	12	168	1	4	6	195	102	2,138
Pennsylvania	1,336	117,312	171	1,636	3	14	101	4,526	1,611	123,488
South Dakota (lignite)	(2)	(2)	[2] 6	[2] 46	2	7	6	16	14	69
Tennessee	116	8,378	28	522			2	272	146	9,172
Texas:										
Bituminous coal	1	7	1	36			1	25	3	68
Lignite			5	152			1	50	6	202
Total Texas	1	7	6	188			2	75	9	270
Utah	36	2,517	17	128					53	2,645
Virginia	120	18,101	31	327			4	240	155	18,668
Washington	41	2,160							41	2,160
West Virginia	726	111,497	76	1,257	1	4	28	991	831	113,749
Wyoming	52	4,187	10	29	1	6	4	88	67	4,310
Total United States	5,066	423,290	1,226	15,979	30	273	500	17,439	6,822	456,981

[1] Includes mines where the day was more than 9 or less than 7 hours or was irregular; also includes some mines which failed to answer.

[2] Mines and men working "7 hours" included under "8 hours" for South Dakota lignite.

TABLE 20.—*Strikes, suspensions, and lock-outs in bituminous-coal and lignite mines in the United States, by States, in 1941*

State	Number of men employed	Number of men on strike	Man-days idle on account of strike	Average number of days lost on account of strike	
				Per man employed	Per man on strike
Alabama	24,935	18,558	718,801	29	39
Alaska	153	50	200	1	4
Arizona, Georgia, Idaho, and Oregon	188				
Arkansas	3,988	1,772	69,775	17	39
Colorado	7,750	5,904	98,366	13	17
Illinois	34,067	22,757	629,873	18	28
Indiana	10,265	6,542	162,198	16	25
Iowa	5,593	2,178	83,862	15	39
Kansas	2,762	61	668	(1)	11
Kentucky	56,796	42,154	1,123,975	20	27
Maryland	2,231	1,756	55,066	25	31
Michigan	757	415	9,515	13	23
Missouri	4,188	852	42,821	10	50
Montana:					
Bituminous coal	1,283				
Lignite	98				
Total Montana	1,381				
New Mexico	1,823	460	7,959	4	17
North Dakota (lignite)	1,275				
Ohio	22,160	14,120	391,325	18	28
Oklahoma	2,138	497	45,564	21	92
Pennsylvania	123,488	101,966	2,737,304	22	27
South Dakota (lignite)	69				
Tennessee	9,172	6,533	186,232	20	29
Texas:					
Bituminous coal	68				
Lignite	202				
Total Texas	270				
Utah	2,645	1,821	38,759	15	21
Virginia	18,668	14,372	329,030	18	23
Washington	2,160	190	5,320	2	28
West Virginia	113,749	100,546	2,474,995	22	25
Wyoming	4,310	341	6,688	2	20
Total United States	456,981	343,845	9,218,296	20	27

[1] One-half day or less.

BITUMINOUS COAL AND LIGNITE LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1941* [1]

Route	State	1941	
		By State	Total for route
RAILROADS			
Alabama Central	Alabama	183,295	183,295
Alabama Great Southern	do	193,246	193,246
Alaska	Alaska	235,230	235,230
Algers, Winslow & Western	Indiana	3,052,345	3,052,345
Alton	Illinois	777,160	798,666
	Missouri	21,506	
Alton & Southern	Illinois	7,008	7,008
Arkansas Western	Arkansas	5,934	5,934
Artemus-Jellico	Kentucky	423,607	423,607
Atchison, Topeka & Santa Fe	Colorado	215,420	2,071,519
	Illinois	581,149	
	Kansas	512,039	
	Missouri	13,774	
	New Mexico	749,137	

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1941*—Continued

Route	State	1941	
		By State	Total for route
RAILROADS—continued			
Baltimore & Ohio	Illinois	187,544	33,134,496
	Indiana	553,076	
	Maryland	127,092	
	Ohio	3,300,967	
	Pennsylvania	11,134,481	
	West Virginia	17,831,336	
Bessemer & Lake Erie	Pennsylvania	4,070,058	4,070,058
Bevier & Southern	Missouri	351,709	351,709
Buffalo Creek & Gauley	West Virginia	622,345	622,345
Cambria & Indiana	Pennsylvania	4,886,391	4,886,391
Campbell's Creek	West Virginia	1,070,993	1,070,993
Carbon County	Utah	437,478	437,478
Caseyville	Illinois	58,834	58,834
Central of Georgia	Alabama	1,036,173	1,069,771
	Georgia	33,598	
Chesapeake & Ohio	Kentucky	8,211,952	52,316,590
	Ohio	611,479	
	West Virginia	43,493,159	
Cheswick & Harmar	Pennsylvania	907,251	907,251
Chicago & Eastern Illinois	Illinois	1,462,404	3,086,476
	Indiana	1,624,072	
Chicago & Illinois Midland	Illinois	5,656,444	5,656,444
Chicago & North Western	do	2,740,528	2,757,944
	Wyoming	17,416	
Chicago, Attica & Southern	Indiana	11,402	11,402
Chicago, Burlington & Quincy	Colorado	375,191	9,219,614
	Illinois	7,803,196	
	Iowa	257,934	
	Missouri	65,390	
	Wyoming	717,903	
Chicago Great Western	Iowa	2,973	2,973
Chicago, Indianapolis & Louisville	Indiana	1,324,634	1,324,634
Chicago, Milwaukee, St. Paul & Pacific	do	5,201,965	6,491,540
	Iowa	423,184	
	Missouri	1,608	
	Montana (bituminous)	790,172	
	North Dakota (lignite)	66,731	
	South Dakota (lignite)		
	Washington	7,880	
Chicago, Rock Island & Pacific	Arkansas	14,233	1,033,307
	Illinois	585,629	
	Iowa	222,073	
	Missouri	113,737	
	Oklahoma	97,635	
Chicago, Springfield & St. Louis	Illinois	466,475	466,475
Cleveland, Cincinnati, Chicago & St. Louis	do	4,547,941	6,875,957
	Indiana	2,328,016	
Clinchfield	Kentucky	168,596	3,048,064
	Virginia	2,879,468	
Colorado & Southeastern	Colorado	117,443	117,443
Colorado & Southern	do	639,853	639,853
Colorado & Wyoming	do	653,698	653,698
Conemaugh & Black Lick	Pennsylvania	46,805	46,805
Crystal River & San Juan	Colorado	60	60
Cumberland & Pennsylvania	Maryland	590,202	590,202
Dardanelle & Russellville	Arkansas	22,938	22,938
Denver & Intermountain	Colorado	93,528	93,528
Denver & Rio Grande Western	do	1,367,168	3,489,196
	New Mexico	27,942	
	Utah	2,094,086	
Denver & Salt Lake	Colorado	838,797	838,797
Des Moines & Central Iowa	Iowa	81,693	81,693
Detroit, Toledo & Ironton	Ohio	18,059	18,059
East Broad Top Railroad & Coal Co	Pennsylvania	558,237	558,237
Eastern Railway & Lumber Co	Washington	110	110
Erie	Ohio	4,400	1,345,101
	Pennsylvania	1,340,701	
Evansville & Ohio Valley	Indiana	5,853	5,853
Evansville, Suburban & Newburgh	do	196,788	196,788
Fort Dodge, Des Moines & Southern	Iowa	22,371	22,371
Fort Smith & Van Buren	Oklahoma	189,157	189,157
Fort Smith & Western	do	11,235	11,235
Fort Smith, Subiaco & Rock Island	Arkansas	29,182	29,182
Galesburg & Great Eastern	Illinois	583,196	583,196

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1941*—Continued

Route	State	1941	
		By State	Total for route
RAILROADS—continued			
Grand Trunk	Michigan	20,236	20,236
Great Northern	Montana (bituminous coal)	473,387	996,810
	Montana (lignite)	394,190	
	North Dakota (lignite)		
	Washington	129,233	
Gulf, Mobile & Ohio	Alabama	141,657	960,696
	Illinois	819,039	
Harriman & Northeastern	Tennessee	133,272	133,272
Huntingdon & Broad Top Mountain Railroad & Coal Co.	Pennsylvania	225,321	225,321
Illinois Central	Alabama	240,785	15,927,955
	Illinois	9,652,654	
	Indiana	137,021	
	Kentucky	5,897,495	
Illinois Terminal	Illinois	281,946	281,946
Indiana	Indiana	483,593	483,593
International-Great Northern [2]	Texas (lignite)	[2] 329,947	[2] 329,947
Interstate	Kentucky	41,291	2,571,133
	Virginia	2,529,842	
Iowa Southern Utilities Co	Iowa	97,279	97,279
Johnstown & Stony Creek	Pennsylvania	224,116	224,116
Joplin-Pittsburg	Kansas	254,062	254,062
Kanawha Central	West Virginia	216,219	216,219
Kansas City Southern	Arkansas	974	796,481
	Kansas	747,783	
	Oklahoma	47,724	
Kansas, Oklahoma & Gulf	do	11,468	11,468
Kelley's Creek & Northwestern	West Virginia	1,674,990	1,674,990
Kentucky & Tennessee	Kentucky	782,926	782,926
Lake Erie, Franklin & Clarion	Pennsylvania	790,046	790,046
Laramie, North Park & Western	Colorado	8,349	8,349
Ligonier Valley	Pennsylvania	97,027	97,027
Litchfield & Madison	Illinois	730,238	730,238
Louisville & Nashville	Alabama	2,628,664	33,402,204
	Illinois	1,829	
	Kentucky	29,169,578	
	Tennessee	1,133,915	
	Virginia	468,218	
Mary Lee	Alabama	983,443	983,443
Michigan Central	Michigan	6,766	6,766
Midland Valley	Arkansas	469,686	605,568
	Oklahoma	135,882	
Minneapolis & St. Louis	Illinois	711,342	837,474
	Iowa	126,132	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota (lignite)	572,913	572,913
Missouri-Illinois	Illinois	30,631	30,631
Missouri-Kansas-Texas	Kansas	157,552	401,888
	Missouri	34,273	
	Oklahoma	210,063	
	Texas (lignite)	(2)	
Missouri Pacific	Arkansas	745,943	7,303,505
	Illinois	5,023,517	
	Kansas	1,129,746	
	Missouri	378,751	
	Oklahoma	25,548	
Monessen Southwestern	Pennsylvania	40,291	40,291
Monongahela	do	2,226,400	13,009,404
	West Virginia	10,783,004	
Montana, Wyoming & Southern	Montana (bituminous coal)	373,931	373,931
Montour	Pennsylvania	5,391,635	5,391,635
Morehead & North Fork	Kentucky	1,302	1,302
Nashville, Chattanooga & St. Louis	Alabama	232	912,356
	Tennessee	912,124	
New York Central (includes coal shipped over Kanawha & Michigan, Kelley's Creek, Toledo & Ohio Central, and Zanesville & Western).	Ohio	5,782,557	11,843,334
	Pennsylvania	5,095,929	
	West Virginia	964,848	
Nicholas, Fayette & Greenbrier	do	2,535,759	2,535,759
Norfolk & Western	Kentucky	4,772,265	48,952,550
	Virginia	9,936,735	
	West Virginia	34,243,550	
Northern Alabama	Alabama	114,486	114,486

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1941*—Continued

Route	State	1941	
		By State	Total for route
RAILROADS—continued			
Northern Pacific	Montana (bituminous coal)	1,396,657	3,086,119
	North Dakota (lignite)	717,087	
	Washington	972,375	
Oneida & Western	Tennessee	35,350	35,350
Pacific Coast	Washington	199,064	199,064
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis).	Illinois	171,980	48,666,878
	Indiana	3,494,987	
	Ohio	6,022,252	
	Pennsylvania	37,866,786	
	West Virginia	1,110,873	
Peoria Terminal	Illinois	330,923	330,923
Pere Marquette	Michigan	92,643	92,643
Pittsburg & Shawmut	Pennsylvania	1,628,469	1,628,469
Pittsburg County	Oklahoma	8,142	8,142
Pittsburgh & Lake Erie	Pennsylvania	3,590,629	3,590,629
Pittsburgh & West Virginia	Ohio	809,501	2,067,516
	Pennsylvania	1,068,064	
	West Virginia	189,951	
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	2,508	2,508
Pittsburgh, Lisbon & Western	Ohio	20,642	24,881
	Pennsylvania	4,239	
Pittsburg, Shawmut & Northern	do	674,911	674,911
Preston	West Virginia	190,159	190,159
Rio Grande Southern	Colorado	6,769	6,769
Rockdale, Sandow & Southern	Texas (lignite)	(2)	(2)
St. Louis & Hannibal	Missouri	2,360	2,360
St. Louis & O'Fallon	Illinois	368,123	368,123
St. Louis-San Francisco	Alabama	1,366,446	3,635,055
	Arkansas	210,159	
	Kansas	842,746	
	Missouri	380,371	
	Oklahoma	835,333	
St. Louis Southwestern of Texas	Texas (lignite)	(2)	(2)
Seaboard Air Line	Alabama	101,261	101,261
Southern	do	2,496,801	9,369,951
	Illinois	3,244	
	Indiana	1,304,345	
	Kentucky	1,194,107	
	Tennessee	2,953,063	
	Virginia	1,418,391	
Southern Pacific	New Mexico	290,013	290,013
Springfield Terminal	Illinois	503,177	503,177
Susquehanna & New York	Pennsylvania	2,000	2,000
Tennessee	Tennessee	828,726	828,726
Tennessee Central	do	415,379	415,379
Tennessee Coal, Iron & Railroad Co	Alabama	2,957,071	2,957,071
Texas & Pacific	Texas (bituminous coal)	10,074	10,074
Texas Short Line	Texas (lignite)	(2)	(2)
Thomas & Sayreton	Alabama	795,564	795,564
Toledo, Peoria & Western	Illinois	120,186	120,186
Union	Pennsylvania	138,885	138,885
Union Pacific	Colorado	642,551	6,279,577
	Utah	26,244	
	Washington	30,839	
	Wyoming	5,579,943	
Unity	Pennsylvania	776,645	776,645
Utah	Utah	985,306	935,306
Virginian	Virginia	179,892	13,055,749
	West Virginia	12,875,857	
Wabash	Illinois	1,551,207	2,041,528
	Iowa	55,534	
	Missouri	433,787	
Western Allegheny	Pennsylvania	216,092	216,092
Western Maryland	Maryland	709,915	5,338,570
	Pennsylvania	513,079	
	West Virginia	4,115,576	
West Virginia Northern	do	311,413	311,413
Wheeling & Lake Erie	Ohio	4,770,461	4,770,461
Winifrede	West Virginia	85,665	85,665
Woodward Iron Co	Alabama	841,879	841,879
Total railroad shipments		425,184,319	425,184,319

See footnotes at end of table.

TABLE 21.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1941*—Continued

Route	State	1941	
		By State	Total for route
WATERWAYS			
Allegheny River	Pennsylvania	1,048,724	1,048,724
Black Warrior River	Alabama	195,480	195,480
Illinois River	Illinois	489,375	489,375
Kanawha River	West Virginia	2,127,532	2,127,532
Monongahela River	Pennsylvania	24,490,010	24,732,051
	West Virginia	242,041	
Muskingum River	Ohio	934,094	934,094
Ohio River	Kentucky	219,836	689,543
	Ohio	54,886	
	Pennsylvania	1,869	
	West Virginia	412,952	
Youghiogheny River	Pennsylvania	23,690	23,690
Total waterway shipments		30,240,489	30,240,489
Total loaded at mines for shipment by railroads and waterways.		455,424,808	455,424,808
Shipped by truck or wagon		40,055,638	40,055,638
Taken by locomotive tenders at tipple		1,099,582	1,099,582
Shipped by conveyor belt or tram to point of consumption.		6,067,697	6,067,697
Coal used by employees		1,872,026	1,872,026
Used at mine for power and heat		2,488,950	2,488,950
Made into beehive coke at mine		7,140,544	7,140,544
Total production		514,149,245	514,149,245

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water. In general, the figures show the quantity of bituminous coal and lignite originated for each railroad and waterway, as reported by the mine operators. It must be noted that in 1 year an operator may report coal loaded on the subsidiary railroad and in another year the same operator may report coal loaded on the parent railroad system.

[2] Texas lignite mines shipping over the Missouri-Kansas-Texas, Rockdale, Sandow & Southern, St. Louis Southwestern of Texas, and the Texas Short Line have been included with the International-Great Northern.

METHODS OF RECOVERY

TABLE 22.—*Bituminous coal and lignite mined by different methods in the United States, by States, in 1941*

State	From underground workings							From strip pits		Grand total production (net tons)
	Mined by hand		Shot off the solid		Cut by machines		Total underground (net tons)	Net tons	Percent of grand total	
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground				
Alabama	449,362	2.9	3,206,397	21.1	11,570,317	76.0	15,226,076	238,447	1.5	15,464,523
Alaska	69,665	29.2	169,295	70.8			238,960			238,960
Arizona, Georgia, Idaho, and Oregon	2,180	4.0	52,637	96.0			54,817			54,817
Arkansas	3,566	.2	130,015	8.8	1,353,201	91.0	1,486,782	87,390	5.6	1,574,172
Colorado	1,615,196	23.3	420,597	6.1	4,897,050	70.6	6,932,843	15,689	.2	6,948,532
Illinois	747,639	1.8	1,989,054	4.9	38,020,958	93.3	40,757,651	13,945,633	25.5	54,703,284
Indiana	41,011	.4	508,793	5.2	9,195,119	94.4	9,744,923	12,739,006	56.7	22,483,929
Iowa	298,294	13.3	974,471	43.5	969,360	43.2	2,242,125	696,501	23.7	2,938,626
Kansas	68,760	8.9	390,051	50.6	312,441	40.5	771,252	3,236,320	80.8	4,007,572
Kentucky	1,673,625	3.2	1,500,913	2.9	49,286,683	93.9	52,461,221	1,249,125	2.3	53,710,346
Maryland	822,056	48.7			865,853	51.3	1,687,909	12,665	.7	1,700,574
Michigan			315	.1	310,460	99.9	310,775			310,775
Missouri	183,780	16.0	108,136	9.5	853,751	74.5	1,145,667	1,999,621	63.6	3,145,288
Montana (bituminous coal)	11,948	.7	25,102	1.4	1,761,938	97.9	1,798,988	1,395,943	43.7	3,194,931
Montana and Texas (lignite)	14,818	4.6	291,195	91.2	13,434	4.2	319,447	76,672	19.4	396,119
New Mexico	490,731	39.2	250,965	20.1	509,424	40.7	1,251,120			1,251,120
North Dakota (lignite)	7,161	.9	188,754	24.2	585,829	74.9	781,744	1,527,144	66.1	2,308,888
Ohio	316,212	1.4	154,257	.7	21,533,127	97.9	22,003,596	7,315,247	25.0	29,318,843
Oklahoma	4,402	.4	199,891	19.5	821,428	80.1	1,025,721	745,387	42.1	1,771,108
Pennsylvania	17,659,297	14.5	3,380,755	2.8	100,769,853	82.7	121,809,905	8,429,778	6.5	130,239,683
South Dakota (lignite)	150	3.4	4,245	96.6			4,395	66,430	93.8	70,825
Tennessee	981,906	13.9	871,749	12.4	5,190,016	73.7	7,043,671	1,600	(1)	7,045,271
Texas (bituminous coal)	15,482	100.0					15,482			15,482
Utah	16,635	.4	160,315	3.9	3,899,829	95.7	4,076,779			4,076,779
Virginia	49,747	.3	1,471,630	8.0	16,916,852	91.7	18,438,229	2,717	(1)	18,440,946
Washington	244,548	13.4	626,537	34.2	958,074	52.4	1,829,159	12,115	.7	1,841,274
West Virginia	6,853,305	4.9	678,868	.5	131,619,456	94.6	139,151,629	1,098,619	.8	140,250,248
Wyoming	30,800	.4	140,127	2.2	6,295,843	97.4	6,466,770	179,560	2.7	6,646,330
Total	32,672,276	7.1	17,895,064	3.9	408,510,296	89.0	459,077,636	55,071,609	10.7	514,149,245

[1] Less than 0.05 percent.

TABLE 23.—*Number of coal-cutting machines in bituminous-coal and lignite mines, average output per machine, and percent of total product of underground mines cut by machines in the United States, by States, in 1941*

State	Number of coal-cutting machines in use			Average output per machine (net tons)	Percent of total product of underground mines cut by machines
	Permissible	Other	Total		
Alabama	224	328	552	20,961	76.0
Arkansas	85	59	144	9,397	91.0
Colorado	211	221	432	11,336	70.6
Illinois	252	655	907	41,919	93.3
Indiana	122	123	245	37,531	94.4
Iowa	48	53	101	9,598	43.2
Kansas	38	13	51	6,126	40.5
Kentucky	469	1,072	1,541	31,984	93.9
Maryland	40	8	48	18,039	51.3
Michigan	12	26	38	8,170	99.9
Missouri	67	27	94	9,082	74.5
Montana:					
Bituminous coal	21	47	68	25,911	97.9
Lignite	(1)	(1)	(1)	(1)	(1)
New Mexico	27	28	55	9,262	40.7
North Dakota (lignite)	[1] 11	[1] 9	[1] 20	[1] 29,963	[1] 71.6
Ohio	302	631	933	23,079	97.9
Oklahoma	66	31	97	8,468	80.1
Pennsylvania	2,134	1,222	3,356	30,027	82.7
Tennessee	41	153	194	26,753	73.7
Utah	89	37	126	30,951	95.7
Virginia	117	212	329	51,419	91.7
Washington	49	3	52	18,425	52.4
West Virginia	897	2,046	2,943	44,723	94.6
Wyoming	53	229	282	22,326	97.4
Total, United States	5,375	7,233	12,608	32,401	89.0

[1] Montana (lignite) included with North Dakota.

STRIPPING OPERATIONS

TABLE 24.—*Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1941*

[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 mines are also shown]

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Average number of employees				Average number of days mines were active	Number of man-days worked	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, Jefferson, Marion, and Walker	8	10	1	3	238,447	251,623	19	141	40	200	253	50,697	4.96
Arkansas:													
Franklin and Johnson	3	1	----------	3	48,331	48,331	----------	39	8	47	171	8,019	6.03
Sebastian	7	2	----------	3	39,059	41,788	5	81	22	108	91	9,806	4.26
Total Arkansas	10	3	----------	6	87,390	90,119	5	120	30	155	115	17,825	5.06
Illinois:													
Crawford, Grundy, Hancock, Henry, Jackson, Knox, Livingston, McDonough, Randolph, Saline, Schuyler, Will, and Williamson	19	1	25	30	5,447,128	5,579,422	52	797	628	1,477	240	354,801	15.73
Fulton	7	----------	17	7	4,177,304	4,177,304	----------	357	387	744	244	181,565	23.01
La Salle	7	----------	2	9	174,622	174,622	----------	64	42	106	165	17,489	9.98
Perry	3	----------	14	4	2,875,428	2,875,428	----------	389	300	689	241	165,735	17.35
St. Clair	3	----------	5	8	1,002,230	1,002,230	----------	107	69	176	252	44,406	22.57
Vermilion	3	----------	----------	6	268,921	268,921	----------	37	36	73	124	9,024	29.80
Total Illinois	42	1	63	64	13,945,633	14,077,927	52	1,751	1,462	3,265	237	773,020	18.21
Indiana:													
Clay	30	5	11	45	1,925,826	1,925,826	----------	460	315	775	192	149,097	12.92
Daviess, Dubois, Knox, Owen, and Spencer	6	----------	2	9	460,205	460,205	----------	82	74	156	195	30,427	15.12
Fountain	6	----------	----------	7	79,658	79,658	----------	34	11	45	162	7,275	10.95
Greene	14	7	10	13	1,838,455	1,838,455	----------	275	407	682	207	141,383	13.00
Pike	17	4	14	19	4,225,665	4,225,665	----------	483	485	968	210	203,370	20.78
Sullivan	8	2	3	8	729,487	729,487	----------	139	158	297	212	63,026	11.57

TABLE 24.—*Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1941*—Con.

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Average number of employees				Average number of days mines were active	Number of man-days worked	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				
Indiana—Continued.													
Vermillion	4		2	3	241,882	241,882		76	56	132	121	15,987	15.13
Vigo	7		4	9	1,216,762	1,216,762		166	223	389	187	72,836	16.71
Warrick	4		8	5	2,021,066	2,021,066		170	253	423	261	110,403	18.31
Total Indiana	96	18	54	118	12,739,006	12,739,006		1,885	1,982	3,867	205	793,804	16.05
Iowa:													
Davis, Greene, Jasper, Keokuk, Monroe, Polk, Warren, and Webster	10		2	8	49,802	49,802		59	35	94	99	9,310	5.35
Mahaska	11			20	272,316	272,316		96	61	157	191	29,921	9.10
Marion	21			26	286,014	286,744	2	139	38	179	191	34,184	8.39
Van Buren	4			4	15,262	15,262		15	5	20	145	2,908	5.25
Wapello	5			9	73,107	73,107		22	29	51	179	9,125	8.01
Total Iowa	51		2	67	696,501	697,231	2	331	168	501	171	85,448	8.16
Kansas:													
Bourbon	4	3	2	1	169,351	169,351		44	20	64	221	14,156	11.96
Cherokee	9	3	9	3	1,012,045	1,012,045		128	197	325	218	70,688	14.32
Crawford	17	15	14	4	1,297,457	1,297,457		284	198	482	189	90,918	14.27
Labette	3	2		1	16,268	16,268		15	6	21	163	3,428	4.75
Linn and Osage	4	3	2	2	741,199	741,199		54	74	128	242	30,957	23.94
Total Kansas	37	26	27	11	3,236,320	3,236,320		525	495	1,020	206	210,147	15.40
Kentucky:													
Christian and Hopkins	5	3	4	6	1,236,778	1,239,253	60	132	125	317	190	60,322	20.54
Laurel and Whitley	3	1		3	12,347	12,347		27	11	38	87	3,309	3.73
Total Kentucky	8	4	4	9	1,249,125	1,251,600	60	159	136	355	179	63,631	19.67
Missouri:													
Barton	5	4	2		221,127	221,127		61	31	92	173	15,939	13.87
Bates	7	5		2	107,997	107,997		65	7	72	167	12,026	8.98
Boone	3	1		3	14,471	14,471		18	2	20	162	3,241	4.46
Callaway	4	3		4	158,238	158,238		48	14	62	287	17,823	8.88

Cedar, Clark, Dade, Howard, Jasper, Johnson, Lincoln, Macon, Moniteau, Monroe, Morgan, Ralls, and Randolph	16	3	6	15	849,323	851,931	4	209	135	348	186	64,606	13.19
Henry	16	10	7	4	582,348	583,528	3	201	106	310	172	53,255	10.96
Vernon	7	8		1	66.117	66,117		51	14	65	150	9,718	6.80
Total Missouri	58	34	15	29	1,999,621	2,003,409	7	653	309	969	182	176,608	11.34
Montana and Texas: Lignite	4	2	2	3	76,672	76,672		38	1	39	73	2,847	26.93
North Dakota: Lignite	67	9	8	29	1,527,144	1,527,144		444	92	536	175	93,878	16.27
Ohio:													
Belmont	4			9	76,400	76,400		42	32	74	94	6,928	11.03
Carroll	7	1		12	294,064	302,064	6	89	54	149	228	33,960	8.89
Columbiana	17	2		38	788,508	788,508		159	77	236	244	57,555	13.70
Coshocton	3	2		3	24,317	53,453	14	16	12	42	243	10,226	5.23
Gallia, Hocking, Holmes, Portage, and Wayne	6	1		10	127,166	127,166		45	22	67	227	15,219	8.36
Harrison	9		4	18	1,492,548	1,657,188	125	214	127	466	202	94,328	17.57
Jackson	5			3	32,881	32,881		22	7	29	192	5,564	5.91
Jefferson	12	5	4	17	2,055,170	2,055,170		326	232	558	191	106,397	19.32
Mahoning	9	3	1	16	387,157	387,157		97	31	128	261	33,355	11.61
Muskingum	3	3		5	54,062	54,062		17	10	27	204	5,516	9.80
Perry	4		1	9	256,603	260,203	7	49	27	83	258	21,413	12.15
Stark	18	1		46	857,984	859,876	4	265	95	364	238	86,487	9.94
Tuscarawas	29	9	2	42	770,074	770,074		270	90	360	228	82,119	9.38
Vinton	8	1		8	98,313	109,869	12	74	13	99	243	24,056	4.57
Total Ohio	134	28	12	236	7,315,247	7,534,071	168	1,685	829	2,682	217	583,123	12.92
Oklahoma:													
Coal, Haskell, Rogers, Sequoyah, and Wagoner	8	7	6	4	731,744	731,744		160	83	243	252	61,252	11.95
Craig	3	2		1	13,643	13,643		23		23	168	3,864	3.53
Total Oklahoma	11	9	6	5	745,387	745,387		183	83	266	245	65,116	11.45
Pennsylvania:													
Allegheny	32	6		39	843,543	1,027,928	164	206	138	508	187	94,941	10.83
Armstrong	9	1	2	14	585,166	862,266	266	150	105	521	196	102,046	8.45
Beaver	9	2	1	26	844,568	844,568		181	59	240	282	67,629	12.49
Butler	10	1		17	384,788	403,988	21	96	35	152	196	29,753	13.58
Cambria, Cameron, Clinton, Fulton, Lycoming, and McKean	7	4	3	4	111,727	322,133	248	70	39	357	208	74,250	4.34
Center	7	4		10	234,277	395,399	275	96	27	398	192	76,269	5.18
Clarion	14	3		34	915,661	915,661		288	114	402	142	56,899	16.09
Clearfield	28	10		31	707,597	796,977	141	284	99	524	173	90,841	8.77
Fayette	25	6		22	558,934	618,622	93	246	96	435	120	52,103	11.87
Jefferson	6	2		8	314,961	327,221	20	122	33	175	168	29,330	11.16
Lawrence	3			5	74,085	83,996	14	16	36	66	180	11,872	7.08
Mercer	4			11	231,379	237,441	9	42	32	83	219	18,211	13.04
Somerset	3			6	163,179	163,179		41	26	67	190	12,700	12.85
Tioga	3			4	94,060	94,060		30	8	38	177	6,734	13.97

TABLE 24.—*Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1941*—Con.

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Average number of employees				Average number of days mines were active	Number of man-days worked	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				
Pennsylvania—Continued.													
Washington	17	5	2	21	1,662,660	1,910,054	206	296	174	676	227	153,647	12.43
Westmoreland	27	6	1	30	703,193	807,899	86	350	117	553	151	83,422	9.68
Total Pennsylvania	204	50	9	282	8,429,778	9,811,392	1,543	2,514	1,138	5,195	185	960,647	10.21
South Dakota: Lignite	8			7	66,430	66,430		44	7	51	195	9,962	6.67
West Virginia:													
Brooke	7			16	517,888	517,888		97	63	160	159	25,383	20.40
Hancock, Mineral, and Monongalia	5			10	180,209	695,721	183	57	80	320	252	80,560	8.64
Harrison	4	1		6	152,027	152,027		49	28	77	78	6,015	25.27
Preston	3	2		4	248,495	305,026	66	45	66	177	205	36,300	8.40
Total West Virginia	19	3		36	1,098,619	1,670,662	249	248	237	734	202	148,258	11.27
Wyoming: Campbell, Carbon, Converse, and Sheridan	5	2	2		179,560	179,560		56	16	• 72	221	15,942	11.26
Other States [1]	7	1	5	6	1,440,729	1,490,011	44	84	29	157	225	35,270	42.25
Total United States	769	200	210	911	55,071,609	57,448,564	2,149	10,861	7,054	20,064	204	4,086,223	14.06

[1] Includes Colorado, Maryland, Montana (bituminous coal), Tennessee, Virginia, and Washington.

TABLE 25.—*Summary of operations of power strip pits proper in the bituminous-coal and lignite fields of the United States, by States, in 1941*

State	Number of strip pits	Number of power shovels			Mined by stripping [1] (net tons)	Number of men employed	Average number of days mines were active	Average tons per man per day
		Steam	Electric	All others				
Power strip pits proper:								
Alabama	5	9	1	1	235,112	166	267	5.31
Arkansas	7	3	-------	6	86,071	145	113	5.25
Illinois	41	1	60	64	13,394,382	3,063	238	18.41
Indiana	90	18	54	118	12,727,256	3,853	205	16.09
Iowa	46	-------	2	67	688,457	479	174	8.26
Kansas	34	26	27	11	3,230,712	1,007	206	15.57
Kentucky	7	4	4	7	1,202,089	261	230	20.05
Missouri	49	34	15	28	1,978,812	924	184	11.67
North Dakota (lignite)	28	9	8	29	1,500,711	450	193	17.26
Ohio	125	27	12	227	7,121,307	2,379	218	13.70
Oklahoma	11	9	6	5	745,387	266	245	11.45
Pennsylvania	161	33	6	245	7,543,594	3,044	174	14.23
South Dakota (lignite)	4	-------	-------	7	63,372	43	210	7.01
West Virginia	17	2	-------	34	1,093,675	389	173	16.23
Other States [2]	12	5	9	8	1,673,438	196	202	42.23
Total	637	180	204	857	53,284,375	16,665	205	15.59
Horse stripping operations	75	-------	-------	-------	113,726	240	112	4.22
Mines combining stripping and underground methods in the same operations [3]	57	20	6	54	1,673,508	[4] 3,159	[4] 203	[4] 6.31
Grand total	769	200	210	911	55,071,609	[4] 20,064	[4] 204	[4] 14.06

[1] Excludes coal produced by underground mining conducted in the same operation.
[2] Includes Colorado, Maryland, Montana (bituminous coal and lignite), Tennessee, Texas (lignite), Virginia, and Wyoming.
[3] Includes operations in Alabama, Arkansas, Illinois, Iowa, Kentucky, Missouri, Ohio, Pennsylvania, Washington, and West Virginia, in which the output was obtained by both methods. In addition to the 1,673,508 tons produced by stripping, this group of 57 mines obtained 2,376,955 tons by underground methods, their total production by both methods being 4,050,463 tons.
[4] Includes data on underground mining conducted in the same operation.

POWER DRILLING

TABLE 26.—*Summary of operations of underground bituminous-coal and lignite mines in the United States where shot holes were power-drilled, in 1941*

State	Number of mines using power drills		Number of power drills								Net tons produced in working places where shot holes were power-drilled			Total production from mines using power drills (net tons)		
			Electric				Compressed air									
	In coal and coal and rock	In rock only	In coal only	In coal and rock	In rock only	Total	In coal only	In coal and rock	In rock only	Total	Electric drills	Compressed air drills	Total	In coal and coal and rock	In rock only	Total
Alabama	48	9	547	286	9	842	1	------	134	135	8,813,263	81,925	8,895,188	12,199,919	815,443	13,015,362
Arkansas	10	17	20	------	17	37	3	2	42	47	238,682	38,118	276,800	341,078	657,062	998,140
Colorado	58	2	216	87	3	306	------	------	23	23	3,530,576	----------	3,530,576	5,126,755	306,830	5,433,585
Illinois	114	2	936	65	9	1,010	1	------	20	21	34,825,384	11,278	34,836,662	35,559,552	250,463	35,810,015
Indiana	26	1	146	38	4	188	------	------	7	7	8,077,117	----------	8,077,117	8,090,996	42,926	8,133,922
Iowa	7	------	17	3	------	20	5	------	------	5	169,126	31,593	200,719	543,320	----------	543,320
Kentucky	177	28	789	105	80	974	5	------	108	113	30,184,979	260,922	30,445,901	39,179,108	5,126,920	44,306,028
Maryland	4	3	18	2	4	24	------	------	1	1	353,059	----------	353,059	671,402	111,096	782,498
Michigan	5	1	5	5	3	13	------	------	1	1	71,893	----------	71,893	209,178	22,946	232,124
Missouri	------	10	------	------	5	5	------	------	5	5	----------	----------	----------	----------	292,550	292,550
Montana (bituminous coal and lignite)	10	------	47	------	------	47	------	------	1	1	1,691,723	----------	1,691,723	1,691,723	----------	1,691,723
New Mexico	3	1	22	------	------	22	------	------	11	11	298,725	----------	298,725	520,136	310,753	830,889
Ohio	47	5	213	91	25	329	4	------	9	13	13,003,117	122,145	13,125,262	14,475,879	963,347	15,439,226
Pennsylvania	145	59	901	318	139	1,358	110	7	445	562	46,225,900	4,350,213	50,576,113	70,830,803	19,529,351	90,360,154
Tennessee	24	6	81	9	7	97	------	------	22	22	2,059,767	----------	2,059,767	3,554,859	1,137,145	4,692,004
Utah	20	------	106	2	1	109	------	------	9	9	3,733,735	----------	3,733,735	3,770,246	----------	3,770,246
Virginia	31	12	158	------	16	174	1	1	42	44	7,357,426	50,955	7,408,381	9,449,307	3,631,035	13,080,342
Washington	17	------	71	19	------	90	73	12	27	112	526,448	835,837	1,362,285	1,619,978	----------	1,619,978
West Virginia	256	56	1,304	229	81	1,614	10	------	304	314	62,842,339	400,636	63,242,975	88,976,639	22,385,172	111,361,811
Wyoming	27	------	365	21	1	387	34	------	7	41	6,208,438	110,993	6,319,431	6,333,492	----------	6,333,492
Other States [1]	24	1	40	11	------	51	13	1	1	15	629,277	77,275	706,552	820,413	30,144	850,557
Total United States	1,053	213	6,002	1,291	404	7,697	260	23	1,219	1,502	230,840,974	6,371,890	237,212,864	303,964,783	55,613,183	359,577,966

[1] Alaska, Kansas, North Dakota (lignite), Oklahoma, and South Dakota (lignite).

MECHANICAL LOADING IN UNDERGROUND BITUMINOUS-COAL AND LIGNITE MINES

Mechanical loading devices used in underground bituminous-coal and lignite mines are divided into two general classes: Those that practically eliminate hand-shoveling, which are known as mobile loaders, scrapers, and self-loading conveyors or duckbills; and those that greatly reduce the labor of hand-shoveling, which are known as hand-loaded face conveyors and pit-car loaders.

The first systematic record of mechanical loading began in 1923 when 60 mines loaded 1,879,726 net tons (0.3 percent of the underground output) with the aid of mechanical loading devices. Ten years later (in 1933) mechanical loading had spread to 283 mines, and 37,820,461 net tons (12 percent of the total underground output) were loaded mechanically. Since 1933 the proportion mechanically loaded has increased each year and in 1941 it amounted to 41 percent of the total underground bituminous coal and lignite mined in the United States.

During the 3 years 1939–41 the percentage loaded by each class has been fairly constant, the mobile loaders, scrapers, and duckbills handling about 76 percent and the hand-loaded conveyors and pit-car loaders about 24 percent of the total.

Detailed statistics on mechanical loading given in the following tables (27 to 33, inclusive) pertain to underground coal mines and do not include strip mines or equipment used for handling coal on the surface. All tonnage figures on coal mechanically loaded include the initial phase of loading only; for instance, if conveyors were used in conjunction with mobile loaders, the tonnage is shown under mobile loading machines and not under conveyors.

Sales of mechanical loading equipment in 1942.—The estimated capacity of mechanical loading equipment sold for underground use in all coal mines was 7.7 percent less in 1942 than in 1941. This decrease was due in part to some of the manufacturers devoting a portion of their facilities to war work. Table 27 shows the sales reported, by type of equipment, and the number of manufacturers reporting for 1935–42.

Sales of conveyors to bituminous-coal and lignite mines in 1942 totaled 1,167 units. This figure excludes duckbills, which have been included in all previous years. Therefore, the figures for 1942 are not comparable with those for 1941 or earlier years. By excluding sales of duckbills, some of the overlapping sales of conveyors are eliminated. For instance, in 1940 there were 2,919 conveyors, including those hand-loaded and those equipped with duckbills, in active use at bituminous-coal and lignite mines, as reported by mine operators. By adding 1940 conveyor and duckbill sales of 1,573 units, 4,492 units appeared available for use in 1941, whereas the actual number reported in use by mine operators was 3,595, or 897 less. This difference represents idle or worn-out and obsolete equipment, duplications in reporting sales, and a small number of conveyors used in conjunction with mobile loaders.

The number of mobile loaders, scrapers, and conveyors shipped into the various States and groups of States in 1942 and the number

of units in actual use in 1941 are shown in table 29. Pennsylvania bituminous-coal mines received the largest number of mobile loaders sold in 1942; West Virginia was in second place, and Alabama and Kentucky tied for third place.

All of the 15 scraper units sold in 1942 went to the bituminous-coal mines.

Conveyor sales in 1942, in relation to the number in actual use in 1941, were greater in the Middle Western States than in any other regions.

Detailed statistics of mechanical loading in bituminous-coal and lignite mines in 1940 and 1941, by types of equipment.—During 1941, the latest year for which records are available, the approximate percentage of the tonnage loaded by each type of equipment was as follows: Mobile loaders, 68; hand-loaded conveyors, 21; duckbills, 8; pit-car loaders, 2; and scrapers, 1.

Mobile loaders have handled more coal than any other type of mechanical loading device, and since 1934 they have loaded more than all the other types together. The most common method of employing mobile loaders is for loading coal directly into mine cars, but they also load into shuttle cars (rubber-tired trackless haulage units) and onto conveyors. During 1941, 86 percent of the bituminous coal and lignite handled by mobile loaders was loaded directly into mine cars, 11 percent into shuttle cars, and 3 percent onto conveyors.

In the underground bituminous-coal and lignite mines, 1,985 mobile loaders handled 126,478,074 net tons in 1941, an average of 63,717 tons per mobile loader per year; hand-loaded face conveyors averaged 14,440; duckbills, 18,932; pit-car loaders, 5,679; and scrapers, 11,832 per year per unit for the same period (see tables 30 and 31).

Mechanical loading, by States.—Illinois led all other States in underground tonnage mechanically loaded from 1928 to 1938; then it was passed by West Virginia in 1939. In 1941, West Virginia produced 57,511,968 net tons of mechanically loaded coal, followed by Pennsylvania with 35,164,964 net tons, Illinois with 33,273,976, Ohio with 11,943,605, and Kentucky with 11,496,678. These five States produced 80 percent of the total output of mechanically loaded bituminous coal in the United States in 1941.

Detailed data, by States, on number of mines and machines and production of mechanically loaded coal compared with total production at mines using mechanical loading devices are given in table 31. Comparative changes in underground mechanical loading in 1940–41, by States, are shown in table 32.

Table 33 gives bituminous coal and lignite mined by stripping compared with underground hand-loaded and machine-loaded tonnage, by States, for 1941.

TABLE 27.—*Units of mechanical loading equipment sold to bituminous-coal, anthracite, and lignite mines for underground use in the United States, as reported by manufacturers, 1935–42, inclusive*

	1935	1936	1937	1938	1939	1940	1941	1942	Change, 1942 from 1941 (percent)
Type of equipment:									
Mobile loaders	115	344	292	241	292	233	368	352	−4.3
Scrapers [1]	22	28	29	10	26	39	11	29	+163.6
Conveyors [2]	681	994	1,095	990	1,311	1,762	2,130	[3] 1,491	(3)
Pit-car loaders	28	11	32	139	2	3	10	2	−80.0
Total, all types	846	1,377	1,448	1,380	1,631	2,037	2,519	[3] 1,874	(3)
Number of manufacturers reporting	28	28	28	29	31	32	32	28	

[1] Reported as scrapers or scraper haulers and hoists.
[2] Includes hand-loaded conveyors and those equipped with duckbills and other self-loading heads. Sales of both loading heads and shaker conveyors are counted for 1935–41, inclusive, but the figure for 1942 does not include loading heads separately; see text for additional explanation.
[3] Not comparable with previous years; see footnote 2.

TABLE 28.—*Sales of mechanical loading equipment in the United States in 1942 compared with total number of machines in active use in preceding years*

	Number of machines in active use as reported by mine operators									Number of machines sold as reported by manufacturers in 1942
	1933	1934	1935	1936	1937	1938	1939	1940	1941	
Bituminous-coal and lignite mines:										
Mobile loading machines	523	534	657	980	(1)	1,405	1,573	1,720	1,985	352
Scrapers	93	119	78	106	(1)	117	131	116	109	15
Pit-car loaders	2,453	2,288	2,098	1,851	(1)	1,392	873	697	607	2
Conveyors equipped with duckbills and other self-loading heads	132	157	179	234	(1)	346	559	656	788	(2)
Hand-loaded conveyors—number of units	525	574	670	936	(1)	1,526	1,834	2,263	2,807	[2] 1,167
Anthracite mines (Pennsylvania):										
Mobile loading machines	18	14	1	(3)	(4)	(4)	(4)	(3)	(3)	
Scrapers	455	517	507	[3] 504	539	545	535	[3] 547	[3] 505	14
Pit-car loaders	19	25	22	(5)	(4)	(4)	(4)	(5)	(5)	
Conveyors equipped with duckbills and other self-loading heads	12	13	30	(5)	(4)	(4)	(4)	(5)	(5)	(2)
Hand-loaded conveyors—number of units	940	1,338	1,563	[5] 1,790	[4] 1,855	[4] 1,831	[4] 1,997	[5] 2,189	[5] 2,432	[2] 324

[1] Data for 1937 not available for bituminous-coal and lignite mines.
[2] Conveyors equipped with duckbills are included with hand-loaded conveyors. In sales for 1942 loading heads were not counted as a separate unit.
[3] Mobile loading machines are included with scrapers.
[4] Mobile loading machines, pit-car loaders, and conveyors equipped with duckbills and other self-loading heads are included with hand-loaded conveyors.
[5] Pit-car loaders and conveyors equipped with duckbills and other self-loading heads are included with hand-loaded conveyors.

TABLE 29.—*Comparison of mobile loaders, scrapers, and conveyors in actual use in bituminous-coal and lignite mines in the United States in 1941 with sales reported in 1942, by States and regions*

State and region	Mobile loaders		Scrapers		Conveyors [1]	
	In use in 1941	Sales in 1942	In use in 1941	Sales in 1942	In use in 1941	Sales in 1942
Northern Appalachian States:						
Pennsylvania	373	116	26	2	734	191
Maryland					28	
Ohio	122	31			153	75
Michigan					5	
Southern Appalachian States:						
Alabama	29	32	48	4	330	100
Kentucky	142	32			284	81
Tennessee	3				90	23
West Virginia	464	75	5	3	1,077	485
Virginia	41	2			111	45
Middle Western States:						
Illinois	540	28			20	32
Indiana	135	13			14	2
Trans-Mississippi States [2]	136	23	30	6	749	133
Total	1,985	352	109	15	3,595	1,167

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading devices.
[2] Includes Arkansas, Colorado, Iowa, Montana, New Mexico, North Dakota, Oklahoma, Utah, Washington, and Wyoming.

TABLE 30.—*Bituminous coal and lignite mechanically loaded underground in the United States, 1940–41, by types of machines*

Type of machine	1940		1941	
	Net tons	Percent	Net tons	Percent
Mobile loading machines	100,961,745	68.3	126,478,074	67.8
Scraper loaders	1,255,396	.8	1,289,710	.7
Conveyors equipped with duckbills or other self-loading devices	10,361,694	7.0	14,918,583	8.0
Pit-car loaders	3,979,209	2.7	3,447,028	1.8
Hand-loaded conveyors	31,312,208	21.2	40,533,855	21.7
Grand total loaded mechanically	147,870,252	100.0	186,667,250	100.0

TABLE 31.—*Mechanical loading underground in bituminous-coal and lignite mines in the United States, by States, in 1941*

[This table includes all soft-coal mines that produced any part of their tonnage with the aid of mechanical loading devices in 1941]

State	Number of mines				Number of machines					Production mechanically loaded (net tons)			Total production at mines using mechanical loading devices (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills and other self-loading devices	Pit-car loaders	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	15	24	6	45	29	48	2	35	328	2,006,569	3,841,428	5,847,997	4,354,383	4,934,111	2,641,677	11,930,171
Arkansas	2	26	------	28	------	12	------	------	77	(4)	(4)	1,053,603	(4)	(4)	------	1,053,603
Colorado	24	25	5	54	23	------	120	4	109	2,090,978	851,409	2,942,387	3,137,786	1,124,268	605,063	4,867,117
Illinois	49	7	12	68	540	------	6	187	14	32,173,463	1,100,513	33,273,976	27,470,071	477,562	6,453,479	34,401,112
Indiana	21	4	3	28	135	------	7	21	7	8,070,401	189,901	8,260,302	7,757,932	98,267	660,011	8,516,210
Iowa	1	4	------	5	3	------	------	------	19	(4)	(4)	174,958	(4)	(4)	------	506,760
Kentucky	54	27	11	92	142	------	130	29	154	9,631,877	1,864,801	11,496,678	13,084,681	6,460,043	4,243,534	23,788,258
Maryland	------	4	------	4	------	------	------	------	28	------	(4)	(4)	------	(4)	------	(4)
Michigan	------	1	------	1	------	------	------	------	5	------	(4)	(4)	------	(4)	------	(4)
Montana (bituminous coal)	6	------	1	7	41	------	2	6	------	(4)	(4)	1,621,024	(4)	------	(4)	1,653,089
New Mexico	3	------	------	3	7	10	------	------	------	(4)	------	(4)	(4)	------	------	(4)
North Dakota (lignite)	1	------	------	1	3	------	------	------	------	(4)	------	(4)	(4)	------	------	(4)
Ohio	22	10	4	36	122	------	96	1	57	10,860,007	1,083,598	11,943,605	11,854,828	743,455	1,100,767	13,699,050
Oklahoma	------	11	------	11	------	------	------	------	29	------	421,973	421,973	------	429,344	------	429,344
Pennsylvania	65	57	25	147	373	26	40	196	694	23,807,589	11,357,375	35,164,964	37,245,474	14,976,454	10,864,729	63,086,657
Tennessee	3	20	2	25	3	------	8	------	82	144,414	1,276,989	1,421,403	(4)	2,797,162	(4)	3,582,737
Utah	7	7	3	17	36	------	16	------	40	2,878,639	488,209	3,366,848	2,582,870	708,399	438,927	3,730,196
Virginia	15	9	3	27	41	------	11	------	100	2,458,841	1,434,171	3,893,012	5,752,724	1,806,068	830,105	8,388,897
Washington	4	7	------	11	1	------	8	------	82	94,760	923,632	1,018,392	385,441	932,559	------	1,318,000
West Virginia	101	99	60	260	464	5	144	102	933	40,556,952	16,955,016	57,511,968	48,204,871	21,625,860	21,497,034	91,327,765
Wyoming	16	7	4	27	22	8	198	26	49	5,517,515	659,930	6,177,445	5,085,998	300,202	879,834	6,266,034
Undistributed:																
East of Mississippi River	------	------	------	------	------	------	------	------	------	------	441,813	441,813	3,083,239	710,388	361,844	710,388
West of Mississippi River	------	------	------	------	------	------	------	------	------	2,394,362	1,090,125	634,902		1,412,897		858,953
Total: 1941	409	349	139	897	1,985	109	788	607	2,807	142,686,367	43,980,883	186,667,250	170,000,298	59,537,039	50,577,004	280,114,341
1940	372	315	124	811	1,720	116	656	697	2,263	112,578,835	35,291,417	147,870,252	137,883,289	59,874,127	43,623,716	241,381,132
Change, 1941 over 1940 (percent)	+9.9	+10.8	+12.1	+10.6	+15.4	−6.0	+20.1	−12.9	+24.0	+26.7	+24.6	+26.2	+23.3	−0.6	+15.9	+16.0

[1] Includes those mines in which all of the tonnage mechanically loaded was obtained with machines that substantially eliminate hand shoveling; that is, mobile loaders, scrapers, and conveyors equipped with duckbills and other self-loading heads. Some mines in this class also use conveyors in conjunction with mobile loaders to perform the initial phase of transportation.

[2] Includes those mines in which all the tonnage mechanically loaded was obtained with hand-loaded conveyors and pit-car loaders.

[3] Number of units.

[4] Included under "Undistributed" to avoid disclosing individual operations.

TABLE 32.—*Comparative changes in underground mechanical loading of bituminous coal and lignite by principal types of machines in the United States, by States, 1940–41*

State	1940 (net tons)			1941 (net tons)			Percent handled by each class			
							1940		1941	
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Loaded by machines [1]	Handled by conveyors [2]
Alabama	1,603,194	3,401,717	5,004,911	2,006,569	3,841,428	5,847,997	32.0	68.0	34.3	65.7
Arkansas	(3)	(3)	945,052	(3)	(3)	1,053,603	(3)	(3)	(3)	(3)
Colorado	1,868,794	683,932	2,552,726	2,090,978	851,409	2,942,387	73.2	26.8	71.1	28.9
Illinois	28,156,030	1,364,457	29,520,487	32,173,463	1,100,513	33,273,976	95.4	4.6	96.7	3.3
Indiana	7,176,040	230,880	7,406,920	8,070,401	189,901	8,260,302	96.9	3.1	97.7	2.3
Iowa	(3)	(3)	132,947	(3)	(3)	174,958	(3)	(3)	(3)	(3)
Kentucky	5,494,346	1,656,208	7,150,554	9,631,877	1,864,801	11,496,678	76.8	23.2	83.8	16.2
Maryland		(3)	(3)		(3)	(3)		100.0		100.0
Michigan		(3)	(3)		(3)	(3)		100.0		100.0
Montana (bituminous coal)	(3)	(3)	1,511,123	(3)	(3)	1,621,024	(3)	(3)	(3)	(3)
New Mexico	(3)	(3)	(3)	(3)		(3)	(3)	(3)	100.0	
North Dakota (lignite)	(3)		(3)	(3)		(3)	100.0		100.0	
Ohio	7,750,819	493,023	8,243,842	10,860,007	1,083,598	11,943,605	94.0	6.0	90.9	9.1
Oklahoma	(3)	(3)	422,692		421,973	421,973	(3)	(3)		100.0
Pennsylvania	18,031,402	9,203,654	27,235,056	23,807,589	11,357,375	35,164,964	66.2	33.8	67.7	32.3
Tennessee	93,601	622,215	715,816	144,414	1,276,989	1,421,403	13.1	86.9	10.2	89.8
Utah	2,519,675	353,285	2,872,960	2,878,639	488,209	3,366,848	87.7	12.3	85.5	14.5
Virginia	1,996,634	1,111,788	3,108,422	2,458,841	1,434,171	3,893,012	64.2	35.8	63.2	36.8
Washington	62,000	733,494	795,494	94,760	923,632	1,018,392	7.8	92.2	9.3	90.7
West Virginia	30,878,128	13,100,403	43,978,531	40,556,952	16,955,016	57,511,968	70.2	29.8	70.5	29.5
Wyoming	4,799,234	571,885	5,371,119	5,517,515	659,930	6,177,445	89.4	10.6	89.3	10.7
Undistributed:										
East of Mississippi River		388,831	388,831		441,813	441,813	(4)	(4)	(4)	(4)
West of Mississippi River	2,148,938	1,375,645	512,769	2,394,362	1,090,125	634,902	(4)	(4)	(4)	(4)
Total	112,578,835	35,291,417	147,870,252	142,686,367	43,980,883	186,667,250	76.1	23.9	76.4	23.6

[1] Includes mobile loaders, scrapers, and duckbills.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Included under "Undistributed" to avoid disclosing individual operations.
[4] Included in total; percentage by types not given because State groups are not comparable.

TABLE 33.—*Bituminous coal and lignite in the United States mined underground and from strip pits and method of loading underground, in net tons, by States, in 1941*

State	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total	
Alabama	238,447	9,378,079	5,847,997	15,226,076	15,464,523
Arkansas	87,390	433,179	1,053,603	1,486,782	1,574,172
Colorado	15,689	3,990,456	2,942,387	6,932,843	6,948,532
Illinois	13,945,633	7,483,675	33,273,976	40,757,651	54,703,284
Indiana	12,739,006	1,484,621	8,260,302	9,744,923	22,483,929
Iowa	696,501	2,067,167	174,958	2,242,125	2,938,626
Kansas	3,236,320	771,252		771,252	4,007,572
Kentucky	1,249,125	40,964,543	11,496,678	52,461,221	53,710,346
Maryland	12,665	(1)	(1)	1,687,909	1,700,574
Michigan		(1)	(1)	310,775	310,775
Missouri	1,999,621	1,145,667		1,145,667	3,145,288
Montana (bituminous coal)	1,395,943	177,964	1,621,024	1,798,988	3,194,931
Montana, South Dakota, and Texas (lignite)	143,102	323,842		323,842	466,944
New Mexico		(1)	(1)	1,251,120	1,251,120
North Dakota (lignite)	1,527,144	(1)	(1)	781,744	2,308,888
Ohio	7,315,247	10,059,991	11,943,605	22,003,596	29,318,843
Oklahoma	745,387	603,748	421,973	1,025,721	1,771,108
Pennsylvania	8,429,778	86,644,941	35,164,964	121,809,905	130,239,683
Tennessee	1,600	5,622,268	1,421,403	7,043,671	7,045,271
Texas (bituminous coal)		15,482		15,482	15,482
Utah		709,931	3,366,848	4,076,779	4,076,779
Virginia	2,717	14,545,217	3,893,012	18,438,229	18,440,946
Washington	12,115	810,767	1,018,392	1,829,159	1,841,274
West Virginia	1,098,619	81,639,661	57,511,968	139,151,629	140,250,248
Wyoming	179,560	289,325	6,177,445	6,466,770	6,646,330
Other States [2]		293,777		293,777	293,777
Undistributed		2,954,833	1,076,715		
Total	55,071,609	272,410,386	186,667,250	459,077,636	514,149,245

[1] Included under "Undistributed."
[2] Includes Alaska, Arizona, Georgia, Idaho, and Oregon.

MECHANICAL CLEANING

Complete annual data on the mechanical cleaning of bituminous coal in the United States were first gathered for 1927; during that year 5.3 percent of the total production was cleaned by wet or pneumatic methods. This percentage increased annually, and in 1941 amounted to 23 percent or 117,469,857 net tons of clean coal. Tables 34, 35, 37, and 38 include data on all coal mined in the United States (excluding Alaska) except Pennsylvania anthracite. Tables 36 and 39 are upon the same basis but do not include consumer-operated plants. There are no mechanical cleaning plants at lignite mines.

For purposes of comparison, data on Alaska, which had one wet-washing installation, have not been included in the following tables. This one plant produced 52,754, 64,567, and 69,665 net tons of cleaned coal in 1939, 1940, and 1941, respectively.

Consumer-operated plants include plants owned by steel companies which receive coal from various mines (but usually from affiliated companies), clean it, and then consume it directly at the plant.

Table 34 compares bituminous coal cleaned in 1940 and 1941, by method of cleaning. Both wet and pneumatic methods increased in 1941 over 1940.

Mechanical cleaning, by types of equipment.—The tonnage of bituminous coal cleaned by wet-washing methods reached 100,307,969 net tons in 1941—an increase of 15 percent over 1940. The quantity

cleaned by pneumatic methods was 17,161,888 net tons—also a 15-percent increase over 1940.

Table 35 compares the number of cleaning plants and the net tons of cleaned coal, by types of equipment, for 1940 and 1941. During 1941, 380 wet-washing and 80 pneumatic cleaning plants were in operation. Forty-four tipples used both wet and dry methods at the same plant; deducting these duplications gives a net total of 416 plants that cleaned coal in 1941 compared with 386 in 1940.

Wet methods of cleaning coal include piston- or common-type jigs, Baum-type jigs, concentrating tables, launders and upward-current classifiers, and combinations of jigs with concentrating tables and jigs with launders or upward-current classifiers. Baum-type jigs cleaned approximately 40 percent of the coal cleaned by wet methods during 1941.

Pneumatic methods of coal cleaning include air tables, air flow, air sand, and any combinations of these three methods. During 1941, air tables cleaned over 50 percent of the coal cleaned by pneumatic methods.

Table 36 lists the total production in 1940 and 1941 at bituminous-coal mines that have cleaning plants, by types of equipment. This table shows that 185,398,504 net tons were produced at mines with cleaning plants in 1941, but the cleaned coal obtained at these mines totaled 108,218,314 net tons (see table 38) or 58 percent of the total produced. The remainder of the output (42 percent) presumably represents the larger sizes, which are generally hand-picked.

Coal cleaning, by States.—In volume of total tonnage of bituminous coal mechanically cleaned in 1941, Pennsylvania led; West Virginia, Illinois, Alabama, and Indiana followed in the order named. These five States supplied 98,839,286 tons (84 percent) of the total. Table 37 shows the number of plants in operation, net tons of clean coal, and percentage of State output mechanically cleaned in 1940 and 1941.

Results of operations and the relation between raw coal, clean coal, and refuse at bituminous-coal-cleaning plants by States in 1941 are shown in table 38.

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 39 shows the mining methods at mines that have cleaning plants. Production of coal from strip mines in 1941 was 55,071,609 tons (see table 33); 24,773,543 tons (45 percent) came from strip mines having mechanical cleaning tipples. There were 186,667,250 tons of underground coal loaded mechanically in 1941, of which 93,373,789 tons (50 percent) passed through tipples equipped with mechanical cleaning devices. Hand-loaded underground coal production in 1941 totaled 272,410,386 tons, of which 25 percent passed through tipples equipped with cleaning plants.

TABLE 34.—*Bituminous coal mechanically cleaned by wet and pneumatic methods, in the United States, in net tons of clean coal, 1940–41* [1]

Method of cleaning	1940	1941	Change, 1941 from 1940 (percent)
By wet methods:			
At mines	78,475,302	91,056,426	+16.0
At consumer-operated cleaning plants	8,750,220	9,251,543	+5.7
Total wet methods	87,225,522	100,307,969	+15.0
By pneumatic methods	14,979,664	17,161,888	+14.6
Grand total	102,205,186	117,469,857	+14.9

[1] Figures do not include Alaska, which had 1 wet-washing installation.

TABLE 35.—*Bituminous coal cleaned in the United States, by types of equipment in actual operation, 1940–41* [1]

[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		Percent cleaned by each type	
	1940	1941	1940	1941	1940	1941
Wet methods:						
Jigs	186	201	46,999,035	53,216,901	46.0	45.3
Concentrating tables	13	13	2,330,413	2,510,186	2.3	2.2
Jigs in combination with concentrating tables	16	20	2,765,237	4,364,220	2.7	3.7
Jigs in combination with launders and upward-current classifiers	11	11	4,408,148	5,446,245	4.3	4.6
Launders and upward-current classifiers	124	135	30,722,689	34,770,417	30.0	29.6
Total wet methods	350	380	87,225,522	100,307,969	85.3	85.4
Pneumatic methods	77	80	14,979,664	17,161,888	14.7	14.6
Grand total	[2] 427	[2] 460	102,205,186	117,469,857	100.0	100.0

[1] Figures do not include Alaska, which had 1 wet-washing installation.
[2] Number of plants using both wet and pneumatic methods was 41 in 1940 and 44 in 1941.

TABLE 36.—*Total production of all coal at bituminous mines in the United States having cleaning plants, in net tons, 1940–41* [1]

[Does not include any estimate for mines that may ship to consumer-operated plants]

Type of equipment	1940	1941	Change, 1941 from 1940 (percent)
Wet methods:			
Jigs	75,391,008	85,683,303	+13.7
Concentrating tables	1,733,048	1,927,109	+11.2
Jigs in combination with concentrating tables	3,385,168	5,097,435	+50.6
Jigs in combination with launders and upward-current classifiers	7,026,222	8,325,444	+18.5
Launders and upward-current classifiers	56,412,328	69,351,140	+22.9
Total wet methods	143,947,774	170,384,431	+18.4
Pneumatic methods	41,129,603	45,471,216	+10.6
Grand total	185,077,377	215,855,647	+16.6
Less duplication [2]	23,405,810	30,457,143	+30.1
Net total	161,671,567	185,398,504	+14.7
United States production of bituminous coal [3]	460,597,656	513,910,285	+11.6
Percent produced at mines having cleaning plants	35.1	36.1	----------

[1] Figures do not include Alaska, which had 1 wet-washing installation.
[2] Mines using both wet and pneumatic methods.
[3] For historical comparison, the United States production figures include lignite. Alaska is not included in total production.

TABLE 37.—*Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, by States, 1940–41* [1]

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania are included]

State	Plants in operation		Net tons of clean coal		Percent of State output mechanically cleaned	
	1940	1941	1940	1941	1940	1941
Alabama	52	57	12,923,860	12,835,169	84.3	83.0
Colorado	10	10	1,067,856	1,216,128	16.2	17.5
Illinois	47	49	18,840,805	22,126,723	37.2	40.4
Indiana	16	19	5,103,522	7,205,041	27.0	32.0
Kansas	8	7	1,620,407	2,283,689	45.3	57.0
Kentucky	13	16	2,004,360	3,005,717	4.1	5.6
Missouri	10	11	1,236,799	1,517,861	39.9	48.3
Ohio	6	10	3,533,632	4,626,146	15.5	15.8
Pennsylvania [2]	58	57	27,616,594	29,948,020	23.7	23.0
Tennessee	6	5	314,541	337,159	5.2	4.8
Virginia	19	22	2,315,560	2,733,166	15.1	14.8
Washington	18	21	1,362,856	1,632,427	82.6	88.7
West Virginia [3]	115	123	23,384,440	26,724,333	18.5	19.1
Undistributed:						
East of Mississippi River [4]	3	2	64,785	58,661	----	----
West of Mississippi River [5]	5	7	815,169	1,219,617	----	----
Total	[6] 386	[7] 416	102,205,186	117,469,857	22.2	22.9

[1] Excludes Alaska.
[2] Includes some coal mined in Pennsylvania and cleaned in Ohio.
[3] Includes some coal mined in West Virginia and cleaned in Ohio.
[4] Includes Georgia and Michigan.
[5] Includes Arkansas, Montana, New Mexico, and Utah.
[6] Represents 41 plants using both wet and pneumatic methods of cleaning plus 345 plants using only 1 cleaning method.
[7] Represents 44 plants using both wet and pneumatic methods of cleaning plus 372 plants using only 1 cleaning method.

TABLE 38.—*Result of operations at bituminous-coal-cleaning plants in the United States, by States, in net tons, in 1941* [1]

State	Total raw coal moved to cleaning plants [2]	Coal obtained in cleaning process	Refuse resulting in cleaning process [2]	Percent of refuse to raw coal [3]	Total production from mines that moved coal to cleaning plants [4]
Alabama	14,733,805	12,835,169	1,898,636	12.9	13,822,090
Colorado	(5)	(5)	(5)	9.6	(5)
Illinois	26,343,179	22,126,723	4,216,456	16.0	34,786,567
Indiana	8,305,137	7,205,041	1,100,096	13.2	12,027,378
Kansas	2,794,917	2,283,689	511,228	18.3	2,339,900
Kentucky	3,369,161	3,005,717	363,444	10.8	6,517,713
Missouri	1,917,673	1,517,861	399,812	20.8	1,755,793
Ohio	5,652,020	4,626,146	1,025,874	18.2	6,728,638
Pennsylvania [6]	(5)	(5)	(5)	8.8	(5)
Tennessee	366,535	337,159	29,376	8.0	1,304,094
Virginia	2,932,547	2,733,166	199,381	6.8	9,699,108
Washington	1,874,768	1,632,427	242,341	12.9	1,728,864
West Virginia [7]	29,835,542	26,724,333	3,111,209	10.4	59,168,194
Other States [8]	25,405,030	23,190,883	2,214,147	----	35,520,165
Total at mines only [9]	123,530,314	108,218,314	15,312,000	12.4	185,398,504
Consumer plants [10]	9,749,848	9,251,543	498,305	5.1	----
Grand total	133,280,162	117,469,857	15,810,305	11.9	----

[1] Excludes Alaska.
[2] Exact figures on raw coal or refuse could not be furnished by many operators; in such instances, estimates were made from all available information at hand.
[3] In Alabama (for example) for every 100 tons of raw coal cleaned in 1941, an average of 12.9 tons of refuse was discarded and 87.1 tons of clean marketable coal obtained.
[4] Based upon shipping weights; includes some marketable coal that did not pass through cleaning plants.
[5] Included with "Other States."
[6] Includes some coal mined in Pennsylvania and cleaned in Ohio.
[7] Includes some coal mined in West Virginia and cleaned in Ohio.
[8] Includes Arkansas, Colorado, Georgia, Michigan, Montana, New Mexico, Pennsylvania, and Utah.
[9] Includes all mechanical cleaning other than washeries operated by consumer steel companies.
[10] Includes central washeries in Colorado and Pennsylvania operated by consumer steel companies.

TABLE 39.—*Method of mining at bituminous-coal mines in the United States served by cleaning plants, 1939–41* [1]

[Does not include any estimate for mines that may ship to consumer-operated plants]

Method of mining in use	Total production from mines that move coal to cleaning plants (net tons) [2]			Change, 1941 from 1940 (percent)
	1939	1940	1941	
Mined from strip pits	17,960,049	20,029,770	24,773,543	+23.7
Mechanically loaded underground	53,495,851	66,148,465	93,373,789	+41.2
Hand-loaded underground	61,805,096	75,493,332	67,251,172	−10.9
Total	133,260,996	161,671,567	185,398,504	+14.7

[1] Excludes Alaska.
[2] Based upon shipping weights and includes some marketable coal that did not pass through cleaning plants.

DETAILED STATISTICS, BY STATES AND COUNTIES

Detailed production and employment statistics are given in table 40 for each coal-producing county in the United States from which three or more operators submitted reports for 1941. Statistics on counties with less than three reporting producers have been combined with data for other counties in the same State to avoid disclosing individual returns, unless permission to publish has been granted by the operators. 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.

In this series the reported production is classified according to the principal methods of distribution or use. Beginning with 1932, the series was expanded to include data on the growing volume of coal moving from mine to consumer by truck. For 1933–36 this tonnage was shown as "commercial sales by truck or wagon." In 1937 this tonnage was shown as "truck deliveries, including local sales." (See Minerals Yearbook, 1939, p. 813.) In 1938 the truck tonnage was shown as "shipped by truck or wagon." The truck figures for 1933 to 1936, inclusive, and 1938 to 1941, inclusive, are reasonably comparable.

The data in this report, like those published for many years by the Bureau of Mines, relate only to mines with an annual output of 1,000 tons or more. Although all mines, regardless of size, are subject to regulation under the provisions of the National Bituminous Coal Act of 1937, it seemed advisable to maintain the continuity of the old series by excluding the very small mines that sell by truck or wagon. This fact should be borne in mind when the statistics in this report are compared with similar data compiled by State mine departments. Differences arise largely from variations in coverage of the State reports, some of which include data for all mines, regardless of size, and others only data for mines employing more than a specified minimum number, which ranges from 2 to 10 men.

Because of a change in the method of reporting, the statistics of average production per man per day for 1932 to 1936 and 1938 to 1941 are not precisely comparable with those for earlier years. Before 1932 they were based upon the calculated number of man-shifts, obtained by multiplying the average number of men employed at each mine by the number of days worked at the mine. Since 1932

operators have been asked to make a special report of the number of man-shifts actually worked, if possible. The number of operators able to furnish this information has been small, although it is increasing from year to year. These reports were utilized to improve the accuracy of the record. Otherwise, the man-shifts were calculated by multiplying the number employed underground and on the surface by the number of days worked by the mine and tipple, respectively.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
ALABAMA													
Bibb	677,489	16,028	2,851	16,469	712,837	$3.01	1,213	----------	200	1,413	199	280,943	2.54
Blount	86,331	56,932	533	1,632	145,428	2.71	300	33	54	387	183	70,870	2.05
Cullman	----------	42,204	105	18	42,327	2.78	106	----------	16	122	184	22,456	1.88
Etowah	18,835	13,604	----------	----------	32,439	2.72	61	----------	13	74	188	13,917	2.33
Jackson	232	33,241	----------	----------	33,473	2.95	60	----------	15	75	223	16,711	2.00
Jefferson	8,125,625	329,779	42,221	[4] 31,396	8,529,021	2.71	12,190	6	1,662	13,858	214	2,972,394	2.87
Marion	221,896	81,000	1,408	196	304,500	3.58	501	8	115	624	204	127,183	2.39
Shelby	409,640	110,567	2,919	2,065	525,191	3.29	872	----------	137	1,009	214	215,711	2.43
Tuscaloosa	120,006	54,307	1,009	----------	175,322	2.38	311	----------	83	394	201	79,202	2.21
Walker	3,392,845	173,527	53,424	5,163	3,624,959	2.60	4,174	94	595	4,863	213	1,036,210	3.50
Winston	3,836	19,281	60	----------	23,177	2.50	44	----------	7	51	162	8,283	2.80
Other counties (Cherokee, Fayette, and St. Clair)	1,219,748	33,898	14,046	48,157	1,315,849	2.53	1,740	----------	325	2,065	262	541,021	2.43
Total Alabama	14,276,483	964,368	118,576	[4] 105,096	15,464,523	2.71	21,572	141	3,222	24,935	216	5,384,901	2.87
ALASKA													
Total Alaska	235,230	----------	----------	[5] 3,730	238,960	$3.95	110	----------	43	153	311	47,617	5.02
ARIZONA, GEORGIA, IDAHO, AND OREGON													
Total Arizona, Georgia, Idaho, and Oregon	33,598	19,468	1,071	[5] 680	54,817	$2.74	136	----------	52	188	222	41,659	1.32

See footnotes at end of table.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
ARKANSAS													
Franklin	65,668	9,128	399	1,923	77,118	$3.54	224	22	35	281	100	28,084	2.75
Johnson	237,578	16,464	781	1,856	256,679	3.40	481	17	111	609	137	83,737	3.07
Logan	458,319	3,749	2,098	1,928	466,094	4.52	1,179	----------	213	1,392	131	182,583	2.55
Sebastian	705,973	31,552	782	1,375	739,682	3.35	1,174	81	215	1,470	153	225,479	3.28
Other counties (Pope and Scott)	31,511	1,722	120	1,246	34,599	4.34	209	----------	27	236	63	14,908	2.32
Total Arkansas	1,499,049	62,615	4,180	[5] 8,328	1,574,172	3.74	3,267	120	601	3,988	134	534,791	2.94
COLORADO													
Boulder	223,254	418,534	6,484	6,062	654,334	$2.90	574	1	116	691	244	168,843	3.88
Delta	40,605	28,015	423	4,201	73,244	2.76	55	----------	22	77	215	16,523	4.43
El Paso	32,882	160,383	37,405	6,882	237,552	2.89	166	----------	39	205	232	47,483	5.00
Fremont	159,840	350,053	3,564	2,704	516,161	3.12	631	----------	132	763	196	149,407	3.45
Garfield	7,647	28,422	50	1,225	37,344	3.11	32	----------	12	44	246	10,809	3.45
Gunnison	668,840	19,879	8,607	10,711	708,037	2.62	487	----------	135	622	227	141,320	5.01
Huerfano	739,732	70,193	3,918	1,789	815,632	2.91	821	----------	173	994	201	199,382	4.08
La Plata	12,569	18,614	230	30	31,443	2.32	31	----------	7	38	241	9,155	3.43
Las Animas	1,153,863	54,153	6,286	[6] 137,817	1,352,119	2.96	1,457	----------	219	1,676	230	384,676	3.51
Mesa	65,099	36,125	568	4,462	106,254	2.41	96	----------	19	115	214	24,641	4.31
Moffat	27,109	13,485	8,865	----------	49,459	2.94	17	----------	13	30	221	6,644	7.44
Montrose	----------	37,171	7,808	----------	44,979	2.72	46	----------	6	52	307	15,971	2.82
Rio Blanco	----------	12,235	134	10	12,379	3.22	14	----------	3	17	242	4,120	3.00
Routt	811,688	19,792	14,537	32,935	878,952	3.01	868	----------	263	1,131	165	187,179	4.70
Weld	913,762	324,525	10,972	26,972	1,276,231	2.53	929	----------	202	1,131	214	241,783	5.28

Other counties:													
Elbert, Jackson, Jefferson, and Larimer	101,877	44,591	1,127	901	148,496	2.46	112	15	25	152	237	36,017	4.12
Montezuma and Pitkin	60	4,644	1,212	----------	5,916	3.30	9	----------	3	12	214	2,562	2.31
Total Colorado	4,958,827	1,640,814	112,190	[6] 236,701	6,948,532	2.83	6,345	16	1,389	7,750	213	1,647,015	4.22
ILLINOIS													
Bureau	766	56,039	2,348	3,586	62,739	$3.26	213	----------	16	229	132	30,292	2.07
Christian	5,416,030	123,946	1,350	15,688	5,557,014	1.52	1,706	----------	530	2,236	214	478,806	11.61
Clinton	124,711	88,846	2,870	13,103	229,530	1.70	278	----------	47	325	139	45,080	5.09
Edgar	----------	26,533	92	2,383	29,008	2.13	51	----------	9	60	140	8,412	3.45
Franklin	9,866,534	96,541	88,252	160,299	10,211,626	1.90	4,780	----------	1,445	6,225	170	1,057,473	9.66
Fulton	4,364,883	448,518	7,570	12,702	4,833,673	1.70	629	357	482	1,468	227	333,733	14.48
Gallatin	1,290	39,306	----------	2,868	43,464	1.94	67	----------	21	88	134	11,835	3.67
Grundy	----------	78,465	1,101	1,709	81,275	3.37	75	21	11	107	178	19,012	4.27
Henry	498,676	114,916	1,278	594	615,464	2.02	178	78	101	357	208	74,167	8.30
Jackson	1,887,600	86,300	3,898	6,647	1,984,445	1.79	647	89	197	933	223	208,466	9.52
Knox	598,821	193,142	1,977	2,845	796,785	2.06	258	61	100	419	223	93,275	8.54
LaSalle	102,422	291,312	14,928	935	409,597	2.97	419	64	80	563	203	114,461	3.58
Livingston	----------	8,010	115	120	8,245	2.97	25	3	5	33	117	3,848	2.14
Macoupin	3,903,822	237,532	24,818	137,429	4,303,601	1.52	2,187	----------	464	2,651	213	565,452	7.61
Madison	933,230	824,895	14,214	70,807	1,843,146	1.76	1,249	----------	288	1,537	204	314,268	5.86
Menard	----------	120,516	2,160	1,753	124,429	2.23	156	----------	22	178	216	38,394	3.24
Mercer	----------	17,737	270	50	18,057	3.20	35	----------	5	40	197	7,868	2.29
Peoria	330,923	474,533	1,657	1,536	808,649	2.06	814	----------	107	921	184	169,458	4.77
Perry	3,763,036	80,029	6,803	39,774	3,889,642	1.63	753	389	446	1,588	200	317,336	12.26
Randolph	1,438,419	85,992	4,484	26,719	1,555,614	1.58	351	51	210	612	184	112,763	13.80
Rock Island	----------	15,604	15	----------	15,619	3.11	29	----------	5	34	166	5,648	2.77
St. Clair	895,247	1,190,402	137,754	43,155	2,266,558	1.74	1,352	107	316	1,775	144	254,821	8.89
Saline	4,637,048	74,652	7,657	47,563	4,766,920	2.07	2,056	155	520	2,731	182	496,416	9.60
Sangamon	2,043,442	568,546	11,172	21,629	2,644,789	1.88	2,447	----------	334	2,781	178	495,032	5.34
Schuyler	23,952	78,777	900	1,115	104,744	1.87	67	11	28	106	217	22,969	4.56
Shelby	----------	8,154	----------	40	8,194	3.67	31	----------	6	37	209	7,739	1.06
Stark	----------	9,837	43	36	9,916	2.69	19	----------	3	22	220	4,840	2.05
Vermilion	1,704,577	429,886	12,190	11,015	2,157,668	1.97	1,805	37	222	2,064	176	363,884	5.93
Washington	170,329	68,335	300	11,149	250,113	1.65	225	----------	58	283	136	38,571	6.48
Williamson	1,380,245	683,244	4,381	49,636	2,117,506	1.79	1,231	53	330	1,614	181	292,159	7.25
Other counties [7]	2,160,916	693,459	15,852	85,027	2,955,254	2.07	1,263	275	512	2,050	174	356,914	8.28
Total Illinois	46,246,919	7,314,004	370,449	[8] 771,912	54,703,284	1.81	25,396	1,751	6,920	34,067	186	6,343,392	[8] 8.62

See footnotes at end of table.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
INDIANA													
Clay	1,505,404	499,213	2,852	6,241	2,013,710	$1.98	111	460	337	908	191	173,745	11.59
Daviess		81,818	478	843	83,139	2.32	50	9	19	78	226	17,630	4.72
Dubois		13,839		67	13,906	2.19	12	4	5	21	193	4,062	3.42
Fountain	11,402	73,921	32	489	85,844	2.33	22	34	16	72	143	10,318	8.32
Gibson	993,185	139,745	85	24,847	1,157,862	1.79	482		103	585	177	103,636	11.17
Greene	2,491,723	84,849	2,335	12,847	2,591,754	1.76	334	275	509	1,118	210	234,270	11.06
Knox	2,473,560	370,373	6,201	18,216	2,868,350	1.56	1,054	19	345	1,418	240	340,885	8.41
Parke		115,917	270	2,770	118,957	2.65	179		35	214	183	39,072	3.04
Perry		40,837	178	39	41,054	1.87	57		6	63	222	13,986	2.94
Pike	4,156,222	68,317	15,968	13,389	4,253,896	1.47	36	483	496	1,015	208	210,861	20.17
Spencer	112,393	32,043	387	117	144,940	2.42	34	33	34	101	192	19,362	7.49
Sullivan	1,931,611	103,466	3,678	20,712	2,059,467	1.93	773	139	327	1,239	187	231,894	8.88
Vermillion	401,802	114,365	582	2,290	519,039	1.80	323	76	124	523	144	75,179	6.90
Vigo	3,127,781	259,840	344,633	19,376	3,751,630	1.71	1,333	166	457	1,956	189	369,802	10.14
Warrick	2,407,347	196,760	2,737	4,545	2,611,389	1.51	273	170	342	785	229	179,652	14.54
Other counties (Martin, Owen, Vanderburgh, and Warren)	105,667	62,790	315	220	168,992	2.03	113	17	39	169	155	26,259	6.44
Total Indiana	19,718,097	2,258,093	380,731	[5] 127,008	22,483,929	1.70	5,186	1,885	3,194	10,265	200	2,050,613	[5] 10.96
IOWA													
Adams		22,759	57	46	22,862	$3.50	108		17	125	158	19,808	1.15
Appanoose	200,823	181,549	3,666	920	386,958	2.77	1,183		140	1,323	127	167,494	2.31
Boone	164,867	65,566	5,632	1,805	237,870	3.33	475		43	518	184	95,539	2.49
Greene	260	16,574	117	10	16,961	3.32	35	5	8	48	113	5,406	3.14

Guthrie		21,656	457	24	22,137	4.02	74		9	83	159	13,162	1.68
Jasper	842	50,934	721	130	52,627	2.88	68	14	17	99	166	16,448	3.20
Lucas	104,896	22,833	2,122	901	130,752	2.65	238		28	266	120	31,831	4.11
Mahaska	175,079	137,920	1,144	1,138	315,281	2.44	47	96	72	215	190	40,850	7.72
Marion	201,298	386,210	3,898	3,307	594,713	2.38	446	139	108	693	187	129,633	4.59
Monroe	90,961	88,309	2,385	2,195	183,850	2.27	281	6	45	332	159	52,807	3.48
Page		39,233			39,233	3.78	86		9	95	236	22,458	1.75
Polk	81,693	223,638	11,748	1,651	318,730	2.96	630	7	45	682	152	103,344	3.08
Van Buren		24,420	200	145	24,765	2.91	17	15	9	41	171	6,993	3.54
Wapello	36,789	117,402	632	730	155,553	2.58	175	22	70	267	145	38,641	4.03
Warren	2,973	55,118	986	1,890	60,967	3.16	80	15	34	129	112	14,446	4.22
Wayne		18,297	250	100	18,647	2.75	56		9	65	173	11,223	1.66
Webster	16,220	20,605	223		37,048	3.10	36	4	13	53	236	12,485	2.97
Other counties (Dallas, Davis, Jefferson, Keokuk, and Taylor)	213,472	99,986	5,002	1,212	319,672	2.95	509	8	42	559	178	99,775	3.20
Total Iowa	1,290,173	1,593,009	39,240	[8] 16,204	2,938,626	2.74	4,544	331	718	5,593	158	882,343	3.33

KANSAS

Bourbon	153,249	14,962	48	1,092	169,351	$2.00		44	20	64	221	14,156	11.96
Cherokee	964,162	56,861	3,084	1,868	1,025,975	2.07	47	128	204	379	201	76,109	13.48
Crawford	1,731,043	129,186	4,732	5,958	1,870,919	2.06	870	284	279	1,433	191	273,906	6.83
Labette		15,548		720	16,268	2.58		15	6	21	163	3,428	4.75
Linn	735,223	23,245	316	460	759,244	1.56	46	50	84	180	220	39,610	19.17
Osage	1,830	89,356	1,619		92,805	3.44	269	4	32	305	158	48,197	1.93
Other counties (Franklin and Leavenworth)	58,421	14,589			73,010	2.18	282		98	380	264	100,425	.73
Total Kansas [9]	3,643,928	343,747	9,799	[8] 10,098	4,007,572	1.98	1,514	525	723	2,762	201	555,831	[10] 7.21

KENTUCKY

Eastern district:													
Bell	2,463,956	133,890	17,072	3,938	2,618,856	$2.35	3,115		468	3,583	207	740,427	3.54
Boyd		71,344	114		71,458	2.25	174		37	211	250	52,832	1.35
Breathitt	8,994	4,650	44,870		58,514	2.25	115		19	134	162	21,678	2.70
Carter	36,559	82,527	2,473		121,559	2.16	165		54	219	237	51,803	2.35
Clay	224,521	89,372	2,202	25	316,120	2.19	560		138	698	222	154,820	2.04
Floyd	5,472,029	7,073	10,544	18,554	5,508,200	2.32	4,697		737	5,434	210	1,140,772	4.83
Greenup		5,036	20		5,056	2.03	13		3	16	148	2,370	2.13
Harlan	14,087,519	30,578	76,928	10,400	14,205,425	2.43	14,146		1,718	15,864	227	3,603,769	3.94
Jackson		261,051	117	[11] 7,851	269,019	2.32	432		88	520	246	127,990	2.10
Johnson	723,923	2,704	4,801	1,297	732,725	2.65	885		115	1,000	236	235,519	3.11
Knott	413,938	3,101	2,032		419,071	2.24	419		58	477	185	88,323	4.74
Knox	522,562	35,464	5,511	825	564,362	2.31	822		127	949	194	184,568	3.06

See footnotes at end of table.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
KENTUCKY—Continued													
Eastern district—Continued.													
Laurel	23,287	70,780	25	451	94,543	$2.26	192	13	50	255	218	55,665	1.70
Lawrence	2,000	7,905	75	100	10,080	3.45	21		8	29	248	7,205	1.40
Lee	7,745	19,256	65	5	27,071	2.22	45		10	55	222	12,230	2.21
Letcher	4,552,561	5,250	22,390	6,237	4,586,438	2.33	4,448		525	4,973	209	1,038,055	4.42
Martin	317,225	1,250	86		318,561	1.97	192		38	230	206	47,442	6.71
Menifee		5,538			5,538	2.26	14		4	18	206	3,710	1.49
Perry	5,313,111	11,995	121,086	109	5,446,301	2.32	4,707		721	5,428	208	1,128,705	4.83
Pike	5,090,633	52,467	208,116	2,329	5,353,545	2.08	4,508		877	5,385	209	1,126,263	4.75
Pulaski		54,113			54,113	2.11	101		36	137	176	24,080	2.25
Rockcastle	373	14,598	44	25	15,040	2.11	23		15	38	234	8,890	1.69
Whitley	347,675	41,536	2,073	8,677	399,961	2.64	754	14	132	900	177	159,303	2.51
Wolfe		13,861	55	5	13,921	1.94	20		6	26	238	6,200	2.25
Other counties [12]	884,373	17,661	12,931		914,965	2.39	1,188		205	1,393	217	301,956	3.03
Total Eastern Kentucky	40,492,984	1,043,000	533,630	[11] 60,828	42,130,442	2.33	41,756	27	6,189	47,972	215	10,324,575	4.08
Western district:													
Butler	904	37,839	15	36	38,794	1.68	69		21	90	192	17,309	2.24
Christian	44,816	19,874	439	1,486	66,615	1.76	68	18	17	103	160	16,510	4.03
Daviess	9,035	138,793	614	3,281	151,723	1.45	139		43	182	198	35,983	4.22
Hancock		23,817	114		23,931	1.69	42		9	51	201	10,269	2.33
Henderson	11,282	106,732	840	6,237	125,091	1.67	214		46	260	164	42,542	2.94
Hopkins	5,020,154	266,711	45,738	7,620	5,340,223	1.59	2,456	114	683	3,253	219	710,830	[8] 7.51
Muhlenberg	3,508,835	210,950	5,878	55,211	3,780,874	1.56	2,285		530	2,815	216	609,124	6.21
Ohio	119,280	54,592	1,339	75	175,286	1.41	186		48	234	211	49,476	3.54
Union	676,419	113,237	31,466	12,858	833,980	1.55	661		117	778	220	171,460	4.86
Webster	999,246	25,478	80	6,757	1,031,561	1.54	883		142	1,025	215	220,837	4.67

Other counties (Edmonson and McLean)	----------	11,810	16	----------	11,826	1.63	21	----------	12	33	147	4,840	2.44
Total Western Kentucky	10,389,971	1,009,833	86,539	93,561	11,579,904	1.57	7,024	132	1,668	8,824	214	1,889,180	6.13
Total Kentucky	50,882,955	2,052,833	620,169	[11] 154,389	53,710,346	2.17	48,780	159	7,857	56,796	215	12,213,755	4.40
MARYLAND													
Allegany	812,912	181,955	10,262	805	1,005,934	$2.51	1,271	----------	151	1,422	217	309,085	3.25
Garrett	614,297	70,140	3,622	6,581	694,640	2.26	686	8	115	809	213	172,113	4.04
Total Maryland	1,427,209	252,095	13,884	[5] 7,386	1,700,574	2.40	1,957	8	266	2,231	216	481,198	3.53
MICHIGAN													
Saginaw	6,766	46,161	1,146	2,760	56,833	$4.48	159	----------	28	187	165	30,816	1.84
Other counties (Bay, Huron, Shiawassee, and Tuscola)	112,879	127,007	5,619	8,437	253,942	4.17	513	----------	57	570	161	91,803	2.77
Total Michigan	119,645	173,168	6,765	[5] 11,197	310,775	4.22	672	----------	85	757	162	122,619	2.53
MISSOURI													
Adair	34,402	94,669	320	3,955	133,346	$2.20	183	----------	37	220	191	41,940	3.18
Barton	202,042	24,654	338	1,390	228,424	2.15	8	61	33	102	172	17,559	[10] 13.01
Bates	85,177	33,350	225	3,047	121,799	2.06	19	65	12	96	172	16,535	[10] 7.37
Boone	----------	22,149	26	14	22,189	2.31	23	18	7	48	156	7,476	2.97
Callaway	----------	161,361	300	415	162,076	2.14	13	48	16	77	259	19,923	[10] 8.14
Clay	----------	144,457	2,758	2,272	149,487	3.15	444	----------	42	486	164	79,462	1.88
Harrison	----------	23,088	150	459	23,697	3.04	60	----------	9	69	163	11,281	2.10
Henry	464,750	127,239	237	4,460	596,686	1.94	47	201	120	368	170	62,559	[10] 9.54
Lafayette	111,697	111,792	4,095	2,077	229,661	2.83	680	----------	69	749	154	115,589	1.99
Linn	12,807	62,265	1,284	70	76,426	2.75	195	----------	15	210	210	44,047	1.74
Macon	369,890	65,564	3,136	1,785	440,375	1.85	117	63	75	255	191	48,608	[10] 9.06
Putnam	----------	54,823	182	44	55,049	2.28	159	----------	38	197	140	27,500	2.00
Ralls	900	14,276	89	----------	15,265	2.55	32	6	6	44	187	8,230	1.85
Randolph	459,701	112,181	902	10	572,794	2.03	180	40	90	310	237	73,371	[10] 7.81
Ray	15,783	143,268	4,009	782	163,842	3.10	590	----------	51	641	136	87,062	1.88
Vernon	30,638	38,685	254	2,320	71,897	2.08	20	51	17	88	132	11,626	[10] 6.18
Other counties [18]	9,479	70,974	60	1,762	82 275	2.67	86	100	42	228	151	34,426	2.39
Total Missouri [9]	1,797,266	1,304,795	18,365	[5] 24,862	3,145,288	2.23	2,856	653	679	4,188	169	707,194	4.45

See footnotes at end of table.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
MONTANA													
Montana bituminous coal:													
Carbon	373,995	33,560	3,036	497	411,088	$2.10	151	----------	103	254	198	50,205	8.19
Cascade	473,356	31,608	1,168	129	506,261	1.47	249	----------	39	288	209	60,098	8.42
Chouteau	----------	5,804	50	----------	5,854	3.76	9	----------	2	11	153	1,678	3.49
Hill	31	7,221	90	----------	7,342	3.70	10	----------	3	13	218	2,837	2.59
Musselshell	791,757	45,150	3,585	3,274	843,766	2.01	420	----------	179	599	182	109,288	7.72
Rosebud	1,395,008	3,399	943	----------	1,399,350	.92	6	47	14	67	272	18,240	[10] 76.72
Other counties [14]	----------	20,836	128	306	21,270	4.05	41	----------	10	51	206	10,491	2.03
Total bituminous coal	3,034,147	147,578	9,000	4,206	3,194,931	1.48	886	47	350	1,283	197	252,817	12.64
Montana lignite	4,483	54,042	228	40	58,793	1.79	68	8	22	98	174	17,083	3.44
Total Montana	3,038,630	201,620	9,228	[5] 4,246	3,253,724	1.48	954	55	372	1,381	195	269,900	12.06
NEW MEXICO													
Colfax	530,482	26,194	3,043	3,062	562,781	$2.88	463	----------	117	580	184	106,709	5.27
McKinley	413,620	70,481	4,676	31,514	520,291	3.21	656	----------	205	861	223	192,413	2.70
Rio Arriba	27,942	4,746	----------	----------	32,688	2.10	54	----------	13	67	241	16,174	2.02
Sandoval	----------	4,841	----------	----------	4,841	3.60	17	----------	4	21	114	2,400	2.02
San Juan	----------	4,948	24	----------	4,972	1.73	14	----------	4	18	167	3,010	1.65
Other counties (Bernalillo, Lincoln, Santa Fe, and Socorro)	95,048	21,980	3,437	5,082	125,547	3.22	223	----------	53	276	285	78,756	1.59
Total New Mexico	1,067,092	133,190	11,180	[5] 39,658	1,251,120	3.03	1,427	----------	396	1,823	219	399,462	3.13

NORTH DAKOTA (LIGNITE)

Total North Dakota	1,709,100	411,880	[18] 163,515	[5] 24,393	2,308,888	$1.27	562	444	269	1,275	177	225,657	10.23

OHIO

Athens	1,976,974	70,542	3,203	17,566	2,068,285	$2.12	1,669		440	2,109	201	424,321	4.87
Belmont	7,980,827	184,026	27,872	19,167	8,211,892	1.96	5,615	42	867	6,524	233	1,517,367	5.41
Carroll	196,646	473,449	2,125	737	672,957	2.15	361	89	105	555	225	124,883	5.39
Columbiana	60,613	953,466	955	547	1,015,581	2.06	272	159	122	553	220	121,767	[10] 8.34
Coshocton	29,620	305,701	680	1,288	337,289	2.18	293	16	57	366	217	79,514	4.24
Gallia	8,892	88,182	34	100	97,208	2.06	93	12	23	128	191	24,469	3.97
Guernsey	517,108	78,351	2,238		597,697	1.95	504		53	557	225	125,555	4.76
Harrison	3,782,420	37,971	436	11,410	3,832,237	1.84	1,147	214	399	1,760	240	422,824	[5] 9.06
Hocking	234,669	155,578	1,004	5	391,256	2.12	380	8	52	440	202	88,835	4.40
Holmes		47,297	22	33	47,352	2.50	43	4	10	57	209	11,921	3.97
Jackson	65,830	93,221	22,566	6	181,623	2.23	207	22	34	263	210	55,317	3.28
Jefferson	5,430,966	407,361	9,135	14,973	5,862,435	1.98	2,815	326	778	3,919	234	916,518	[5] 6.40
Lawrence		112,253	7,838	5	120,096	2.01	141		21	162	236	38,302	3.14
Mahoning		409,635	753	2,591	412,979	2.32	41	97	33	171	247	42,154	[10] 9.80
Meigs	111,055	139,665	82		250,802	1.91	247		34	281	226	63,375	3.96
Morgan	187,489	8,492			195,981	2.11	159		27	186	260	48,401	4.05
Muskingum	959,980	299,367	222	207	1,259,776	1.84	660	17	111	788	212	167,246	[5] 7.53
Perry	694,977	300.914	2,327	579	998,797	1.98	1,002	49	185	1,236	177	218,255	4.58
Stark	794	911,448	412	84	912,738	2.00	130	265	112	507	207	104,808	[10] 8.71
Tuscarawas	86,179	1,509,184	961	316	1,596,640	2.19	833	270	226	1,329	211	279,936	5.70
Vinton	4,259	136,430	36	2,305	143,030	2.18	65	74	25	164	227	37,270	3.84
Washington		6,755			6,755	2.47	13		3	16	181	2,896	2.33
Wayne		24,721			24,721	2.46	21	6	6	33	124	4,089	[10] 6.05
Other counties (Noble, Portage, and Trumbull)		79,156	500	1,060	80,716	2.55	23	15	18	56	299	16,763	4.82
Total Ohio	22,329,298	6,833,165	83,401	[5] 72,979	29,318,843	1.99	16,734	1,685	3,741	22,160	223	4,936,786	5.94

OKLAHOMA

Coal		21,766	133	19	21,918	$4.02	43	2	14	59	167	9,871	2.22
Craig		13,512	30	101	13,643	2.83		23		23	168	3,864	3.53
Latimer	32,880	1,641	7	109	34,637	3.69	58		13	71	198	14,090	2.46
LeFlore	366,857	3,551	400	2,011	372,819	3.34	685		145	830	147	122,118	3.05
Okmulgee	330,867	36,424	108	690	368,089	2.35	327		56	383	176	67,394	[5] 5.46
Pittsburg	130,866	27,706	1,619	1,736	161,927	3.69	283		73	356	167	59,480	2.72
Rogers	76,521	26,709		2,957	106,187	2.43	2	54	19	75	272	20,382	[10] 5.21
Tulsa	6,530	28,778	50	30	35,388	2.90	82		13	95	158	14,992	2.36
Other counties:													
Haskell and Sequoyah	100,441	2,903	165	868	104,377	2.67	44	39	27	110	213	23,483	4.44
Muskogee and Wagoner	527,225	24,381	517		552,123	1.99	16	65	55	136	222	30,167	[10] 18.30
Total Oklahoma	1,572,187	187,371	3,029	[5] 8,521	1,771,108	2.65	1,540	183	415	2,138	171	365,841	4.84

See footnotes at end of table.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
PENNSYLVANIA (BITUMINOUS COAL)													
Allegheny	12,743,099	2,298,521	1,081,928	12,118	16,135,666	$2.20	11,422	206	1,748	13,376	224	2,994,908	5.39
Armstrong	4,809,484	200,341	47,344	593	5,057,762	2.15	4,045	150	553	4,748	214	1,018,300	4.97
Beaver	310,022	655,679	8,772	6,069	980,542	2.14	200	181	92	473	243	114,866	[8] 8.54
Bedford	141,719	115,805	212,186	616	470,326	2.65	652	----------	94	746	197	146,742	3.21
Blair	87,421	106,600	1,228	----------	195,249	2.56	298	----------	30	328	216	70,765	2.76
Bradford	----------	10,185	12	----------	10,197	3.19	14	----------	2	16	250	4,004	2.55
Butler	611,414	537,213	10,848	465	1,159,940	2.27	1,038	96	174	1,308	208	272,137	4.26
Cambria	16,090,373	525,625	1,721,834	[16] 264,997	18,602,829	2.48	17,831	23	2,714	20,568	223	4,581,680	4.06
Center	719,765	235,993	5,932	208	961,898	2.16	991	96	139	1,226	203	248,911	3.86
Clarion	1,813,275	337,130	35,032	195	2,185,632	2.04	1,283	288	255	1,826	211	386,008	5.66
Clearfield	4,166,513	463,418	5,391	23,056	4,658,378	2.26	4,534	284	712	5,530	216	1,194,676	3.90
Clinton	54,047	65,510	165	15	119,737	2.22	74	27	24	125	224	27,968	4.28
Elk	699,094	115,139	4,429	20,929	839,591	2.26	952	----------	152	1,104	227	250,364	3.35
Fayette	16,677,510	1,617,568	102,608	[16] 4,395,480	22,793,166	2.34	18,324	246	2,194	20,764	228	4,728,611	4.82
Greene	6,035,255	59,079	13,908	[16] 24,001	6,132,243	2.19	4,340	----------	700	5,040	229	1,152,879	5.32
Huntingdon	411,888	94,659	3,483	2,945	512,975	2.66	759	----------	78	837	225	188,740	2.72
Indiana	7,442,940	168,750	305,717	[16] 397,608	8,315,015	2.11	6,374	----------	795	7,169	224	1,606,769	5.17
Jefferson	2,147,360	175,632	3,199	3,495	2,329,686	2.19	2,131	122	264	2,517	212	532,742	4.37
Lawrence	192,489	116,861	172	127	309,649	2.42	340	16	78	434	201	87,112	3.55
Lycoming	2,000	63,403	250	130	65,783	2.58	98	3	16	117	226	26,401	2.49
Mercer	112,845	332,743	1,457	1,101	448,146	2.26	212	42	66	320	241	76,996	5.82
Somerset	6,030,969	199,083	30,375	53,713	6,314,140	2.43	6,076	41	882	6,999	221	1,544,148	4.09
Tioga	235,865	96,065	348	7,467	339,745	2.90	313	30	55	398	199	79,137	4.29
Venango	----------	25,453	10	----------	25,463	2.47	28	----------	6	34	255	8,661	2.94
Washington	19,112,737	676,525	284,558	23,832	20,097,652	2.25	15,820	296	2,014	18,130	225	4,071,979	4.94
Westmoreland	8,203,254	1,251,799	196,527	[16] 1,278,430	10,930,010	2.18	7,506	350	1,204	9,060	234	2,122,123	5.15
Other counties (Cameron, Forest, Fulton, and McKean)	229,951	18,105	----------	207	248,263	2.66	244	17	34	295	230	67,761	3.66
Total Pennsylvania	109,081,289	10,562,884	4,077,713	[16] 6,517,797	130,239,683	2.28	105,899	2,514	15,075	123,488	224	27,605,388	4.72

SOUTH DAKOTA (LIGNITE)

Total South Dakota	37,338	33,364	[16] 123	([16])	70,825	$1.52	15	44	10	69	174	12,001	5.90

TENNESSEE

Anderson	1,170,595	30,884	8,994	423	1,210,896	$2.38	1,310	----------	139	1,449	214	309,962	3.91
Campbell	1,894,216	60,203	27,833	193	1,982,445	2.52	2,174	----------	362	2,536	225	571,214	3.47
Claiborne	1,711,258	38,079	14,990	4,098	1,768,425	2.25	1,784	----------	268	2,052	226	463,421	3.82
Fentress	349,296	23,514	2,121	6,532	381,463	1.86	354	----------	41	395	256	100,930	3.78
Grundy	454,203	6,157	6,603	[17] 12,764	479,727	2.34	493	----------	62	555	212	117,925	4.07
Hamilton	20,484	30,756	125	----------	51,365	2.04	71	----------	17	88	198	17,431	2.95
Marion	405,281	85,191	4,204	1,541	496,217	2.61	731	----------	115	846	206	174,334	2.85
Morgan	133,272	15,431	1,518	10,075	160,296	2.06	293	----------	81	374	168	62,776	2.55
Overton	15,710	28,253	11	180	44,154	1.61	41	----------	8	49	250	12,248	3.60
Scott	119,151	16,464	1,732	2,406	139,753	2.23	240	3	44	287	176	50,622	2.76
Sequatchie	18,575	89,728	290	582	109,175	2.15	144	----------	32	176	19	35,019	3.12
White	----------	5,670	----------	----------	5,670	1.77	13	----------	1	14	22	3,136	1.81
Other counties:													
Cumberland and Putnam	85,723	42,276	837	66	128,902	1.81	157	----------	52	209	238	49,805	2.59
Bledsoe, Rhea, and Van Buren	34,065	52,649	69	----------	86,783	2.11	121	----------	21	142	202	28,734	3.02
Total Tennessee	6,411,829	525,255	69,327	[17] 38,860	7,045,271	2.34	7,926	3	1,243	9,172	218	1,997,557	3.53

TEXAS

Texas bituminous coal:													
Palo Pinto and Wise	10,074	5,282	126	----------	15,482	$3.41	57	----------	11	68	94	6,405	2.42
Total bituminous coal	10,074	5,282	126	----------	15,482	3.41	57	----------	11	68	94	6,405	2.42
Texas lignite	329,947	[15] 7,379	----------	([15])	337,326	.84	154	30	18	202	180	36,301	9.29
Total Texas	340,021	[15] 12,661	126	([15])	352,808	.95	211	30	29	270	158	42,706	8.26

UTAH

Carbon	2,820,774	326,604	17,598	[18] 27,150	3,192,126	$2.35	1,539	----------	561	2,100	202	424,667	7.52
Emery	656,354	105,991	4,292	5,066	771,703	2.27	308	----------	129	437	218	95,328	8.10
Summit	26,244	21,717	1,132	35	49,128	2.01	34	----------	16	50	277	13,867	3.54
Other counties (Grand, Iron, Sevier, and Uintah)	39,742	23,959	93	28	63,822	2.56	45	----------	13	58	224	13,010	4.91
Total Utah	3,543,114	478,271	23,115	[18] 32,279	4,076,779	2.33	1,926	----------	719	2,645	207	546,872	7.45

See footnotes at end of table.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [2]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
VIRGINIA													
Buchanan	5,520,947	10,154	19,348	2,995	5,553,444	$2.32	3,859	----------	442	4,301	219	942,880	5.89
Dickenson	2,045,350	21,727	7,422	772	2,075,271	2.26	1,925	----------	223	2,148	262	562,461	3.69
Lee	1,407,626	84,065	11,619	2,044	1,505,354	2.49	1,726	----------	255	1,981	220	436,622	3.45
Scott	----------	26,862	40	100	27,002	2.82	64	----------	14	78	218	17,006	1.59
Tazewell	3,731,744	56,564	27,574	11,125	3,827,007	2.45	3,517	----------	564	4,081	221	902,070	4.24
Wise	3,610,408	90,617	24,445	[10] 530,474	4,255,944	2.21	4,217	----------	543	4,760	222	1,057,546	4.02
Other counties (Chesterfield, Montgomery, and Russell)	1,096,471	86,966	8,828	4,659	1,196,924	2.29	1,099	4	216	1,319	231	304,688	3.93
Total Virginia	17,412,546	376,955	99,276	[10] 552,169	18,440,946	2.33	16,407	4	2,257	18,668	226	4,223,273	4.37
WASHINGTON													
King	344,294	289,325	5,070	542	639,231	$3.76	694	6	156	856	228	195,228	3.27
Kittitas	821,626	23,425	79,511	11,005	935,567	3.37	730	----------	209	939	241	226,228	4.14
Lewis	6,629	27,974	90	312	35,005	2.74	27	----------	6	33	197	6,514	5.37
Pierce	7,069	13,001	132	24	20,226	4.29	20	----------	4	24	229	5,503	3.68
Other counties (Thurston and Whatcom)	159,883	46,992	1,161	3,209	211,245	3.51	241	----------	67	308	158	48,656	4.34
Total Washington	1,339,501	400,717	85,964	[8] 15,092	1,841,274	3.52	1,712	6	442	2,160	223	482,129	3.82

Barbour	1,463,451	8,398	2,771	70	1,474,690	$1.88	1,197	----------	177	1,374	204	280,638	5.25
Boone	4,520,623	674	18,180	1,432	4,540,909	2.25	3,280	----------	612	3,892	214	832,868	5.45
Braxton	9,043	4,773	15	200	14,031	1.88	31	----------	11	42	104	4,357	3.22
Brooke	759,277	371,534	901,872	90	2,032,773	1.87	908	97	209	1,214	234	283,700	[3] 7.17
Clay	694,454	3,705	12,579	23,933	734,671	2.22	433	----------	124	607	268	162,374	4.52
Fayette	12,436,149	22,922	383,772	[20] 396,110	13,238,953	2.44	11,315	----------	1,813	13,128	227	2,976,459	4.45
Gilmer	50,832	2,755	18	----------	53,605	1.93	62	----------	13	75	226	16.955	3.16
Grant	3,987	61,579	274	97	65,937	2.42	114	----------	25	139	261	36,258	1.82
Greenbrier	2,155,551	81,805	9,698	734	2,247,788	2.37	1,920	----------	221	2,141	229	490,862	4.58
Hancock	29,806	136,640	90	1,133	167,669	1.81	42	27	16	85	208	17,698	[3] 9.47
Harrison	5,088,898	37,873	64,398	2,820	5,193,989	1.94	2,612	49	590	3,251	219	712,209	[3] 7.29
Kanawha	7,998,338	72,926	50,035	6,869	8,128,168	2.18	6,439	----------	826	7,265	233	1,694,302	4.80
Lewis	1,530	16,607	500	----------	18,637	1.80	18	----------	4	22	261	5,750	3.24
Logan	19,295,907	7,963	101,116	4,082	19,409,068	2.12	10,196	----------	2,308	12,504	220	2,752,892	[3] 7.05
McDowell	26,173,848	42,834	317,787	83,017	26,617,486	2.37	18,389	----------	3,741	22,130	231	5,106,583	5.21
Marion	10,043,286	57,782	247,373	38,472	10,386,913	1.97	5,571	----------	924	6,495	236	1,534,766	[3] 6.77
Marshall	484,098	130,214	181,447	3,277	799,036	2.20	526	----------	72	598	247	147,737	5.41
Mason	56,176	35,702	11,949	----------	103,827	1.99	124	----------	43	167	208	34,799	2.98
Mercer	3,632,902	24,168	28,056	954	3,686,080	2.47	3,132	----------	720	3,852	230	887,085	4.16
Mineral	151,116	34,158	476	250	186,000	2.61	216	6	51	273	224	61,143	3.04
Mingo	4,171,436	4,260	26,868	120	4,202,684	2.16	3,129	----------	547	3,676	215	792,066	5.31
Monongalia	9,613,907	86,972	32,008	311	9,733,198	1.91	4,079	24	1,019	5,122	243	1,244,876	[3] 7.82
Nicholas	189,197	63,990	5,150	----------	258,337	2.12	270	----------	39	309	227	70,286	3.68
Ohio	1,746,413	199,099	2,025	10	1,947,547	2.00	1,543	----------	165	1,708	262	446,870	4.36
Preston	1,222,945	5,167	133,678	[20] 68,215	1,430,005	2.06	1.183	45	225	1,453	234	340,256	4.20
Putnam	350,558	8,994	1,925	56	361,533	2.27	649	----------	56	705	146	102,641	3.52
Raleigh	14,240,016	44,363	112,340	50,211	14,446,930	2.44	11,548	----------	2,062	13,610	225	3,063,011	4.72
Randolph	1,525,039	65,648	5,689	20,973	1,617,349	2.28	1,232	----------	260	1,492	231	344,724	4.69
Taylor	561,455	17,176	224	1	578,856	1.92	445	----------	64	509	219	111,648	5.18
Tucker	577,431	4,622	3,339	20,206	605,598	2.51	511	----------	78	589	213	125,654	4.82
Upshur	283,373	22,391	555	3,340	309,659	1.94	153	----------	64	217	242	52,541	5.89
Wayne	124,723	25,930	----------	----------	150,653	1.79	123	----------	34	157	204	32,054	4.70
Webster	1,250,630	6,878	820	3.014	1,261,342	2.48	950	----------	179	1,129	225	254,217	4.96
Wyoming	4,191,827	7,260	24,508	22,732	4,246,327	2.58	3,320	----------	499	3,819	232	886,906	4.79
Total West Virginia	135,098,222	1,717,762	2,681,535	[20] 752,729	140,250,248	2.23	95,710	248	17,791	113,749	228	25,907,185	5.41

See footnotes at end of table.

TABLE 40.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States in 1941*—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
WYOMING													
Carbon	694,103	39,367	2,813	18,442	754,725	$2.03	280	26	93	399	232	92,495	8.16
Converse		11,848	20	355	12,223	2.26	3	9	1	13	168	2,184	5.60
Fremont	17,416	11,476	306	5,304	34,502	2.55	22		10	32	206	6,589	5.24
Hot Springs	63,173	20,483	360	1,157	85,173	3.30	111		25	136	120	16,266	5.24
Johnson		10,799	110	340	11,249	1.95	10		4	14	252	3,523	3.19
Lincoln	439,669	34,594	4,513	7,521	486,297	2.63	377		119	496	182	90,125	5.40
Sheridan	562,410	31,462	3,340	1,234	598,446	1.79	177	3	60	240	204	49,002	12.21
Sweetwater	4,436,932	11,528	24,049	47,607	4,520,116	2.08	2,403		513	2,916	205	597,139	7.57
Other counties (Big Horn, Campbell, Natrona, Park, and Uinta)	101,559	29,977	843	11,220	143,599	1.37	24	18	22	64	269	17,245	8.33
Total Wyoming	6,315,262	201,534	36,354	[5] 93,180	6,646,330	2.09	3,407	56	847	4,310	203	874,568	[8] 7.60

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water.

[2] Includes coal transported from mines to points of use by conveyor, chute, or aerial tramway.

[3] Value received or charged for coal f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[4] Includes 4,830 tons made into beehive coke at mines in Jefferson County, Ala., in 1941.

[5] No coal was made into beehive coke at mines in 1941.

[6] Includes 124,198 tons made into beehive coke at mines in Las Animas County, Colo., in 1941.

[7] "Other counties" in Illinois include Bond, Crawford, Greene, Hancock, Jefferson, Logan, McDonough, Macon, Marion, Marshall, Montgomery, Tazewell, Wabash, Warren, Will, and Woodford.

[8] Much of the output is obtained from strip pits or by use of loading machines, in which types of operations production per man per day is large.

[9] Production of Home Riverside and Alston mines is credited to Missouri, and production of Hume-Sinclair (Tiger mine) is credited to Kansas.

[10] Output obtained chiefly from strip pits, in which production per man per day is large.

[11] Includes 3,424 tons made into beehive coke at mines in Jackson County, Ky., in 1941.
[12] "Other counties" in Eastern Kentucky include Elliott, Leslie, McCreary, Madison, Magoffin, Morgan, and Owsley.
[13] "Other counties" in Missouri include Cedar, Chariton, Clark, Dade, Daviess, Grundy, Howard, Jasper, Johnson, Lincoln, Moniteau, Monroe, and Morgan.
[14] "Other counties" in Montana bituminous coal include Blaine, Fergus, Flathead, Gallatin, Judith Basin, Park, Phillips, and Pondera.
[15] In North Dakota some lignite "made into briquets" is included with "Other uses at mine." In South Dakota a small amount of colliery fuel is included with "Other uses." In Texas a small amount of colliery fuel is included with "Shipped by truck or wagon."
[16] Includes coal made into beehive coke at mines in the following counties in Pennsylvania in 1941: Cambria, 109,623 tons; Fayette, 4,371,446 tons; Greene, 7,635 tons; Indiana, 305,201 tons; and Westmoreland, 1,243,842 tons—a grand total of 6,037,747 tons.
[17] Includes 11,920 tons made into beehive coke at mines in Grundy County, Tenn., in 1941.
[18] Includes 20,106 tons made into beehive coke at mines in Carbon County, Utah, in 1941.
[19] Includes 525,067 tons made into beehive coke at mines in Wise County, Va., in 1941.
[20] Includes coal made into beehive coke at mines in the following counties in West Virginia in 1941: Fayette, 347,934 tons; Preston, 65,318 tons—a grand total of 413,252 tons.

STATISTICS ON LIGNITE IN 1941[2]

PRODUCTION

The statistics in this chapter on the lignite industry in the United States were compiled by the Bureau of Mines from annual reports received from producers of lignite in the areas mapped as lignite in Geological Survey Professional Paper 100-A, The Coal Fields of the United States. Subbituminous coal, sometimes called black lignite, is not included in these statistics.

The production of lignite continued to decline in 1941, amounting to 2,775,832 net tons compared with 2,939,201 tons in 1940 and 3,042,537 tons in 1939. These figures do not include the output from some mines producing less than 1,000 net tons annually. The average value per net ton was $1.24 in 1941, an increase from $1.16 per ton in 1940. The number of employees in 1941 totaled 1,644, compared with 2,070 in 1940; and the average output per man per day, based upon calculated man-days, was 9.54 net tons, ranging from a low of 3.44 tons in Montana to a high of 10.23 tons in North Dakota. The industry worked an average of 177 days in 1941 and 178 days in 1940. The length of the working day in most of the mines was 8 hours, although some mines reported a 7-hour day to the Bureau, and a few, a 9-hour day.

North Dakota produced 83 percent of the total United States output of lignite in 1941; Texas followed with 12 percent, and the output of South Dakota and Montana taken together totaled 5 percent. In 1940 the North Dakota production represented 75 percent of the total, that of Texas 21 percent, and South Dakota and Montana combined 4 percent.

For 1941 the Bureau of Mines received reports from 195 lignite mines. Of the total output of the industry, 6 mines, producing 200,000 to 500,000 net tons each, supplied 62 percent; 1 mine reporting production of 100,000 to 200,000 tons, 6 percent; 5 with an output of 50,000 to 100,000 tons each, 13 percent; 12 in the 10,000- to 50,000-ton class, 8 percent; and 171 mines producing less than 10,000 tons each, 11 percent. North Dakota, with 155, had the greatest number of mines. Montana was next, with 20 mines, and South Dakota and Texas followed, with 14 and 6, respectively.

Strip-pit operations were the source of 60 percent of the total production of lignite in 1941, whereas only 13 percent of the total Pennsylvania anthracite production was mined by this method and about 10 percent of the bituminous-coal output was recovered from strip pits.

According to the Federal Power Commission, 842,250 net tons of lignite were used in 1941 for generating electric energy in the United States; this tonnage was equivalent to 30 percent of the total 1941 production. The consumption in the West North Central Division was 583,954 tons, and the West South Central and Mountain Divisions consumed 250,262 and 8,034 tons, respectively.

The following tables contain detailed statistics for lignite in 1941. Statistics of the lignite industry in 1942 were not available for inclusion in this chapter but may be obtained in mimeographed form upon request to the Coal Economics Division of the Bureau of Mines.

[2] Compiled by J. A. Corgan and A. V. Coleman, Coal Economics Division, Bureau of Mines.

TABLE 41.—*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 1941, by States*

	North Dakota	Texas	South Dakota	Montana [1]	Total
Production (net tons):					
Loaded at mines for shipment	1,709,100	329,947	37,338	4,483	2,080,868
Commercial sales by truck or wagon	411,880	[2] 7,379	33,364	54,042	506,665
Used by employees, taken by locomotives at tipple, and other uses	[3] 163,515	----------	[4] 123	228	163,866
Used at mines for power and heat	24,393	(2)	(4)	40	24,433
Total production: 1941	2,308,888	337,326	70,825	58,793	2,775,832
1940	2,218,434	606,418	66,085	48,264	2,939,201
Value:					
Total: 1941	$2,937,000	$284,000	$108,000	$105,000	$3,434,000
1940	$2,587,000	$637,000	$88,000	$86,000	$3,398,000
Average per ton: 1941	$1.27	$0.84	$1.52	$1.79	$1.24
1940	$1.17	$1.05	$1.33	$1.78	$1.16
Number of employees:					
Underground	562	154	15	68	799
Surface (including strip pits)	713	48	54	30	845
Total employees: 1941	1,275	202	69	98	1,644
1940	1,377	546	63	84	2,070
Average number of days mines operated:					
1941	177	180	174	174	177
1940	182	170	168	161	178
Man-days of labor: 1941 [5]	225,657	36,301	12,001	17,083	291,042
Average output per man per day: 1941 [5]	10.23	9.29	5.90	3.44	9.54

[1] Includes output of Custer, Dawson, McCone, Richland, Roosevelt, Sheridan, and Valley Counties.
[2] Some colliery fuel is included in "Commercial sales by truck or wagon."
[3] Includes some lignite "made into briquets."
[4] Some colliery fuel is included in "Other uses."
[5] Based upon calculated number of man-days.

TABLE 42.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1941, by States and counties*

MONTANA

County	Total production (net tons)	Value		Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average tons per man per day [1]
		Total (thousand dollars)	Average per ton				
Custer, Dawson, and Valley	19,681	33	$1.68	28	4,605	164	4.27
McCone	3,455	6	1.74	13	1,752	135	1.97
Richland and Roosevelt	15,834	36	2.27	31	5,660	183	2.80
Sheridan	19,823	30	1.51	26	5,066	195	3.91
Total	58,793	105	1.79	98	17,083	174	3.44

NORTH DAKOTA

Adams and Billings	66,662	103	$1.55	92	14,985	163	4.45
Bowman	9,675	16	1.65	16	2,445	153	3.96
Burke	278,490	356	1.28	76	12,617	166	[2] 22.07
Burleigh	283,251	357	1.26	85	17,677	208	[2] 16.02
Divide	181,464	221	1.22	55	12,850	234	[2] 14.12
Dunn	5,655	8	1.41	15	1,475	98	3.83
Golden Valley	7,296	11	1.51	12	1,860	155	3.92
Grant	12,807	18	1.41	26	2,484	96	5.16
Hettinger	13,454	18	1.34	32	3,294	103	4.08
McKenzie	3,629	6	1.65	7	855	122	4.24
McLean	131,935	189	1.43	113	19,459	172	6.78
Mercer	656,773	820	1.25	284	53,741	189	12.22
Morton	23,943	32	1.34	49	5,135	105	4.66
Mountrail	11,863	18	1.52	23	3,640	158	3.26
Oliver	10,382	10	.96	13	2,000	154	5.19
Slope and Stark	116,171	136	1.17	89	22,198	249	5.23
Ward	470,079	580	1.23	236	41,992	178	[2] 11.19
Williams	25,359	38	1.50	52	6,950	134	3.65
Total	2,308,888	2,937	1.27	1,275	225,657	177	10.23

See footnotes at end of table.

TABLE 42.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States, in 1941, by States and counties*—Continued

SOUTH DAKOTA

County	Total production (net tons)	Value		Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average tons per man per day [1]
		Total (thousand dollars)	Average per ton				
Corson and Dewey	65,730	99	$1.51	47	9,732	207	6.75
Harding and Meade	2,127	4	1.88	10	1,075	108	1.98
Perkins	2,968	5	1.68	12	1,194	100	2.49
Total	70,825	108	1.52	69	12,001	174	5.90

TEXAS

Bastrop and Milam	79,191	39	$0.49	75	5,670	76	[2] 13.97
Henderson and Titus	258,135	245	.95	127	30,631	241	8.43
Total	337,326	284	.84	202	36,301	180	9.29

[1] Based upon "calculated" man-days.
[2] Output is obtained chiefly from strip pits, in which production per man per day is large.

NUMBER AND SIZE OF MINES

TABLE 43.—*Number and production of lignite mines in the United States, in 1941, classified by size of output*

Class	Mines		Production		
	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent
1 (200,000–500,000 tons)	6	3.1	1,710,669	285,112	61.6
2 (100,000–200,000 tons)	1	.5	177,624	177,624	6.4
3 (50,000–100,000 tons)	5	2.6	358,414	71,683	12.9
4 (10,000–50,000 tons)	12	6.1	219,442	18,287	7.9
5 (Under 10,000 tons)	171	87.7	309,683	1,811	11.2
Total	195	100.0	2,775,832	14,235	100.0

METHODS OF RECOVERY

TABLE 44.—*Lignite mined by different methods in the United States in 1941, by States, in net tons*

State	Mined by hand	Shot off the solid	Cut by machines [1]	From strip pits	Total
Montana	[2] 14,818	[2] 291,195	13,434	[2] 76,672	58,793
North Dakota	7,161	188,754	585,829	1,527,144	2,308,888
South Dakota	150	4,245	----------	66,430	70,825
Texas	(2)	(2)	----------	(2)	337,326
Total	22,129	484,194	599,263	1,670,246	2,775,832

[1] A total of 20 machines was used—11 "permissible" and 9 of other types.
[2] Montana includes Texas.

STRIPPING OPERATIONS

The output of lignite from strip pits in 1941 amounted to 1,670,246 tons, compared with 1,512,308 tons in 1940. Lignite produced by this method of mining represented 60 percent of the total output of the industry in 1941 and 51 percent in 1940. As for many years in the

past, the largest producer of lignite from strip pits was North Dakota, whose output in 1941 was 1,527,144 tons compared with a combined total of 143,102 tons from Texas, Montana, and South Dakota.

Detailed statistics for stripping operations in the lignite industry in 1941 are given in table 45.

TABLE 45.—*Summary of stripping operations that produced lignite in the United States in 1941, 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			Average number of days mines operated	Man-days of labor [3]	Average tons per man per day [3]
						In strip pits	All others	Total			
Montana and Texas	4	7	76,672	41	$0.53	38	1	39	73	2,847	26.93
North Dakota	67	46	1,527,144	1,898	1.24	444	92	536	175	93,878	16.27
South Dakota	8	7	66,430	101	1.52	44	7	51	195	9,962	6.67
Total	79	60	1,670,246	2,040	1.22	526	100	626	170	106,687	15.66

[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 the coal was excavated by machine and loaded by hand.
[3] Based upon calculated man-days.

IMPORTS AND EXPORTS [1]

TABLE 46.—*Bituminous coal [2] imported for consumption in the United States, 1941–42, by countries and customs districts, in net tons*

	1941	1942
COUNTRY		
North America:		
Canada	71,041	493,953
Mexico		215
Europe: United Kingdom	319,008	2,753
Africa: Union of South Africa		560
	390,049	497,481
CUSTOMS DISTRICT		
Alaska	4,291	9,763
Buffalo		37
Chicago	1	
Dakota	831	215
Duluth and Superior	1,494	377
Galveston	2,016	
Maine and New Hampshire	195,847	175,434
Maryland	179	379
Michigan	8	
Montana and Idaho	140,796	247,837
New York		2,772
Philadelphia	1,953	
St. Lawrence	376	12
Vermont	865	
Virginia		597
Washington	41,392	60,058
	390,049	497,481

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.
[2] Includes slack, culm, and lignite.

TABLE 47.—*Exports of bituminous coal to Canada and Mexico, the West Indies, and Central America,[1] and "overseas" destinations, 1938–42, in thousands of net tons*

Year	Canada and Mexico	West Indies and Central America	"Overseas" (all other countries)						Grand total
			Newfoundland, Miquelon, Bermuda, Greenland, and Iceland	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
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	106	1,660	653	29	26		2,474	16,466
1941	18,196	332	186	1,541	370	25	62	28	2,212	20,740
1942	21,008	440	90	925	263	4	204		1,486	22,934

[1] Includes Bahamas and Panama.

TABLE 48.—*Bituminous coal exported from the United States, 1941–42, by countries, in net tons* [1]

Country	1941	1942	Country	1941	1942
North America:			South America—Continued.		
Bermuda	4,860	4,477	Paraguay	12	
British Honduras	131	71	Peru	99	
Canada	18,194,959	21,006,779	Surinam	4,142	7,634
Central America:			Uruguay	120,463	79,098
Costa Rica	1,593	20	Venezuela	354	7
El Salvador	56	34	Other South America	1,123	1,220
Guatemala	296	67		1,540,838	925,108
Honduras	582	164			
Nicaragua	53	4	Europe:		
Panama:			Portugal	353,721	244,934
Canal Zone	65,182	100,313	Spain	2,670	
Republic of	15	13	Switzerland	6,804	
Greenland	228	668	Other Europe	6,878	18,390
Iceland		2,145		370,073	263,324
Mexico	661	964			
Newfoundland and Labrador	181,443	82,579	Asia:		
West Indies:			Iraq		3,932
British:			Netherlands Indies	13,627	
Barbados	624	3,714	Philippine Islands	6,793	
Jamaica	22,551	33,158	Other Asia	4,426	10
Trinidad and Tobago	27,871	95,160		24,846	3,942
Other British	2,611	56			
Cuba	177,044	197,156	Oceania	28,840	
Curacao (N. W. I.)	2,967	530			
Dominican Republic	118	98	Africa:		
French	30,106	8,940	Canary Islands	22,236	7,202
Haiti		7	Egypt		152,597
	18,713,951	21,537,117	Liberia		11
			Morocco	22,637	44,284
South America:			Union of South Africa	1,792	
Argentina	343,029	172,988	Other Africa	15,258	30
Bolivia	31,375	30,076		61,923	204,124
Brazil	981,842	611,307			
Chile	58,205	22,492	Grand total	20,740,471	22,933,615
Colombia	55	15			
Ecuador	139	271			

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated 1,643,010 tons in 1941 and 1,584,763 tons in 1942.

TABLE 49.—*Bituminous coal exported from the United States, 1941–42, by customs districts, in net tons*

Customs district	1941	1942	Customs district	1941	1942
North Atlantic:			Pacific Coast—Continued.		
Maine and New Hampshire	6,527	1,817	San Diego	90	92
Massachusetts	76	2,363	San Francisco	35	----------
New York	9,445	122,713	Washington	----------	1,046
Philadelphia	47,247	44,566	Northern border:		
South Atlantic:			Buffalo	1,131,767	1,495,223
Maryland	302,757	222,175	Chicago	1,695	179,047
South Carolina	28,902	1,147	Dakota	6,066	10,893
Virginia	2,073,528	1,263,533	Duluth and Superior	20,086	37,112
Gulf Coast:			Michigan	2,027,566	1,669,816
Florida	9,307	88,123	Montana-Idaho	326	49
Mobile	11,448	111,363	Ohio	10,631,883	11,243,027
New Orleans	1,556	11,423	Rochester	2,939,606	3,687,813
Mexican border:			St. Lawrence	1,470,355	2,729,361
Arizona	292	362	Vermont	16,886	8,557
El Paso	75	188	Wisconsin	685	1,061
Laredo	19	217	Miscellaneous: Alaska	96	528
Pacific Coast:					
Oregon	2,150	----------		20,740,471	22,933,615

Shipments to Alaska, Hawaii, 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, Puerto Rico, and the Virgin Islands. Shipments in 1941–42 are shown in the following table.

TABLE 50.—*Shipments of bituminous coal to noncontiguous Territories, 1941–42*

Territory	1941		1942	
	Net tons	Value	Net tons	Value
Alaska:				
Anthracite	21,805	$218,029	9,812	$205,255
Bituminous				
Hawaii	1,466	34,623	469	8,775
Puerto Rico	16,185	80,691	11,150	62,435
Virgin Islands	132,128	591,242	39,368	201,741

WORLD PRODUCTION

TABLE 51.—*World production of coal and lignite, 1938–42, by countries, in thousands of metric tons* [1]

[Compiled by B. B. Waldbauer, Bureau of Mines]

Country [1]	1938	1939	1940	1941	1942
North America:					
Canada:					
Coal	9,815	10,985	12,638	12,872	12,987
Lignite	3,153	3,094	3,298	3,662	4,103
Greenland	7	[2]	6	[3]	[3]
Mexico	893	628	816	856	908
United States:					
Anthracite	41,820	46,708	46,706	51,136	54,728
Bituminous	313,473	355,445	415,336	466,426	526,172
Lignite	2,720	2,760	2,666	2,518	
South America:					
Brazil	883	1,047	1,336	1,408	[4] 1,800
Chile	2,044	1,850	1,937	2,051	1,916
Colombia	331	349	521	403	[3]
Peru	75	108	153	195	[5] 120
Venezuela	6	3	5	4	8
Europe:					
Albania: Lignite	4	[2]	[3]	[3]	[3]
Belgium	29,585	29,847	[3]	[3]	[3]
Bulgaria:					
Coal	142	164	188	[3]	[3]
Lignite	1,855	2,134	2,700	[3]	[4] 2,800
Czechoslovakia:					
Coal	15,800	[2]	[3]	[3]	[3]
Lignite	14,717	[6] 779	[6] 805	[6] 816	[6] 1,000
Eire	120	120	118	155	[3]
Faroe Islands: Lignite	8	8	[3]	[3]	[3]
France:					
Coal	46,498	51,000	[3]	[3]	[3]
Lignite	1,057				
Germany:					
Coal	186,177	200,000	[3]	[3]	[7] 139,000
Lignite	195,312	230,000	[3]	[3]	[3]
Austria:					
Coal	227	[2]	[3]	[3]	[3]
Lignite	3,342	[2]	[3]	[3]	[3]
Greece: Lignite	108	139	[3]	[4] 180	[4] 350
Hungary:					
Coal	1,042	1,107	1,207	[3]	[3]
Lignite	8,317	9,518	9,485	[3]	[3]
Italy:					
Coal	1,480	2,025	[3]	[3]	[3]
Lignite	873	1,058	[3]	[3]	[3]
Netherlands:					
Coal	13,488	12,861	[3]	[3]	[3]
Lignite	171	197	[3]	[3]	[3]
Poland:					
Coal	38,104	[2]	[3]	[3]	[3]
Lignite	10	[2]	[3]	[3]	[3]
Portugal:					
Coal	299	313	310	460	[8] 380
Lignite	15	35	67	93	[8] 92
Rumania:					
Coal	299	285	[3]	[3]	[4] 6,500
Lignite	2,097	2,300	[3]	[3]	
Spain:					
Coal	5,649	6,755	8,849	8,775	[9] 5,315
Lignite	166	205	568	819	[9] 615
Svalbard (Spitsbergen)	627	640	[3]	[3]	[3]
Sweden	431	444	498	583	[3]
Switzerland	3	3	8	[3]	[3]
United Kingdom:					
Great Britain	230,659	236,700	[4] 233,700	[4] 216,800	[4] 215,900
Northern Ireland	[10]	[2]	[3]	[3]	[3]
U. S. S. R.:					
Coal	98,627	[2]	148,700	[3]	[4] 247,000
Lignite			15,900	[3]	
Yugoslavia:					
Coal	450	444	[3]	[3]	[3]
Lignite	5,287	5,622	[11] 3,170	[11] 2,600	[3]
Asia:					
British Borneo	[10]	[10]	[3]	[3]	[3]
China	[2]	[2]	[3]	[12] 6,000	[3]
Manchuria	15,000	19,000	[3]	24,500	[3]
Chosen	3,200	4,481	[3]	[3]	[3]

See footnotes at end of table.

TABLE 51.—*World production of coal and lignite, 1938–42, by countries, in thousands of metric tons* [1]—Continued

Country [1]	1938	1939	1940	1941	1942
Asia—Continued.					
Federated Malay States	486	448	794	(2)	(2)
India, British	28,798	28,214	[4] 26,000	[4] 26,000	(2)
Indochina:					
Coal	2,340	2,588	2,456	[13] 1,117	[13] 732
Lignite	4	27	30	(2)	(2)
Japan:					
Japan proper:					
Coal	(2)	(2)	(2)	(2)	(2)
Lignite	(2)	(2)	(2)	(2)	(2)
Karafuto	(2)	(2)	(2)	(2)	(2)
Taiwan	(2)	(2)	(2)	(2)	(2)
Netherlands Indies	1,457	1,781	2,009	[14] 778	(2)
Philippine Islands	41	47	(2)	(2)	(2)
Syria and Lebanon: Lignite	(10)	1	2	(2)	(2)
Turkey:					
Coal	2,589	2,696	3,019	(2)	(2)
Lignite	129	151	280	(2)	(2)
U. S. S. R.:					
Coal	34,261	(2)	(2)	(2)	(2)
Lignite					
Africa:					
Algeria	13	(2)	50	72	(2)
Belgian Congo: Coal	42	(2)	23	(2)	(2)
Morocco, French	123	116	143	145	[4] 110
Nigeria	368	311	313	(2)	(2)
Portuguese East Africa	10	8	20	(2)	(2)
Southern Rhodesia	1,044	1,118	(2)	(2)	(2)
Union of South Africa	16,284	16,890	17,176	[8] 16,982	[8] 17,403
Oceania:					
Australia:					
New South Wales	9,725	11,376	[15] 9,551	[15] 11,939	[15] 12,497
Queensland	1,131	1,339	(2)	(2)	(2)
Tasmania	85	99	(2)	(2)	(2)
Victoria:					
Coal	312	371	(2)	(2)	(2)
Lignite	3,734	3,710	(2)	(2)	(2)
Western Australia	614	566	548	(2)	(2)
New Zealand:					
Coal	994	1,061	1,163	1,199	2,709
Lignite	1,264	1,319	1,393	1,483	
Total, all grades	1,469,000	1,639,000	(2)	(2)	(2)
Lignite (total of items shown above)	264,000	301,000	(2)	(2)	(2)
Bituminous and anthracite (by subtraction)	1,205,000	1,338,000	(2)	(2)	(2)

[1] Coal is also mined in Argentina, Iran, and Italian East Africa, but production figures for these countries are not available.
[2] Estimate included in total.
[3] Data not yet available.
[4] Estimated.
[5] Bituminous coal.
[6] Estimated production of Slovakia only.
[7] Estimated production of Ruhr only.
[8] January to October, inclusive.
[9] January to July, inclusive.
[10] Production less than 1,000 tons.
[11] Estimated production of Croatia only.
[12] Free China.
[13] January to June, inclusive.
[14] Production of Government mines only.
[15] Preliminary.

PENNSYLVANIA ANTHRACITE

By J. A. Corgan, J. W. Buch, and A. V. Coleman

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REVIEW OF 1942

The accelerated demand for Pennsylvania anthracite in 1942 was created largely by the shortages of fuel oil and coke in the New England and Middle Atlantic States, and by increased industrial activity, expanded purchasing power, and rising exports, particularly to Canadian markets. The output of 60,328,000 net tons in 1942 was the largest since 1930 and represented an increase of 7 percent over the production of 56,368,000 tons in 1941; despite the increase of about 4,000,000 tons, the output was not sufficient to meet the demand for anthracite. In 1942 the contract between the producers and the United Mine Workers of America permitted the industry to work 40 weeks of 5 days each and 12 weeks of 6 days each. In January 1943 a 6-day week was inaugurated, and this increased working time should tend to alleviate somewhat the manpower shortage that existed in 1942; thus, should the demand for anthracite continue at the same level, the industry will be in a better position regarding working time than in 1942.

The Bureau of Mines cooperated closely with the Office of Solid Fuels Coordination for War in handling problems relating to production, consumption, distribution, utilization, and transportation of anthracite, bituminous coal, and coke.

Funds for research pertaining to the Pennsylvania anthracite industry's problems, to be expended at the direction of the Secretary of the Interior acting through the Bureau of Mines, were authorized in

December 1942 by the Congress, but no appropriation for the work has yet been made available.

The Federal Anthracite Coal Commission, created by House Joint Resolution 255 to investigate economic conditions in the anthracite-producing areas of the United States, submitted its report to the President and the Congress in April 1942. The report recommended measures for both short-term and long-term improvements which are discussed elsewhere in this chapter.

The Anthracite Commission continued its functions relating to the production of anthracite, and through its efforts arrangements were made for legitimate companies to purchase "bootleg" coal lawfully and to employ men formerly working in illicit operations.

Anthracite Industries, Inc., financially supported by producers representing more than 80 percent of the anthracite output, is working on the most extensive research program ever undertaken by the anthracite industry.

The Anthracite Tidewater Emergency Bureau, a voluntary organization representing anthracite producers, wholesalers, and railroads delivering at tidwater points, was established at the suggestion of the Interstate Commerce Commission and the Car Service Division of the American Association of Railroads to expedite rapid turn-around movement of railroad cars at terminal piers. This newly formed Bureau compiles statistics concerning cars of coal standing at tidewater piers and endeavors to prevent undue detention of such cars, thereby assisting the railroads in meeting the increased demands for transportation due to the war. It is thought that the Bureau will bring about more efficient utilization of railroad equipment, boats, and barges at a time when full use of this equipment is urgently needed.

The failure of the anthracite operators and miners to agree upon terms of a new contract to supersede the agreement that expired on April 30, 1943, was followed by several stoppages of work and the loss of considerable tonnage. These developments and the bitter controversies arising therefrom received widespread attention, and the public has been fully advised of them by press and radio. They will be detailed for the record in the 1943 edition of this chapter.

Definition of Pennsylvania anthracite.—Pennsylvania anthracite includes all nonbituminous coal mined in that State, and for historical purposes data on the output of the Bernice Basin in Sullivan County are included in this chapter, although the coal of this basin has been officially classified as semianthracite. The anthracite fields are in the northeastern part of the State, and the coal is mined in the following counties: Carbon, Columbia, Dauphin, Lebanon, Lackawanna, Luzerne, Northumberland, Schuylkill, Susquehanna, and Wayne.

Statistical trends.—Tables 1 and 2 present pertinent statistical data on the Pennsylvania anthracite industry.

TABLE 1.—*Statistical trends of Pennsylvania anthracite industry, 1938–42*

	1938	1939	1940	1941	1942
Production:					
Loaded at mines for shipment:					
Breakers—net tons	39,010,935	[1] 43,660,662	[1] 43,800,127	46,864,422	51,173,756
Washeries—do	1,679,509	1,766,384	1,761,942	2,538,692	1,957,926
Dredges—do	373,425	565,236	613,884	1,008,983	778,019
Sold to local trade and used by employees—net tons	2,722,206	3,081,073	3,052,626	3,695,125	4,059,403
Used at collieries for power and heat—net tons	2,312,952	2,414,022	2,256,061	2,261,045	2,358,625
Total production—do	46,099,027	51,487,377	51,484,640	56,368,267	60,327,729
Value at breaker, washery, or dredge	$180,600,000	$187,175,000	$205,490,000	$240,275,000	$271,673,000
Average sales realization per net ton on breaker shipments:					
Domestic:					
Lump and Broken	$5.24	$4.63	$5.49	$5.72	$6.03
Egg	$5.18	$4.73	$5.32	$5.84	$6.24
Stove	$5.33	$4.84	$5.47	$5.93	$6.26
Chestnut	$5.36	$4.87	$5.49	$5.93	$6.28
Pea	$3.88	$3.65	$4.13	$4.50	$4.85
Total domestic	$5.10	$4.64	$5.24	$5.68	$6.05
Steam:					
Buckwheat No. 1	$3.03	$2.90	$3.18	$3.37	$3.46
Buckwheat No. 2 (Rice)	$2.35	$2.20	$2.35	$2.52	$2.63
Buckwheat No. 3 (Barley)	$1.61	$1.62	$1.68	$1.78	$1.89
Other, including Buckwheat No. 4	$0.87	$0.91	$0.92	$1.02	$1.09
Total steam	$2.33	$2.25	$2.41	$2.55	$2.58
Total all sizes	$4.16	$3.85	$4.27	$4.59	$4.79
Percent by sizes in total breaker shipments:					
Domestic:					
Lump and Broken	0.3	0.6	0.3	0.3	0.3
Egg	5.4	5.2	4.5	4.2	5.2
Stove	23.7	24.1	24.1	24.3	23.6
Chestnut	26.0	25.8	25.9	25.5	24.9
Pea	10.6	11.0	11.1	10.8	9.6
Total domestic	66.0	66.7	65.9	65.1	63.6
Steam:					
Buckwheat No. 1	14.8	14.3	14.7	14.6	14.5
Buckwheat No. 2 (Rice)	7.7	7.8	7.8	8.2	8.0
Buckwheat No. 3 (Barley)	8.6	8.5	8.8	8.9	9.6
Other, including Buckwheat No. 4	2.9	2.7	2.8	3.2	4.3
Total steam	34.0	33.3	34.1	34.9	36.4
Producers' stocks on Dec. 31 [2]—net tons	1,458,000	994,000	939,000	1,274,000	798,000
Exports—do	1,909,000	2,590,000	2,668,000	3,380,000	4,439,000
Imports—do	363,000	298,000	135,000	75,000	141,000
Consumption (calculated)—do	45,200,000	49,700,000	49,000,000	52,700,000	56,500,000
Average number of days worked	171	183	186	203	239
Man-days lost on account of strikes and lock-outs	579,457	241,688	176,432	397,616	279,641
Number of men on strike during year	27,435	27,795	19,464	39,768	26,631
Average number of men employed	96,417	93,138	91,313	88,054	82,121
Output per man per day—net tons	2.79	3.02	3.02	3.04	2.95
Output per man per year—do	478	553	562	617	705
Quantity cut by machines—do	1,588,407	1,881,884	1,816,483	1,855,422	2,285,640
Quantity mined by stripping—do	5,095,341	5,486,479	6,352,700	7,316,574	9,070,933
Quantity loaded by machines underground—net tons	10,151,669	11,773,833	12,326,000	13,441,987	14,741,459
Distribution:					
Total receipts in New England [3]—net tons	4,468,000	4,902,000	4,822,000	5,551,000	5,974,000
Exports to Canada—do	1,896,000	2,577,000	2,627,000	3,361,000	4,418,000
Loaded into vessels at Lake Erie [4]—net tons	450,000	531,000	430,000	536,000	575,000
Receipts at Duluth-Superior [5]—do	155,000	202,000	138,000	253,000	222,000

[1] Includes small quantity of washery coal.
[2] Anthracite Committee. Figures represent prepared coal in ground storage; 1941 figures are through December 27; 1942 figures are through Jan. 3, 1943.
[3] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[4] Ore and Coal Exchange, Cleveland, Ohio.
[5] U. S. Engineer Office, Duluth, Minn.

TABLE 2.—*Statistical summary of monthly developments in Pennsylvania anthracite industry in 1942*

[All tonnage figures represent net tons]

	1942														1941 (total)
													Year		
	January	February	March	April	May	June	July	August	September	October	November	December	Total	Change from 1941 (percent)	
Production, including mine fuel, local sales, and dredge coal:															
Monthly total	4,560,000	4,801,000	5,116,000	5,185,000	4,873,000	5,153,000	5,374,000	5,212,000	5,459,000	5,132,000	4,824,000	4,639,000	60,328,000	+7.0	56,368,000
Shipments,[1] breakers, and washeries only:															
Monthly total, all sizes	3,751,707	3,969,257	4,185,411	4,572,156	4,215,351	4,302,793	4,551,595	4,387,242	4,486,023	4,279,337	4,002,680	3,846,217	50,549,769	+8.0	46,798,819
Distribution:															
Lake Erie loadings [2]	----------	----------	----------	55,700	65,199	78,477	50,512	65,276	78,201	51,060	130,548	203	575,176	+7.2	536,490
Receipts at Duluth-Superior [3]	----------	----------	----------	27,720	20,675	38,092	29,370	21,713	21,010	7,312	55,901	----------	221,793	−12.3	252,951
Upper Lake dock trade:[4]															
Receipts:															
Lake Superior	----------	28	----------	27,719	20,675	23,001	14,138	14,632	13,877	7,386	40,136	139	161,731	−33.8	244,370
Lake Michigan	2,757	1,710	1,394	22,563	46,184	34,730	22,144	29,867	25,549	30,547	60,463	3,594	281,502	−2.9	289,987
Deliveries (reloadings):															
Lake Superior	18,656	9,199	6,354	20,621	26,597	25,393	15,042	10,293	20,412	27,969	29,924	20,758	231,218	+19.1	194,112
Lake Michigan	25,596	20,508	19,770	42,208	48,078	34,196	30,653	15,058	23,791	26,697	14,836	23,979	325,370	+13.1	287,687
Retail yards—159 selected dealers:															
Deliveries [4]	296,205	293,531	259,331	346,298	366,150	376,957	306,926	242,524	218,027	202,589	175,687	287,874	3,372,099	----------	(5)
New England receipts:[6]															
By tide (including imports)	38,602	44,713	39,614	49,464	81,245	37,207	39,341	40,974	36,765	54,380	60,364	57,956	580,625	−14.8	681,733
By rail	317,830	435,172	465,224	378,304	445,536	453,294	461,813	522,676	538,006	478,969	460,131	436,520	5,393,475	+10.8	4,869,640
Exports [7]	222,671	272,169	341,731	310,219	335,126	284,881	320,758	379,898	724,088	358,905	457,968	430,175	4,438,589	+31.3	3,380,189
Imports [7]	4,944	19,062	17,547	12,711	403	5,951	----------	11,432	----------	18,940	15,260	34,524	140,774	+88.5	74,669
Industrial consumption by:															
Railroads (class I only)[8]	117,242	94,276	143,871	105,690	93,899	81,810	81,437	82,367	82,830	97,712	103,230	119,536	1,203,900	−13.7	1,394,211
Electric power utilities [9]	228,850	210,760	216,792	207,272	228,149	230,203	259,594	257,017	256,750	247,423	221,427	240,958	2,805,195	−3.1	2,895,725
Other industrial consumers [10] (selected represented plants only)	134,026	129,693	132,987	113,926	91,998	95,532	104,904	94,042	106,516	123,026	121,450	128,533	(5)	----------	(5)
Number of industrial firms reporting [10]	70	76	76	76	73	72	71	67	80	79	76	75	(5)	----------	(5)
Stocks at end of period shown:															
Railroads (class I only)[8]	180,690	169,905	160,940	154,763	158,260	158,839	175,857	184,781	205,226	217,689	214,302	195,419	195,419	−18.2	238,871

Electric power utilities [9]	1,202,096	1,148,671	1,170,580	1,215,320	1,293,276	1,418,342	1,483,791	1,581,706	1,598,572	1,545,353	1,638,968	1,579,064	1,579,064	+25.6	1,257,478
Other industrial consumers [10] (selected represented plants only)	277,669	306,151	359,543	389,657	397,355	502,020	551,514	506,071	574,097	534,554	533,332	478,461	478,461		(5)
Stocks on Upper Lake docks: [4]															
Lake Superior	105,945	96,772	90,418	97,513	91,496	89,102	88,194	92,530	85,992	65,409	75,767	55,145	55,145	−55.7	124,603
Lake Michigan	126,286	107,488	89,112	69,050	67,558	68,092	59,583	74,892	76,650	80,500	126,238	105,853	105,853	−29.0	149,124
Retail stocks—159 selected dealers [4]	417,988	381,286	362,118	346,376	317,723	288,406	284,585	294,171	282,965	334,806	366,987	348,057	348,057	−25.6	468,001
Producers' stocks [11]	915,295	754,870	655,560	465,857	292,225	140,465	181,159	289,023	472,320	608,351	792,009	797,815	797,815	−37.4	1,273,788
Prices at mines, average per net ton: [12]															
Company Stove	$6.75	$6.75	$6.75	$6.50	$6.75	$6.75	$6.75	$6.75	$6.75	$6.75	$6.75	$6.75	$6.73	+4.2	$6.46
Company Buckwheat No. 1	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	+2.7	$3.65
Wholesale prices: [13]															
On tracks, destination:															
Chestnut	$10.29	$10.29	$10.28	$10.12	$10.31	$10.35	$10.35	$10.34	$10.34	$10.34	$10.34	$10.38	$10.31	+3.0	$10.01
Pea	$8.89	$8.89	$8.88	$8.73	$8.89	$8.98	$8.93	$8.93	$8.93	$8.93	$8.93	$9.01	$8.90	+3.6	$8.59
Index numbers (1926=100)	85.3	85.3	85.2	83.7	85.3	85.7	85.7	85.7	85.7	85.7	85.7	86.2	85.4	+3.3	82.7
Labor conditions: [13]															
Average weekly earnings	$26.31	$33.23	$34.43	$30.57	$35.05	$40.25	$32.09	$34.00	$35.40	$34.36	$35.05	$36.14	$33.85	+23.5	$27.41
Index of employment (1939 average=100)	97.3	96.9	96.1	94.9	95.7	90.4	93.0	92.8	92.5	91.8	91.8	90.9	93.7	−5.1	98.7
Index of pay-roll totals (1939 average=100)	100.7	126.6	130.1	114.2	131.6	142.9	117.2	123.0	128.1	123.4	125.6	128.4	124.3	+17.4	105.9

[1] Furnished by Anthracite Institute.
[2] Ore and Coal Exchange, Cleveland, Ohio.
[3] U. S. Engineer Office, Duluth, Minn.
[4] Bituminous Coal Division, U. S. Department of the Interior.
[5] Data not available.
[6] Furnished by Commonwealth of Massachusetts, Division on the Necessaries of Life. Figures are preliminary.
[7] Department of Commerce.
[8] Association of American Railroads.
[9] Federal Power Commission.
[10] National Association of Purchasing Agents.
[11] Anthracite Committee. Represents coal in storage closest available date to the end of the month
[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.

The war and anthracite.—Anthracite has contributed to the physical well-being of millions of people who live in the highly populated and industrialized New England and Middle Atlantic States (a large number being employed in vital war industries) and who depend entirely on anthracite for warmth and comfort in the home. In addition to supplying the fuel requirements of those normally using anthracite, the industry was called upon to increase its output substantially to provide heat for thousands of people who had used fuel oil and coke before the war but who were unable to obtain their normal supply on account of shortages resulting from difficulties incurred in transporting oil and the withdrawal of coke from the domestic market because of metallurgical demands. In addition to its use in heating homes, apartments, hotels, hospitals, and public buildings, anthracite is used by railroads, public utilities, and industrial plants; and Army camps are now using substantial quantities for space heating and cooking.

Anthracite aided the war effort not only in the United States but also in Canada, where shortages of gas and oil required increased use of coal. Exports, virtually all of which went to Canada, increased from 2,668,000 net tons in 1940 to 3,380,000 tons in 1941 and totaled 4,439,000 tons in 1942. About 90 percent of the exported coal was Pea and larger; these sizes are used for comfort heating.

In November 1941 the President by letter requested the Secretary of the Interior to act as Solid Fuels Coordinator for National Defense to handle problems relating to the production, distribution, consumption, and utilization of both anthracite and bituminous coal. Pursuant to this request the Office of Solid Fuels Coordinator for National Defense was established in the Department of the Interior to provide the machinery for carrying out the President's directions. The name of the Office was changed to the Office of Solid Fuels Coordinator for War by direction of the President in May 1942, and in April 1943 the President, in an executive order, abolished the Coordinator's Office and established within the Department of the Interior the Solid Fuels Administration for War with the Secretary of the Interior as Administrator. A Solid Fuels Advisory War Council, organized by the Secretary and composed of representatives of anthracite, bituminous coal, and coke producers, retail dealers, transporters, wholesalers, labor, and the public, met monthly in 1942 to assist and advise the Secretary on matters pertaining to coordination of the Nation's fuel supply to best meet wartime demands.

The needs of the Coordinator's Office for additional basic and current information, both economic and technical, regarding supplies and disposition of the solid fuels necessitated a substantial expansion in the work of the Bureau of Mines regarding these commodities. This applied particularly to coke, production of which could barely meet the needs arising from the great expansion in the metallurgical industries as a result of the war.

Federal Anthracite Coal Commission.—The Commission's report,[1] containing recommendations for both short-term and long-term measures of improvement, was prepared by the Commission after hearings in the Pennsylvania anthracite regions and study of special reports from Federal, State, and local governmental agencies, civic organizations, and private citizens. The investigation indicated that

[1] Economic Conditions in the Anthracite Coal Regions, House Document 709, 77th Congress, 2d Sess. April 21, 1942.

the anthracite area has substantial possibilities for industrial expansion. The measures recommended for immediate improvement called attention to the unused manpower with mechanical aptitude and industrious habits and to a reserve of housing facilities, and suggested that war plants, particularly those for the production of aluminum, zinc, castings, armor plate, machine parts, and ammunition, be established in the anthracite regions. The report urged that the industry continue the development of industrial and domestic stokers and automatic heating equipment and investigate ways to expand the industrial uses of anthracite. It was recommended also that current surveys on mine flooding be completed. The measure for long-term improvement included a recommendation that a research station under the direction of the Federal Bureau of Mines be located in the anthracite area to investigate new uses for anthracite, study mining methods, assist in the solution of acid and silt problems in the mine waters, and serve as headquarters for the engineering organization concerned with the industrial development of the area. It was suggested also that an agency be created to study the economic problems arising from the depletion of anthracite reserves and that a survey be made of the anthracite forest region with a view to reforestation.

Anthracite Committee.—Operators whose production represented more than 90 percent of the total output of the industry continued to function under the Voluntary Production-Control Plan for stabilizing the industry. The plan was inaugurated in January 1940 through the cooperation of the Commonwealth of Pennsylvania, the United Mine Workers of America, and the producers and was enacted into the laws of Pennsylvania in 1941. The committee kept in close contact with the illicit mining industry and made every effort to alleviate this highly unfavorable economic and social problem.

Anthracite Industries, Inc.—One of the immediate objectives of an expanded research program was the development of inexpensive auxiliary equipment to improve the efficiency and convenience of anthracite-burning equipment now in use. The plan also called for cooperation with equipment manufacturers to develop, design, and improve boilers, furnaces, tank heaters, stokers, and other types of equipment for burning anthracite. With new and improved heating equipment, the anthracite industry hopes to take a leading place in the postwar period and to compete successfully with other fuels. This research program is additional to current activities of the organization in assisting the plumbing trade, architects, real estate concerns, and Government agencies interested in the proper equipment for burning anthracite. The anthracite industry's laboratory at Primos, Pa., established standards to guide utilization engineers of the anthracite-producing companies in recommending grate equipment to convert oil-burning boilers and furnaces to anthracite.

Anthracite Institute.—The Anthracite Institute was particularly active in voicing its opposition to the proposed extension of natural-gas pipe lines into the vital eastern markets. In addition, its members represented the producers before various organizations and committees on other problems affecting the anthracite industry. Through its information services it kept the operators informed of pertinent State and Federal legislation, freight rates, Government regulations

and restrictions on the use of oil and gas for fuel, and many other matters important to the anthracite industry.

Labor.—In December 1942 about 19,000 men went on strike in the Wyoming region in protest against an increase of $6.00 a year in dues and assessments payable to their union, the United Mine Workers of America, and demanded a wage increase of $2.00 a day. A general suspension throughout the anthracite region was threatened. Representatives of the producers, the striking miners, and union officials were summoned before the War Labor Board, January 15, 1943, to state fully the reasons for the strike. After hearing the testimony of the interested parties, the Board ordered the miners back to work and suggested that grievances be adjusted through the machinery established in the contract between the producers and the union. Many of the miners refused to obey the order, and on January 19 the War Labor Board turned the case over to the President, who ordered the miners to resume work; within a few days all of them had returned to their jobs.

To meet increased demands for anthracite, the operators and miners agreed to extend the work week from 5 days to 6; the agreement stated that the mine workers were to be paid time and a half and rate and a half for the sixth consecutive day worked in any 1 week. The agreement was contingent on an increase of maximum prices of anthracite by the Office of Price Administration necessary to compensate for increased costs occasioned by payment of overtime for the sixth day. A price increase of approximately 50 cents a ton was authorized, effective January 9, 1943, and within a few weeks the industry commenced the 6-day week schedule.

Research.—In December 1942 the President approved S. 357, an act passed by the Senate and House of Representatives (56 Stat. 1056), providing for the establishment and operation of a research laboratory in the Pennsylvania anthracite region. Investigations and researches to be conducted through the laboratory facilities will relate to the mining, preparation, and utilization of anthracite; to the development of new uses and markets for anthracite and its products; to safety, health, and sanitation in mining operations; and to any other matters relating to problems of the anthracite industry. The laboratory is to be established, equipped, and maintained by the Secretary of the Interior, acting through the Bureau of Mines. The act authorized appropriation of $450,000 for the erection and equipment of the necessary buildings and $175,000 annually for the maintenance and operation of the experiment station.

The cooperative research program sponsored by the Commonwealth of Pennsylvania and the Anthracite Industry at Pennsylvania State College was continued, special attention being paid to the use of anthracite in water-gas generators and in the preparation of activated carbon.

Research undertaken by Anthracite Industries, Inc., is discussed elsewhere in this chapter under the subheading Anthracite Industries, Inc.

Competitive fuels in the United States and in principal markets.—More than 95 percent of the anthracite shipped from the mines to points in the United States is destined to the New England States, New York, New Jersey, Pennsylvania, Maryland, Delaware, and the District of Columbia. Data on the consumption of all fuels in these

markets are not available; however, the apparent consumption of anthracite, coke, briquets, and heating and range oils, in terms of anthracite, amounted to 84,831,000 net tons in 1941. The sales of heating and range oils in this area in 1941 were the equivalent of 33,284,000 tons of anthracite, and the mine shipments of anthracite to these States totaled 47,466,000 tons. According to the Pennsylvania State Department of Mines, anthracite rail and truck shipments in 1942 to this area totaled 51,546,000 tons. In addition, considerable quantities of "bootleg" or illicit coal were shipped to these markets. The demand for coke for metallurgical use was chiefly responsible for the decline in its consumption for domestic heating from 4,052,000 tons in 1940 to 3,169,000 tons in 1942. Details are shown in table 3.

TABLE 3.—*Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1939–42*

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Delaware	Maryland	Pennsylvania	District of Columbia	Total	
								Thousands of net tons	Percent of total fuels
Anthracite:									
All users: [1]									
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	54.2
1941	5,540	[2] 16,308	[2] 10,190	361	681	14,103	283	47,466	56.0
1942	5,844	[2] 17,988	[2] 10,395	373	835	15,813	298	51,546	(3)
Imports: [4]									
1939	298	-------	-------	-------	-------	-------	-------	298	.4
1940	135	-------	-------	-------	-------	-------	-------	135	.2
1941	75	-------	-------	-------	-------	-------	-------	75	.1
1942	140	1	-------	-------	-------	-------	-------	141	(5)
Briquets:									
Domestic use:									
1939	46	23	1	-------	2	11	1	84	.1
1940	52	26	1	(5)	2	10	(5)	91	.1
1941	52	25	1	(5)	3	14	(5)	95	.1
1942	54	26	1	(5)	4	22	(5)	107	(3)
Imports: [4]									
1939	1	-------	-------	-------	-------	-------	-------	1	(5)
1940	-------	-------	-------	-------	-------	-------	-------	-------	-------
1941	-------	-------	-------	-------	-------	-------	-------	-------	-------
1942	-------	-------	-------	-------	-------	-------	-------	-------	-------
Coke:									
Domestic use:									
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	5.0
1941	1,363	1,350	470	1	28	474	2	3,688	4.3
1942	1,252	1,064	408	2	13	428	2	3,169	(3)
Imports: [4]									
1939	12	19	-------	-------	-------	-------	-------	31	.1
1940	15	58	-------	-------	3	-------	-------	76	.1
1941	65	51	-------	-------	107	-------	-------	223	.3
1942	-------	56	-------	-------	-------	-------	-------	56	(5)
Oil: Heating and range: [8]									
1939	10,787	8,967	3,770	107	694	2,279	458	27,062	36.2
1940	13,027	10,726	4,503	120	885	2,704	578	32,543	40.4
1941	13,253	10,940	4,584	121	963	2,793	630	33,284	39.2
1942	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total fuel: [9]									
1939	16,713	27,421	13,244	371	1,337	14,963	725	74,774	100.0
1940	19,198	28,623	13,807	426	1,526	16,166	869	80,615	100.0
1941	20,348	28,674	15,245	483	1,782	17,384	915	84,831	100.0
1942	(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] Department of 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] Excludes bituminous coal.

In general, the supplies of fuel commonly used for space heating in the United States increased in 1942 over 1941. The increase in anthracite was quite pronounced; coke sales declined, and although data for 1942 on sales of heating and range oils are not available, it is not believed that the use of oil increased appreciably. Details on supplies of various fuels are given in table 4.

TABLE 4.—*Total supplies of fuels commonly used for space heating purposes in the United States, 1924 and 1939–42*

[Wherever available, figures represent quantity actually consumed for domestic heating or for space heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available but where the fuel is known to be used chiefly for domestic or space heating purposes, total production (or imports) is shown to indicate trend of growth]

	1924	1939	1940	1941	1942
SOLID FUELS (NET TONS)					
Anthracite:					
Production:					
Shipments of domestic sizes	56,576,296	29,504,632	29,076,573	30,912,649	32,924,518
Shipments of Buckwheat No. 1	9,510,508	6,569,902	6,771,387	7,357,542	7,789,168
Shipments of smaller steam sizes [1]	11,160,695	9,917,748	10,327,993	12,141,906	13,196,015
Local sales	3,043,939	3,081,073	3,052,626	3,695,125	4,059,403
Total commercial production	80,291,438	49,073,355	49,228,579	54,107,222	57,969,104
Exports	4,017,785	2,590,000	2,667,632	3,382,189	4,438,589
Imports for consumption (chiefly from United Kingdom and U. S. S. R.)	117,951	298,153	135,436	74,669	140,774
Fuel briquets [2]	580,508	880,981	1,027,585	1,258,129	1,644,755
Packaged-fuel production		215,507	284,513	269,844	253,048
Coke:					
Byproduct sales for domestic use	2,812,771	7,549,937	8,131,947	6,596,969	5,963,474
Beehive sales for domestic use	139,886	88,204	99,066	85,990	98,220
Imports for consumption	82,833	141,911	112,550	267,886	108,782
Gas-house-coke sales [3]	1,400,000	362,000	(4)	(4)	(4)
Petroleum-coke production	761,100	1,666,400	1,526,600	1,648,800	1,338,400
Anthracite and semianthracite production outside of Pennsylvania	704,513	(4)	(4)	(4)	(4)
Lignite production [5]	2,255,385	3,042,537	2,939,201	2,775,832	(4)
Bituminous-coal sales for domestic use	(6)	(6)	(6)	(6)	(6)
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil	(4)	37,061,000	44,692,000	46,110,000	(4)
Heating oils: [7]					
Domestic	5,021,000	136,232,000	160,379,000	167,514,000	(4)
Commercial	(4)				
Liquefied petroleum gases, domestic	(4)	2,084,000	3,191,000	5,255,000	(4)
GAS (MILLION CUBIC FEET)					
Natural-gas consumption for domestic and commercial use [8]	285,152	509,487	578,290	586,911	671,000
Manufactured-gas sales for [9]—					
Domestic use	(4)	192,338	198,752	198,700	205,778
House heating	(4)	55,561	68,498	67,151	79,600

[1] A considerable part of the 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] An estimated one-half is used for domestic purposes.
[6] Exact data not available; estimated between 55 and 77 million tons a year, including lignite. Anthracite and semianthracite outside Pennsylvania shown separately.
[7] Includes all grades of fuel oil used for heating buildings.
[8] Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
[9] American Gas Association.

Transportation and distribution of anthracite to principal markets.—According to data compiled from records of the Pennsylvania State Department of Mines, the shipping of anthracite from mines to mar-

kets by trucks has been increasing continuously since 1936, when truck coal totaled 3,177,656 net tons. In 1941 and 1942 the trucked coal amounted to 7,529,479 and 7,955,738 tons, respectively, and in each year comprised 15 percent of the total shipments of anthracite to destinations in the United States. These tonnage figures represent legitimate coal only and do not include the production from illicit or "bootleg" mines, nearly all of which is trucked to market. Legitimate coal is trucked not only to the ultimate consumer but to many retail dealers within a radius of 150 miles of the anthracite-producing regions.

In 1942 Pennsylvania received 71 percent of the total trucked shipments; New Jersey and New York followed, with 15 and 11 percent, respectively. Before 1941 most of the anthracite moved by truck was shipped during December, January, February, and March;

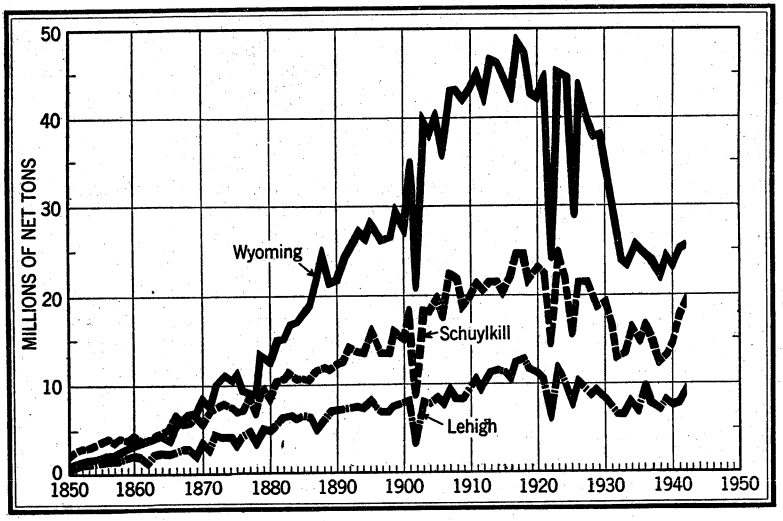

FIGURE 1.—Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1850–1942.

however, in 1941 and 1942, because of increased demand for coal, monthly shipments were fairly uniform throughout the year.

Anthracite shipments, by States of destination, for 1940–42 are shown in table 5, and truck movement of anthracite, by months, for 1941 and 1942 is given in table 6.

According to the Commonwealth of Massachusetts, Division on the Necessaries of Life, rail receipts of Pennsylvania anthracite in New England in 1942 totaled 5,393,475 net tons, a gain of 10.8 percent over 1941. Tidewater receipts, including a small amount of imports, were 580,625 net tons in 1942, a decrease of 14.8 percent from 1941. Table 7 gives details of anthracite moved to New England.

Loadings at Lake Erie ports increased from 536,490 tons in 1941 to 575,176 tons in 1942. Receipts on the upper Lake docks declined from 534,357 tons in 1941 to 443,233 tons in 1942.

Figure 1 illustrates graphically shipments of anthracite from the Lehigh, Schuylkill, and Wyoming regions, 1850–1942.

TABLE 5.—*Shipments of Pennsylvania anthracite, 1940–42, by destinations, in net tons* [1]

[Truck shipments excluded]

Destination	1940	1941	1942
New England States	4,539,026	5,539,936	5,843,834
New York	15,477,318	15,269,752	17,107,566
New Jersey	8,569,913	8,858,652	9,215,932
Pennsylvania	7,906,071	9,168,068	10,154,459
Delaware	197,456	234,454	265,135
Maryland	570,771	627,936	746,568
District of Columbia	280,415	271,921	283,761
Virginia	106,713	118,805	126,779
Ohio	113,553	119,710	113,447
Indiana	83,539	86,809	98,242
Illinois	265,424	281,548	303,824
Wisconsin	347,223	320,500	394,328
Minnesota	61,203	75,334	97,416
Michigan	203,299	247,703	302,160
Other States	68,372	52,223	81,397
Total United States	38,790,296	41,273,351	45,134,848
Canada	2,312,531	2,907,755	3,730,722
Other foreign countries	2,525	13,061	6,528
Grand total	41,105,352	44,194,167	48,872,098

[1] Pennsylvania Department of Mines.

TABLE 6.—*Truck shipments of Pennsylvania anthracite by months in 1942, by States of destination, in net tons* [1]

Destination	January	February	March	April	May	June	July
Pennsylvania:							
Within region	395,055	375,291	303,194	298,950	218,708	199,891	174,498
Outside region	207,610	203,113	183,970	221,447	221,909	193,105	161,726
New York	99,601	83,234	73,643	77,861	86,769	98,424	66,551
New Jersey	128,491	111,911	100,519	114,849	99,365	123,196	79,685
Maryland	4,067	8,395	4,343	4,853	9,301	5,175	4,322
Delaware	13,837	11,266	8,831	10,190	9,970	6,119	7,461
District of Columbia	1,435	1,271	1,161	6	1,507	----------	1,384
Other States	2,431	1,940	2,166	3,465	2,146	2,535	1,789
Total: 1942	852,527	796,421	677,827	731,621	649,675	628,445	497,416
1941	805,254	817,492	808,805	358,788	424,988	621,654	540,308

Destination	August	September	October	November	December	Total	Percent of total trucked
Pennsylvania:							
Within region	232,687	243,142	279,005	269,074	386,453	3,375,948	42.4
Outside region	188,462	185,438	181,844	156,712	177,148	2,282,484	28.7
New York	61,996	55,848	67,105	56,093	53,191	880,316	11.1
New Jersey	93,698	87,664	87,486	74,685	77,764	1,179,313	14.8
Maryland	14,936	7,415	9,275	9,011	7,374	88,467	1.1
Delaware	7,461	10,305	8,630	7,459	6,578	108,107	1.4
District of Columbia	1,347	2,414	1,401	1,006	1,248	14,180	.2
Other States	1,985	1,926	2,094	2,213	2,233	26,923	.3
Total: 1942	602,572	594,152	636,840	576,253	711,989	7,955,738	100.0
1941	617,188	581,878	608,238	523,650	821,236	7,529,479	100.0

[1] Compiled from reports of Pennsylvania Department of Mines.

Consumption.—Consumption of anthracite in the United States in 1942, including colliery fuel, amounted to 56,500,000 net tons, an increase of 3,800,000 tons over the calculated consumption in 1941. These figures consider imports and exports of anthracite and changes in producers' stocks but do not allow for changes in stocks held by retail dealers and small consumers, as data on variations of stocks of

these groups were insufficient. The over-all increase in consumption can be attributed largely to increased industrial use and the substitution of anthracite for fuel oil and coke where shortages of these fuels developed in the principal anthracite markets. Electric power utilities and class I railroads consumed 4,009,095 tons of anthracite in 1942 compared with 4,289,936 tons in 1941.

Changes in stocks.—Anthracite producers found it necessary to draw on stocks to meet the 1942 demands. Stocks of 1,273,788 net tons on December 27, 1941, fell to 797,815 tons by January 2, 1943. As the greatest demand was for Egg, Stove, and Nut sizes, the coal in storage on the latter date was largely Pea and smaller, and very little of the domestic sizes was available.

TABLE 7.—*Receipts of anthracite in New England, 1917, 1920, 1923, and 1927–42, 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	48	4	350	74	172	648	4,174	135	4,687
1941 [4]	57	9	348	58	210	682	4,870	75	5,477
1942 [4]	Not available					581	5,393	139	5,835

[1] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[2] Department of Commerce.
[3] Total receipts by rail and by tide less imports.
[4] Preliminary figures.

Stocks held by 159 selected dealers declined from 417,988 net tons in January 1942 to 282,965 tons in September and at the close of the year amounted to 348,057 net tons.

Stocks held by electric power utilities and railroads (class I) amounted to 1,774,483 tons on December 31, 1942, compared with 1,496,349 tons on the same date in 1941; stocks held by public utilities increased 26 percent, whereas those of railroads declined 18 percent. Stocks on the upper Lake docks declined from 273,727 tons on December 31, 1941, to 160,998 tons on December 31, 1942.

Illicit coal.—According to the Anthracite Committee, the output of anthracite by the illicit or "bootleg" mining industry amounted to 3,931,000 net tons in 1942, a substantial decrease from the estimated production of 5,000,000 tons in 1941. The decline in output can be attributed largely to the efforts of the committee in arranging for the employment of former "bootleggers" by legitimate companies, as well as to the loss of manpower in the illicit industry because many had taken jobs in near-by war industries. A survey by the committee

in March 1941 indicated that 10,762 men were working 3,006 "bootleg" holes, whereas in May 1942 a comparable survey revealed 7,554 men employed in 2,029 holes. In April 1943 the number of holes had decreased to 1,151 and the men employed totaled 3,100. Sixty-five men were killed in "bootleg" mining in 1940, 54 in 1941, and 49 in 1942.

Trend of employment.—The employment and production trends of the anthracite industry have been consistently downward from 1926 (when the number of employees totaled 165,386 and the output was 84,437,000 net tons) to 1941. The production curve reversed itself in 1941 and 1942, when the demand for anthracite increased sharply under the stimulus of war; but the number of employees continued to decline until, at the close of 1942, a shortage of several thousand men below the number necessary to meet production requirements existed within the industry. Employment declined from an average of 88,054 men in 1941 to 82,121 in 1942. The induction of men into the armed forces and the loss of others to near-by war industries were largely responsible for the decrease. These figures do not include men working in "bootleg" holes. Data on employment are given in table 21.

Trend in prices.—In January 1942 circular f. o. b. mine prices for anthracite were quoted as follows: Broken, Egg, Stove, and Chestnut, $6.75 a net ton; Pea $5.25 a ton; Buckwheat, Rice, and Barley, $3.75, $2.90, and $2.15 a ton, respectively. On March 30, 1942 the Office of Price Administration issued Maximum Price Regulation 112, establishing, as maximum prices, those then in effect, which were the same as the January quotations. The regulation also required the granting of seasonal discounts on domestic sizes as follows: April, 50 cents a net ton; May, 40 cents; June, 25 cents; and July, 10 cents. Immediately following issuance of the March 30 price regulation, representatives of the anthracite industry met with price-administration officials on several occasions and urged not only elimination of the discount requirements but also an increase in coal prices. On April 16, 1942, the Price Administrator issued an amendment to Price Regulation 112 which eliminated the seasonal discount and at the same time refused the industry's requests for a 25-cent-per-net-ton price increase for domestic and Pea sizes over the maximum prices established in Price Regulation 112.

Effective January 9, 1943, the Office of Price Administration authorized an increase in maximum prices of anthracite of approximately 50 cents a net ton. The price increase reflected higher production costs incident to extension of the work week from 5 to 6 days, and the payment of time and a half and rate and a half for the sixth consecutive day worked in any 1 week. The new prices, as of January 9, 1943, were $7.30 per net ton f. o. b. mine for Broken, Egg, Stove, and Chestnut sizes; $5.75 for Pea; and $4.20, $3.35, and $2.50 for Buckwheat No. 1, Rice, and Barley sizes, respectively.

Retail prices of anthracite, bituminous coal, coke, and heating oil in selected cities, by months, in 1941 and 1942, are shown in table 8. These prices were compiled from reports of the Bureau of Labor Statistics, United States Department of Labor.

Sales realization.—The average realization on breaker shipments increased from $4.59 a net ton in 1941 to $4.79 in 1942—an increase of 4.4 percent. The average value per net ton of the total anthracite production in 1942 was $4.50 compared with $4.26 in 1941.

TABLE 8.—*Retail prices of selected fuels, 1941–42, by cities and months* [1]

[Coal and coke are per net ton and heating oil per 100 gallons]

City and fuel	January 15		February 15		March 15		April 15		May 15		June 15	
	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942
Baltimore, Md.:												
Anthracite:												
Stove	$12.25	$12.00	$11.25	$12.00	$11.25	$12.00	$11.25	$11.66	$11.14	$12.04	$10.95	$12.04
Buckwheat No. 1	8.75	9.25	8.75	9.25	8.75	9.25	8.75	9.29	8.66	9.29	8.50	9.29
Bituminous coal: Low-Volatile Stove	9.83	10.33	9.83	10.33	9.83	10.33	9.83	10.33	9.75	10.33	9.83	10.33
Coke: Egg	11.83	13.00	11.83	12.50	11.83	12.50	12.00	13.00	12.08	12.52	12.08	12.52
Heating oil:												
Fuel oil No. 2	7.15	7.15	6.95	7.15	6.25	7.15	6.47	7.54	6.97	7.80	7.06	7.80
Fuel oil No. 3												
Boston, Mass.:												
Anthracite:												
Stove	13.75	14.50	13.75	14.50	13.75	14.50	13.75	14.45	13.75	14.52	13.50	14.54
Buckwheat No. 1	10.00	11.00	10.00	11.00	10.00	11.00	10.00	11.00	10.00	11.02	10.50	11.04
Bituminous coal: Low-Volatile Stove												
Coke: Egg	13.12	14.25	13.32	14.25	13.32	14.25	13.32	14.28	13.35	14.38	13.28	14.25
Heating oil:												
Fuel oil No. 2	7.00	7.20	6.80	7.20	6.30	7.20	6.80	7.60	6.90	7.78	6.90	7.80
Fuel oil No. 3	7.00	7.20	6.80	7.20	6.30	7.20	6.80	7.60	6.90	7.80	6.90	7.80
Buffalo, N. Y.:												
Anthracite:												
Stove	11.72	12.38	11.72	12.38	11.72	12.38	11.72	12.20	11.72	12.44	11.72	12.42
Buckwheat No. 1	8.48	8.73	8.48	8.73	8.48	8.73	8.48	8.80	8.48	8.80	8.62	8.77
Bituminous coal: Low-Volatile Stove												
Coke: Egg	9.70	10.86	9.72	10.86	9.72	10.98	9.70	10.94	9.72	10.89	9.72	10.97
Heating oil:												
Fuel oil No. 2	7.30	8.20	7.40	8.20	7.20	8.20	7.40	8.60	7.60	8.80	7.70	8.80
Fuel oil No. 3	7.30	8.20	7.40	8.20	7.20	8.20	7.40	8.60	7.60	8.80	7.70	8.80
Chicago, Ill.: [2]												
Anthracite:												
Stove	14.79	15.55	14.79	15.55	14.79	15.55	14.79	15.19	14.77	15.64	14.77	15.58
Buckwheat No. 1	11.95	12.45	11.95	12.45	11.95	12.45	11.95	12.43	11.95	12.48	11.95	12.45
Bituminous coal: Low-Volatile Stove	11.10	11.87	11.10	11.87	11.10	11.87	11.10	11.59	11.10	11.93	11.14	11.90
Coke: Egg	12.52	13.83	12.52	13.83	12.52	13.83	12.52	13.86	12.50	13.86	12.55	13.84
Heating oil:												
Fuel oil No. 2	7.73	7.65	7.73	7.65	7.73	7.65	7.47	7.65	7.47	7.65	7.47	7.65
Fuel oil No. 3	7.73	7.65	7.73	7.65	7.73	7.65	7.47	7.65	7.47	7.65	7.47	7.65
Milwaukee, Wis.:												
Anthracite:												
Stove	13.70	14.22	13.70	14.22	13.70	14.22	13.70	14.20	13.70	14.24	13.75	14.25
Buckwheat No. 1	11.00	11.22	11.00	11.22	11.00	11.22	11.00	11.20	11.02	11.24	11.15	11.25
Bituminous coal: Low-Volatile Stove	10.90	11.78	10.90	11.78	10.90	11.78	10.90	11.76	10.89	11.76	10.80	11.80
Coke: Egg	11.48	12.46	11.48	12.46	11.48	12.46	11.48	12.44	11.48	12.44	11.48	12.44

See footnotes at end of table.

TABLE 8.—*Retail prices of selected fuels, 1941–42, by cities and months* [1]—Continued

City and fuel	January 15		February 15		March 15		April 15		May 15		June 15	
	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942
Milwaukee, Wis.—Continued.												
Heating oil:												
Fuel oil No. 2	$7.70	$7.70	$7.70	$7.70	$7.70	$7.70	$7.70	$7.70	$7.70	$7.70	$7.70	$7.70
Fuel oil No. 3	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
New York, N. Y.: [3]												
Anthracite:												
Stove	11.72	12.46	11.72	12.49	11.72	12.49	11.72	12.47	11.72	12.45	11.55	12.42
Buckwheat No. 1	8.38	8.59	8.38	8.64	8.38	8.64	8.38	8.62	8.38	8.60	8.47	8.55
Bituminous coal: Low-Volatile Stove	12.27	13.05	12.27	13.05	12.27	13.05	12.27	12.58	11.62	13.05	11.98	13.16
Coke: Egg												
Heating oil:												
Fuel oil No. 2	6.94	7.27	6.45	7.27	6.28	7.27	6.43	7.68	6.83	7.88	6.89	7.88
Fuel oil No. 3	6.94	7.27	6.45	7.27	6.32	7.27	6.43	7.68	6.83	7.88	6.91	7.88
Philadelphia, Pa.:												
Anthracite:												
Stove	10.72	11.67	10.69	11.67	10.72	11.67	10.72	11.25	10.62	11.67	10.60	11.69
Buckwheat No. 1	7.80	8.50	7.80	8.50	7.80	8.50	7.80	8.50	7.80	8.50	7.82	8.52
Bituminous coal: Low-Volatile Stove	10.75	11.75	10.75	11.75	10.75	11.75	10.75	11.81	10.75	11.75	10.75	11.75
Coke: Egg												
Heating oil:												
Fuel oil No. 2	6.75	7.18	6.73	7.18	6.00	7.18	6.41	7.56	6.98	7.76	7.00	7.76
Fuel oil No. 3	6.75	7.17	6.72	7.17	6.00	7.17	6.40	7.56	6.98	7.76	7.00	7.76
Portland, Maine:												
Anthracite:												
Stove	13.50	14.50	13.50	14.50	13.50	14.50	13.50	14.50	13.50	14.50	13.50	14.50
Buckwheat No. 1	10.50	10.75	10.50	10.75	10.50	10.75	10.50	10.75	10.50	10.75	10.50	10.75
Bituminous coal: Low-Volatile Stove	12.50	13.25	12.50	13.25	12.50	13.25	12.50	13.25	12.50	13.25	12.50	13.25
Coke: Egg												
Heating oil:												
Fuel oil No. 2	7.00	7.20	6.83	7.20	6.30	7.20	6.80	7.60	6.90	7.77	6.90	7.77
Fuel oil No. 3												
Washington, D. C.: [4]												
Anthracite:												
Stove	12.95	13.86	12.95	13.70	12.95	13.70	12.95	13.26	12.95	13.76	12.84	13.76
Buckwheat No. 1	9.60	10.12	9.60	10.00	9.60	10.00	9.60	10.04	9.60	10.06	9.63	10.06
Bituminous coal: Low-Volatile Stove	10.86	11.50	10.86	11.38	10.86	11.38	10.86	11.22	10.86	11.38	10.70	11.38
Coke: Egg	11.00	12.54	11.00	12.58	11.00	12.58	11.00	12.61	11.00	12.62	12.00	12.55
Heating oil:												
Fuel oil No. 2	7.38	7.60	7.20	7.60	6.75	7.60	6.75	8.00	7.25	8.20	7.25	8.20
Fuel oil No. 3												

City and fuel	July 15		August 15		September 15		October 15		November 15		December 15	
	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942
Baltimore, Md.:												
Anthracite:												
Stove	$11.49	$12.04	$12.00	$12.04	$12.00	$12.04	$12.00	$12.04	$12.00	$12.04	$12.00	$12.05
Buckwheat No. 1	9.00	9.29	9.25	9.29	9.25	9.29	9.25	9.29	9.25	9.29	9.25	9.30
Bituminous coal: Low-Volatile Stove	10.08	10.33	10.33	10.33	10.33	10.33	10.33	10.33	10.33	10.43	10.33	10.43
Coke: Egg	12.08	12.52	12.08	12.52	12.08	12.52	12.50	12.52	12.50	12.52	12.50	12.52
Heating oil:												
Fuel oil No. 2	7.00	9.47	7.05	8.55	7.15	8.55	7.15	8.70	7.15	8.70	7.15	8.70
Fuel oil No. 3												
Boston, Mass.:												
Anthracite:												
Stove	13.95	14.58	13.95	14.58	14.50	14.58	14.50	14.58	14.50	14.58	14.50	14.58
Buckwheat No. 1	10.50	11.08	10.50	11.08	11.00	11.08	11.00	11.08	11.00	11.08	11.00	11.08
Bituminous coal: Low-Volatile Stove												
Coke: Egg	13.95	14.25	13.95	14.25	13.95	14.25	14.19	14.25	14.25	14.25	14.25	14.25
Heating oil:												
Fuel oil No. 2	6.90	9.80	7.20	8.79	7.20	8.70	7.20	8.70	7.20	8.70	7.20	8.70
Fuel oil No. 3	6.90	9.80	7.20	8.92	7.20	8.70	7.20	8.70	7.20	8.70	7.20	8.70
Buffalo, N. Y.:												
Anthracite:												
Stove	11.98	12.42	12.18	12.42	12.30	12.42	12.38	12.42	12.38	12.42	12.38	12.43
Buckwheat No. 1	8.75	8.77	8.72	8.77	8.72	8.77	8.73	8.77	8.73	8.77	8.73	8.77
Bituminous coal: Low-Volatile Stove												
Coke: Egg	10.16	10.97	10.34	10.97	10.52	10.97	10.71	10.97	10.81	10.97	10.81	10.97
Heating oil:												
Fuel oil No. 2	7.70	10.80	8.00	9.70	8.00	9.70	8.20	9.70	8.27	9.70	8.23	9.70
Fuel oil No. 3	7.70	10.80	8.00	9.70	8.00	9.70	8.20	9.70	8.27	9.70	8.23	9.70
Chicago, Ill.:[2]												
Anthracite:												
Stove	15.10	15.58	15.30	15.58	15.32	15.58	15.47	15.58	15.53	15.58	15.53	15.58
Buckwheat No. 1	12.29	12.45	12.29	12.45	12.32	12.45	12.40	12.45	12.42	12.45	12.42	12.45
Bituminous coal: Low-Volatile Stove	11.51	11.90	11.67	11.90	11.67	11.90	11.81	11.90	11.85	11.90	11.85	11.90
Coke: Egg	13.17	13.81	13.42	13.81	13.46	13.84	13.62	13.84	13.78	13.84	13.81	13.84
Heating oil:												
Fuel oil No. 2	7.47	7.65	7.40	7.65	7.61	7.65	7.65	7.65	7.65	7.65	7.65	7.65
Fuel oil No. 3	7.47	7.65	7.40	7.65	7.56	7.65	7.65	7.65	7.65	7.65	7.65	7.65
Milwaukee, Wis.:												
Anthracite:												
Stove	13.97	14.25	14.23	14.25	14.22	14.25	14.22	14.25	14.22	14.25	14.22	14.25
Buckwheat No. 1	11.26	11.25	11.22	11.25	11.22	11.25	11.22	11.25	11.22	11.25	11.22	11.25
Bituminous coal: Low-Volatile Stove	10.80	11.80	11.28	11.80	11.28	11.80	11.78	11.81	11.78	11.81	11.78	11.81
Coke: Egg	11.48	12.44	11.96	12.44	11.96	12.44	12.46	12.44	12.46	12.44	12.46	12.44
Heating oil:												
Fuel oil No. 2	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Fuel oil No. 3	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70

See footnotes at end of table.

TABLE 8.—*Retail prices of selected fuels, 1941–42, by cities and months* [1]—Continued

City and fuel	July 15		August 15		September 15		October 15		November 15		December 15	
	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942
New York, N. Y.:[3]												
Anthracite:												
Stove	$11.92	$12.42	$12.21	$12.45	$12.44	$12.45	$12.47	$12.45	$12.35	$12.45	$12.35	$12.46
Buckwheat No. 1	8.56	8.55	8.59	8.55	8.57	8.55	8.57	8.55	8.48	8.55	8.48	8.56
Bituminous coal: Low-Volatile Stove												
Coke: Egg	12.64	13.16	12.95	13.16	13.01	13.16	13.12	13.16	12.99	13.16	12.99	13.16
Heating oil:												
Fuel oil No. 2	6.89	9.90	7.20	8.79	7.22	8.79	7.30	8.79	7.27	8.79	7.27	8.79
Fuel oil No. 3	6.91	9.90	7.22	8.79	7.22	8.79	7.29	8.79	7.27	8.79	7.27	8.79
Philadelphia, Pa.:												
Anthracite:												
Stove	10.82	11.69	11.28	11.69	11.58	11.69	11.64	11.70	11.64	11.70	11.64	11.70
Buckwheat No. 1	7.98	8.53	8.17	8.53	8.42	8.53	8.50	8.53	8.50	8.53	8.50	8.53
Bituminous coal: Low-Volatile Stove												
Coke: Egg	11.10	11.75	11.44	11.75	11.50	11.75	11.56	11.75	11.75	11.75	11.75	11.75
Heating oil:												
Fuel oil No. 2	6.98	9.58	6.98	8.59	7.18	8.59	7.18	8.59	7.18	8.56	7.18	8.56
Fuel oil No. 3	6.98	9.56	6.98	8.58	7.17	8.58	7.17	8.58	7.17	8.55	7.17	8.55
Portland, Maine:												
Anthracite:												
Stove	14.00	14.50	14.00	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50
Buckwheat No. 1	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75
Bituminous coal: Low-Volatile Stove												
Coke: Egg	12.50	13.25	12.50	13.25	12.50	13.25	13.25	13.25	13.25	13.25	13.25	13.25
Heating oil:												
Fuel oil No. 2	6.90	9.80	7.15	8.70	7.20	8.70	7.20	8.70	7.20	8.70	7.20	8.70
Fuel oil No. 3												
Washington, D. C.:[4]												
Anthracite:												
Stove	13.12	13.76	13.42	13.76	13.45	13.76	13.70	13.76	13.70	13.76	13.70	13.76
Buckwheat No. 1	9.76	10.06	9.89	10.06	9.90	10.06	10.00	10.06	10.00	10.06	10.00	10.06
Bituminous coal: Low-Volatile Stove	11.00	11.38	11.30	11.41	11.32	11.43	11.38	11.44	11.38	11.44	11.38	11.44
Coke: Egg	12.00	12.55	12.36	12.55	12.42	12.55	12.50	12.55	12.50	12.55	12.50	12.55
Heating oil:												
Fuel oil No. 2	7.25	9.91	7.31	9.10	7.70	9.10	7.70	9.10	7.70	9.10	7.60	9.10
Fuel oil No. 3												

[1] Compiled from reports of the Bureau of Labor Statistics, Department of Labor. 1942 data are preliminary. 1941 coke and oil figures are preliminary.
[2] Includes 3-percent sales tax in 1941 through June and 2-percent July 1941 through December 1942.
[3] Includes 2-percent sales tax. [4] Prices of coal per ton of 2,240 pounds.

Freight rates.—A number of changes affecting the freight-rate structure for anthracite were authorized by the Interstate Commerce Commission in 1942. The so-called motor-compelled rates, which were originally established to compete with the trucking of anthracite, were to expire on December 20, 1942, but were extended to June 20, 1943. Early in 1942 the railroads were authorized to increase freight rates on all commodities, the specific increases on coal being 3 cents per net ton for rates of $1.00 or less and 5 cents per net ton for those over $1.00 a ton. The authorization was issued by the Interstate Commerce Commission on March 2, 1942, and the charges were made effective not later than May 15, 1942. The increases as approved were for the war period and 6 months thereafter. Late in 1942 the Office of Price Administration filed a petition with the Commission asking for reopening of the case and reconsideration with a view to discontinuation of the increases allowed, pointing out that the increases were granted primarily to produce additional revenue for the railroads but that earnings would now be exceedingly favorable if the adjustments granted had not been in effect. In April 1943 the Commission ordered cancellation of the increases, effective May 15, 1943, for a temporary period ending December 31, 1943, during which time further consideration will be given to the comprehensive record along with the developments during the interim. Late in 1942 an examiner of the Interstate Commerce Commission recommended a reduction of 46 cents a gross ton in anthracite freight rates from the mines to New York tidewater piers. The recommendation was argued by interested parties before the Commission in April 1943, and the final decision of that body is pending. The revenue act of 1942 imposed a tax on the transportation of anthracite amounting to 4 cents a net ton, effective December 1, 1942.

Imports and exports.—Exports of anthracite increased from 2,667,632 net tons in 1940 to 3,380,189 tons in 1941 and reached a total of 4,438,589 tons in 1942—the greatest tonnage exported since 1923, when shipments were 5,090,138 tons. Almost all exports were destined to Canada, where a shortage of coke and restrictions on the use of heating oils and gas created a heavy demand for Pennsylvania anthracite. The shipments to Canada were largely domestic sizes, and the industry hopes that gains in this market will be retained after the war. Exports were valued at $21,210,499 in 1940, $27,691,017 in 1941, and $38,286,755 in 1942. Anthracite imports declined from 135,436 tons in 1940 to 74,669 in 1941 and then increased to 140,774 tons in 1942. (See tables 30 to 32.)

Mechanical stokers and oil burners.—Government restrictions on the manufacture and installation of stokers and oil burners were largely responsible for the sharply reduced sales of this equipment in 1942. According to the Bureau of the Census, United States Department of Commerce, factory sales of mechanical stokers (class 1) for burning anthracite decreased from 17,110 units in 1941 to 11,562 in 1942. Sales of class 2 stokers (capacity 61 to 100 pounds of coal per hour) declined from 599 in 1941 to 356 in 1942.

Shipments of oil burners fell from 303,869 units in 1941 to 131,031 in 1942. These figures do not include burners used in water heaters, stoves, ranges, and space heaters, but do include both domestic and foreign shipments.

SOURCES AND ACKNOWLEDGMENTS

Annual statistics of the Pennsylvania anthracite industry are prepared, for the most part, from reports received direct from the producers and shippers of anthracite, as a result of a canvass conducted by mail. More than 95 percent of the tonnage is reported in this manner, and the remainder is obtained personally by a representative of the Bureau of Mines or from reliable collateral evidence. The information as furnished by the producers is voluntary and is held confidential, as is customary with the statistical services of the Bureau of Mines.

In compiling available information, pertinent statistics prepared by the Anthracite Committee, the Anthracite Institute, the American Association of Railroads, and the Pennsylvania Department of Mines have been used to advantage. The Bureau of Mines gratefully acknowledges the cooperation of these and others from whom information has been received.

PRODUCTION

Production of Pennsylvania anthracite in 1942 totaled 60,328,000 net tons—an increase of 7 percent over the output of 56,368,000 tons in 1941. These statistics include deep-mined and strip-pit production, culm-bank coal, anthracite purchased by the legitimate industry from "bootleggers," and river or dredge coal, which is recovered from the rivers and creeks draining the anthracite fields. Also included is a small amount of semianthracite produced in Sullivan County (48,213 net tons in 1942).

See tables 9 to 18 for production and shipments by regions, fields, and counties.

Before 1930 anthracite was mined only by companies who owned or leased the coal lands. During the depression years of the early 1930's unemployed miners dug anthracite from lands of the operating companies without the permission of the owners or lessees, and trucks transported the coal to distant cities where it was sold in competition with the legitimate product. In 1941 the illicit coal tonnage was estimated at about 5,000,000 net tons, and in 1942 the Anthracite Committee estimated "bootleg" production at 3,931,000 tons. Before 1941 "bootleg" coal was not included in the production statistics of the Pennsylvania anthracite industry by the Bureau of Mines. In 1941, however, legitimate operators lawfully purchased run-of-mine coal from "bootleggers" and shipped 1,902,481 tons of the prepared product to market, and in 1942 the purchases totaled 2,616,839 tons. It would be impractical to segregate this purchased "bootleg" coal from the output of the legitimate industry, and it is therefore included in the various production tables in the Minerals Yearbook chapters on Pennsylvania anthracite for 1941 and 1942. For this reason, the production statistics for those years are not exactly comparable with previous years. No attempt has been made to include in the statistics "bootleg" coal other than that purchased by legitimate operators. To compute the output per man per day for the anthracite industry in 1941 and 1942, it was necessary to deduct the "bootleg" purchases from the total tonnage shipped by the legitimate industry since adequate data on man-hours required to produce the bootleg tonnage

are not available. Details of this procedure are discussed in this chapter under Labor Statistics.

Weeks and months.—Tables 9 and 10 summarize the statistics of weekly and monthly production of anthracite. Statistics of current output are estimated from records of car loadings and other pertinent data. The weekly and monthly figures in tables 9 and 10 have been adjusted to the annual total ascertained by direct canvass of the operators.

TABLE 9.—*Estimated weekly production of Pennsylvania anthracite in 1942, in net tons*

Week ended—	Net tons	Week ended—	Net tons
Jan. 3	[1] 113,000	July 18	1,229,000
10	832,000	25	1,237,000
17	1,239,000	Aug. 1	1,259,000
24	1,273,000	8	1,234,000
31	1,103,000	15	1,269,000
Feb. 7	1,157,000	22	1,186,000
14	1,175,000	29	1,244,000
21	1,166,000	Sept. 5	1,248,000
28	1,303,000	12	1,163,000
Mar. 7	1,186,000	19	1,265,000
14	1,182,000	26	1,284,000
21	1,114,000	Oct. 3	1,235,000
28	1,165,000	10	1,166,000
Apr. 4	885,000	17	1,147,000
11	1,119,000	24	1,200,000
18	1,326,000	31	1,117,000
25	1,297,000	Nov. 7	1,091,000
May 2	1,329,000	14	1,181,000
9	1,274,000	21	1,165,000
16	1,270,000	28	1,163,000
23	1,208,000	Dec. 5	1,108,000
30	818,000	12	1,108,000
June 6	1,048,000	19	1,121,000
13	1,186,000	26	779,000
20	1,219,000	31	[1] 749,000
27	1,246,000		
July 4	947,000	Calendar year	60,328,000
11	1,200,000		

[1] Figures represent output of working days in that part of week included in the calendar year 1942. Preliminary production for week of January 2, 1943, was 796,000 tons. Revised total for week of January 3, 1942, was 752,000 tons.

TABLE 10.—*Estimated monthly production of Pennsylvania anthracite, 1935–42, in thousands of net tons* [1]

Month	1935	1936	1937	1938	1939	1940	1941	1942 [2]
January	5,790	5,315	4,236	4,978	5,019	5,783	5,162	4,560
February	4,652	6,952	3,671	3,646	4,169	3,648	4,596	4,801
March	3,228	3,051	4,795	4,257	3,652	3,881	4,765	5,116
April	4,763	4,757	6,779	3,149	5,367	3,853	3,317	5,185
May	5,118	5,104	4,361	4,400	5,141	4,070	4,001	4,873
June	5,724	4,292	4,635	4,450	3,577	4,492	5,072	5,153
July	3,502	3,912	2,748	2,580	2,951	4,534	4,855	5,374
August	3,073	3,492	2,903	2,735	3,883	3,883	5,441	5,212
September	4,113	3,861	3,682	3,388	4,840	4,172	5,334	5,459
October	4,132	4,593	4,848	4,180	4,985	4,355	5,580	5,132
November	3,432	4,320	4,439	3,803	3,989	3,980	3,974	4,824
December	4,632	4,931	4,759	4,533	3,914	4,834	4,271	4,639
	52,159	54,580	51,856	46,099	51,487	51,485	56,368	60,328

[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. 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.

[2] Includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

TABLE 11.—*Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1942, by regions*

Region	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Lehigh:								
Breakers	8,822,265	$41,540,000	457,773	$2,470,000	364,241	$799,000	9,644,279	$44,809,000
Washeries	244,364	806,000	27,849	79,000	2,000	5,000	274,213	890,000
Dredges	9,042	10,000	343	1,000			9,385	11,000
Total Lehigh	9,075,671	42,356,000	485,965	2,550,000	366,241	804,000	9,927,877	45,710,000
Schuylkill:								
Breakers	16,935,772	73,714,000	724,338	2,808,000	333,832	611,000	17,993,942	77,133,000
Washeries	1,580,033	3,974,000	36,792	75,000	27,516	57,000	1,644,341	4,106,000
Dredges	744,910	874,000	503,061	702,000	3,610	4,000	1,251,581	1,580,000
Total Schuylkill	19,260,715	78,562,000	1,264,191	3,585,000	364,958	672,000	20,889,864	82,819,000
Wyoming:								
Breakers	25,390,166	129,724,000	2,287,502	10,802,000	1,591,803	2,164,000	29,269,471	142,690,000
Washeries	133,529	211,000	125	1,000	34,583	61,000	168,237	273,000
Dredges	24,067	34,000					24,067	34,000
Total Wyoming	25,547,762	129,969,000	2,287,627	10,803,000	1,626,386	2,225,000	29,461,775	142,997,000
Total, excluding Sullivan County:								
Breakers	51,148,203	244,978,000	3,469,613	16,080,000	2,289,876	3,574,000	56,907,692	264,632,000
Washeries	1,957,926	4,991,000	64,766	155,000	64,099	123,000	2,086,791	5,269,000
Dredges	778,019	918,000	503,404	703,000	3,610	4,000	1,285,033	1,625,000
Total	53,884,148	250,887,000	4,037,783	16,938,000	2,357,585	3,701,000	60,279,516	271,526,000
Sullivan County: [2] Breakers	25,553	78,000	21,620	68,000	1,040	1,000	48,213	147,000
Grand total: 1942	53,909,701	250,965,000	4,059,403	17,006,000	2,358,625	3,702,000	60,327,729	271,673,000
1941	50,412,097	222,173,000	3,695,125	14,825,000	2,261,045	3,277,000	56,368,267	240,275,000
Change, 1942—percent	+6.9	+13.0	+9.9	+14.7	+4.3	+13.0	+7.0	+13.1

[1] Value given is value at which coal left possession of producing company; does not include margins of separately incorporated sales companies.
[2] For purposes of historical comparison and statistical convenience, the mines of Sullivan County are grouped with the Pennsylvania anthracite region, although the product is classified as semianthracite according to the American Society for Testing Materials Tentative Standard.

Small mines and intercompany sales.—Many small, independently owned mines produce run-of-mine anthracite, which is shipped by rail or truck to breaker companies for preparation and transportation to market. Also, a number of the larger companies have built central cleaning plants for preparing run-of-mine coal from their own mines. This tendency within the industry of transferring run-of-mine coal from one company to another and the trend toward central preparation plants have increased the complexity of compiling the statistics; however, every effort has been made to avoid any duplication of tonnage. The men employed in producing run-of-mine coal have been included in the labor statistics and are an appreciable part of the total number of employees engaged in production work. This reference to independently owned mines concerns legitimate operations only and should not be confused with illicit or "bootleg" mines, for which complete employment data are not available.

Regions, fields, and counties.—The main anthracite region covers an elongated area of about 480 square miles in eastern Pennsylvania, with its longer axis running northeast and southwest. The area is divided into three 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. The Wyoming region covers a single geologic anthracite basin and is about 54 miles long by 6 miles wide at its widest point; the Lehigh region comprises the anthracite lands tributary to the Lehigh River that forms its eastern boundary and contains the Eastern Middle field and the section of the Southern field lying east of Tamaqua; and the Schuylkill region consists of the Western Middle field and the section of the Southern field lying west of Tamaqua.

The area is divided also into four fields, using the grouping of the anthracite geologic basins as a framework, as follows: The Northern field, which is the same as the Wyoming region; the Eastern Middle or Lehigh field, which consists of a group of at least 10 small basins; the Western Middle field, a single basin about 36 miles long by 4½ miles at its widest point; and the Southern field, also a single basin, about 54 miles long by 6 miles at its widest point, which breaks into a long "fishtail" toward its western ends.

TABLE 12.—*Pennsylvania anthracite produced, 1938–42, by fields, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 2,648,273 tons in 1942. 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	1938	1939	1940	1941	1942
Eastern Middle:					
Breakers	5,217,169	[1] 5,444,335	[1] 5,104,708	5,066,892	5,717,908
Washeries	----------	(1)	(1)	217,642	259,378
Dredges	----------	----------	----------	5,032	----------
Total Eastern Middle	5,217,169	5,444,335	5,104,708	5,289,566	5,977,286
Western Middle:					
Breakers	8,877,485	9,242,223	10,168,142	11,531,105	13,122,774
Washeries	940,938	906,992	734,541	946,794	333,089
Dredges	223,961	253,819	447,760	531,129	466,339
Total Western Middle	10,042,384	10,403,034	11,350,443	13,009,028	13,922,202
Southern:					
Breakers	5,447,804	6,196,051	6,615,347	7,445,528	8,797,539
Washeries	625,335	855,659	812,162	1,116,438	1,326,087
Dredges	317,572	432,974	492,684	975,457	794,627
Total Southern	6,390,711	7,484,684	7,920,193	9,537,423	10,918,253

[1] Small quantity of washery coal included with breaker.

TABLE 12.—*Pennsylvania anthracite produced, 1938–42, by fields, in net tons*—Con.

Field	1938	1939	1940	1941	1942
Northern:					
Breakers	24,059,598	27,806,467	26,571,383	28,097,833	29,269,471
Washeries	310,491	295,103	484,569	391,452	168,237
Dredges	29,491	17,067	2,500	5,945	24,067
Total Northern	24,399,580	28,118,637	27,058,452	28,495,230	29,461,775
Total, excluding Sullivan County:					
Breakers	43,602,056	[1] 48,689,076	[1] 48,459,580	52,141,358	56,907,692
Washeries	1,876,764	[1] 2,057,754	[1] 2,031,272	2,672,326	2,086,791
Dredges	571,024	703,860	942,944	1,517,563	1,285,033
Total	46,049,844	51,450,690	51,433,796	56,331,247	60,279,516
Sullivan County: Breakers	49,183	36,687	50,844	37,020	48,213
Grand total	46,099,027	51,487,377	51,484,640	56,368,267	60,327,729

[1] Small quantity of washery coal included with breaker.

TABLE 13.—*Pennsylvania anthracite produced in 1942, by counties*

County	Total shipments		Sold to local trade		Used for power		Total production	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Carbon	3,106,763	$14,479,000	222,304	$1,168,000	107,865	$208,000	3,436,932	$15,855,000
Columbia	129,214	540,000	29,361	59,000	6,853	24,000	165,428	623,000
Dauphin	42,296	107,000	290,393	451,000	1,720	2,000	334,409	560,000
Lackawanna	6,877,722	33,989,000	862,591	4,244,000	446,477	681,000	8,186,790	38,914,000
Luzerne	22,494,868	114,426,000	1,636,016	7,696,000	1,364,214	1,964,000	25,495,098	124,086,000
Northumberland	5,562,365	23,671,000	361,277	1,084,000	82,145	132,000	6,005,787	24,887,000
Schuylkill	15,458,439	62,922,000	452,988	2,002,000	314,151	629,000	16,225,578	65,553,000
Sullivan	25,553	78,000	21,620	68,000	1,040	1,000	48,213	147,000
Snyder, Susquehanna, and Wayne	176,645	706,000	16,844	28,000	34,160	61,000	227,649	795,000
Berks, Lancaster, Northampton, Perry, and York [2]	35,836	47,000	166,009	206,000			201,845	253,000
Total	53,909,701	250,965,000	4,059,403	17,006,000	2,358,625	3,702,000	60,327,729	271,673,000

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.
[2] Counties producing dredge coal only.

TABLE 14.—*Pennsylvania anthracite produced in 1942, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by regions, in net tons*

Region and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Lehigh:						
Breakers	815,954	6,095,234	2,261,370	471,721		9,644,279
Washeries				274,213		274,213
Dredges					9,385	9,385
Total Lehigh	815,954	6,095,234	2,261,370	745,934	9,385	9,927,877
Schuylkill:						
Breakers	1,759,818	9,178,146	5,170,562	1,885,416		17,993,942
Washeries				1,644,341		1,644,341
Dredges					1,251,581	1,251,581
Total Schuylkill	1,759,818	9,178,146	5,170,562	3,529,757	1,251,581	20,889,864
Wyoming:						
Breakers	12,165,687	15,173,647	1,639,001	291,136		29,269,471
Washeries				168,237		168,237
Dredges					24,067	24,067
Total Wyoming	12,165,687	15,173,647	1,639,001	459,373	24,067	29,461,775
Total, excluding Sullivan County:						
Breakers	14,741,459	30,447,027	9,070,933	2,648,273		56,907,692
Washeries				2,086,791		2,086,791
Dredges					1,285,033	1,285,033
Total	14,741,459	30,447,027	9,070,933	4,735,064	1,285,033	60,279,516
Sullivan County: Breakers		48,213				48,213
Grand total	14,741,459	30,495,240	9,070,933	4,735,064	1,285,033	60,327,729

TABLE 15.—*Pennsylvania anthracite produced in 1942, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by fields, in net tons*

Field and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand loaded				
Eastern Middle:						
Breakers	815,954	3,342,837	1,138,967	420,150		5,717,908
Washeries				259,378		259,378
Dredges						
Total Eastern Middle	815,954	3,342,837	1,138,967	679,528		5,977,286
Western Middle:						
Breakers	1,706,354	6,979,239	3,023,783	1,413,398		13,122,774
Washeries				333,089		333,089
Dredges					466,339	466,339
Total Western Middle	1,706,354	6,979,239	3,023,783	1,746,487	466,339	13,922,202
Southern:						
Breakers	53,464	4,951,304	3,269,182	523,589		8,797,539
Washeries				1,326,087		1,326,087
Dredges					794,627	794,627
Total Southern	53,464	4,951,304	3,269,182	1,849,676	794,627	10,918,253
Northern:						
Breakers	12,165,687	15,173,647	1,639,001	291,136		29,269,471
Washeries				168,237		168,237
Dredges					24,067	24,067
Total Northern	12,165,687	15,173,647	1,639,001	459,373	24,067	29,461,775
Total, excluding Sullivan County:						
Breakers	14,741,459	30,447,027	9,070,933	2,648,273		56,907,692
Washeries				2,086,791		2,086,791
Dredges					1,285,033	1,285,033
Total	14,741,459	30,447,027	9,070,933	4,735,064	1,285,033	60,279,516
Sullivan County: Breakers		48,213				48,213
Grand total	14,741,459	30,495,240	9,070,933	4,735,064	1,285,033	60,327,729

TABLE 16.—*Culm-bank coal put through breakers, 1938–42, by fields, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total [1]
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
1941	113,000	57,000	519,000	387,000	1,076,000
1942	291,000	420,000	1,413,000	524,000	2,648,000

[1] No culm-bank coal is put through breakers in Sullivan County.
[2] Includes some washery coal.

TABLE 17.—*Pennsylvania anthracite shipped in 1942, by regions and sizes*

Size	Breaker shipments [1]						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 [2] and Broken	48,161	40,014	49,726	591	137,901	138,492			138,492
Egg	383,080	716,184	1,563,579		2,662,843	2,662,843			2,662,843
Stove	1,914,157	3,064,140	7,080,423	2,472	12,058,720	12,061,192	50,063		12,111,255
Chestnut	2,077,888	3,631,354	7,051,684	7,177	12,760,926	12,768,103	244,145		13,012,248
Pea	935,372	1,751,738	2,200,667	7,422	4,887,777	4,895,199	104,481	(3)	4,999,680
Total domestic sizes	5,358,658	9,203,430	17,946,079	17,662	32,508,167	32,525,829	398,689		32,924,518
Buckwheat No. 1	1,290,503	2,762,553	3,363,951	5,424	7,417,007	7,422,431	349,909	[3] 16,828	7,789,168
Buckwheat No. 2 (Rice)	759,086	1,722,576	1,629,833		4,111,495	4,111,495	277,871	45,689	4,435,055
Buckwheat No. 3 (Barley)	874,317	2,165,725	1,881,539		4,921,581	4,921,581	397,134	198,787	5,517,502
Buckwheat No. 4	372,602	918,009	375,784		1,666,395	1,666,395	456,245	445,016	2,567,656
Other (including silt)	167,099	163,479	192,980	2,467	523,558	526,025	78,078	71,699	675,802
Total steam sizes	3,463,607	7,732,342	7,444,087	7,891	18,640,036	18,647,927	1,559,237	778,019	20,985,183
Grand total	8,822,265	16,935,772	25,390,166	25,553	51,148,203	51,173,756	1,957,926	778,019	53,909,701
Value									
Lump [2] and Broken	$285,000	$249,000	$299,000	$2,000	$833,000	$835,000			$835,000
Egg	2,426,000	4,445,000	9,747,000		16,618,000	16,618,000			16,618,000
Stove	12,109,000	19,120,000	44,301,000	10,000	75,530,000	75,540,000	$268,000		75,808,000
Chestnut	13,222,000	22,717,000	44,205,000	29,000	80,144,000	80,173,000	1,298,000		81,471,000
Pea	4,589,000	8,415,000	10,700,000	23,000	23,704,000	23,727,000	451,000	(3)	24,178,000
Total domestic	32,631,000	54,946,000	109,252,000	64,000	196,829,000	196,893,000	2,017,000		198,910,000
Buckwheat No. 1	4,512,000	9,396,000	11,726,000	13,000	25,634,000	25,647,000	1,090,000	[3] $53,000	26,790,000
Buckwheat No. 2 (Rice)	2,045,000	4,363,000	4,414,000		10,822,000	10,822,000	628,000	99,000	11,549,000
Buckwheat No. 3 (Barley)	1,720,000	3,899,000	3,685,000		9,304,000	9,304,000	676,000	261,000	10,241,000
Buckwheat No. 4	496,000	978,000	480,000		1,954,000	1,954,000	503,000	432,000	2,889,000
Other (including silt)	136,000	132,000	167,000	1,000	435,000	436,000	77,000	73,000	586,000
Total steam	8,909,000	18,768,000	20,472,000	14,000	48,149,000	48,163,000	2,974,000	918,000	52,055,000
Grand total	41,540,000	73,714,000	129,724,000	78,000	244,978,000	245,056,000	4,991,000	918,000	250,965,000

Average value per ton									
Lump [1] and Broken	$5.92	$6.22	$6.01	$3.38	$6.04	$6.03			$6.03
Egg	6.33	6.21	6.23		6.24	6.24			6.24
Stove	6.33	6.24	6.26	4.05	6.26	6.26	$5.35		6.26
Chestnut	6.36	6.26	6.27	4.04	6.28	6.28	5.32		6.26
Pea	4.91	4.80	4.86	3.10	4.85	4.85	4.32	[3]	4.84
Total domestic	6.09	5.97	6.09	3.62	6.05	6.05	5.06		6.04
Buckwheat No. 1	3.50	3.40	3.49	2.40	3.46	3.46	3.12	[3] $3.15	3.44
Buckwheat No. 2 (Rice)	2.69	2.53	2.71		2.63	2.63	2.26	2.17	2.60
Buckwheat No. 3 (Barley)	1.97	1.80	1.96		1.89	1.89	1.70	1.31	1.86
Buckwheat No. 4	1.33	1.07	1.28		1.17	1.17	1.10	.97	1.13
Other (including silt)	.81	.81	.87	.41	.83	.83	.99	1.02	.87
Total steam	2.57	2.43	2.75	1.77	2.58	2.58	1.91	1.18	2.48
Grand total	4.71	4.35	5.11	3.05	4.79	4.79	2.55	1.18	4.66

[1] Figures of shipments from breakers include some culm bank coal handled in the breakers.
[2] Quantity of Lump included is insignificant.
[3] A small amount of Pea included in Buckwheat No. 1.

TABLE 18.—*Sizes of Pennsylvania anthracite shipped from breakers, 1940–42, by regions, in percent of total*

[Note that shipments of dredge and washery coal are not included]

Size	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	1940	1941	1942	1940	1941	1942	1940	1941	1942
Lump [1] and Broken	0.5	0.5	0.6	0.4	0.5	0.2	0.2	0.1	0.2
Egg	3.8	3.5	4.3	3.9	3.6	4.2	5.0	4.7	6.1
Stove	23.3	23.1	21.7	19.1	19.5	18.1	27.0	27.6	27.9
Chestnut	24.7	24.1	23.6	23.3	22.7	21.4	27.6	27.7	27.8
Pea	11.5	11.6	10.6	11.8	11.4	10.4	10.6	10.1	8.7
Total domestic	63.8	62.8	60.8	58.5	57.7	54.3	70.4	70.2	70.7
Buckwheat No. 1	15.6	15.4	14.6	16.2	16.3	16.3	13.6	13.4	13.2
Buckwheat No. 2 (Rice)	8.3	8.4	8.6	9.3	9.7	10.2	6.9	7.2	6.4
Buckwheat No. 3 (Barley)	8.4	8.9	9.9	11.4	11.4	12.8	7.6	7.4	7.4
Other, including Buckwheat No. 4 and Silt	3.9	4.5	6.1	4.6	4.9	6.4	1.5	1.8	2.3
Total steam [2]	36.2	37.2	39.2	41.5	42.3	45.7	29.6	29.8	29.3

Size	Sullivan County			Total—					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	------	------	2.3	0.3	0.3	0.3	0.3	0.3	0.3
Egg	------	------	------	4.5	4.1	5.2	4.5	4.2	5.2
Stove	13.8	5.3	9.7	24.1	24.4	23.6	24.1	24.3	23.6
Chestnut	18.7	14.7	28.1	25.9	25.5	24.9	25.9	25.5	24.9
Pea	12.6	11.9	29.0	11.1	10.8	9.6	11.1	10.8	9.6
Total domestic	45.1	31.9	69.1	65.9	65.1	63.6	65.9	65.1	63.6
Buckwheat No. 1	9.7	3.7	21.2	14.7	14.6	14.5	14.7	14.6	14.5
Buckwheat No. 2 (Rice)	15.8	------	------	7.8	8.2	8.0	7.8	8.2	8.0
Buckwheat No. 3 (Barley)	------	7.4	------	8.8	8.9	9.6	8.8	8.9	9.6
Other, including Buckwheat No. 4 and Silt	29.4	57.0	9.7	2.8	3.2	4.3	2.8	3.2	4.3
Total steam	54.9	68.1	30.9	34.1	34.9	36.4	34.1	34.9	36.4

[1] Quantity of Lump included is insignificant.
[2] Includes all steam sizes.

AVERAGE SALES REALIZATION

The valuation figures in this study represent values at the breaker or washery as reported by the operating companies. The reporting companies are requested to "estimate value of the product not sold" and to "exclude selling expenses" in making their reports.

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 tables for the same sizes of coal.

The average sales realization per net ton on breaker shipments was $4.79 in 1942 compared with $4.59 in 1941 (see table 19). If local sales, colliery fuel, and washery and dredge coal are included, the average value per net ton of the total 1942 production was $4.50 compared with $4.26 in 1941 (see table 20).

TABLE 19.—*Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1940–42, by regions and sizes*

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1940	1941	1942	1940	1941	1942	1940	1941	1942
Lump [1] and Broken	$5.31	$5.61	$5.92	$5.82	$5.82	$6.22	$5.21	$5.61	$6.01
Egg	5.27	5.79	6.33	5.38	5.84	6.21	5.30	5.85	6.23
Stove	5.45	5.92	6.33	5.50	5.94	6.24	5.46	5.93	6.26
Chestnut	5.51	5.95	6.36	5.46	5.88	6.26	5.50	5.94	6.27
Pea	4.15	4.53	4.91	4.09	4.45	4.80	4.15	4.52	4.86
Total domestic	5.23	5.67	6.09	5.19	5.61	5.97	5.27	5.72	6.09
Buckwheat No. 1	3.16	3.36	3.50	3.16	3.34	3.40	3.19	3.40	3.49
Buckwheat No. 2 (Rice)	2.32	2.54	2.69	2.31	2.43	2.53	2.39	2.59	2.71
Buckwheat No. 3 (Barley)	1.70	1.84	1.97	1.59	1.67	1.80	1.75	1.85	1.96
Total steam [2]	2.37	2.53	2.57	2.29	2.42	2.43	2.52	2.67	2.75
Total all sizes	4.18	4.50	4.71	3.99	4.26	4.35	4.45	4.82	5.11

Size	Sullivan County			Total—					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	------	------	$3.38	$5.49	$5.72	$6.04	$5.49	$5.72	$6.03
Egg	------	------	------	5.32	5.84	6.24	5.32	5.84	6.24
Stove	$4.31	$4.09	4.05	5.47	5.93	6.26	5.47	5.93	6.26
Chestnut	4.29	3.69	4.04	5.49	5.93	6.28	5.49	5.93	6.28
Pea	3.32	2.73	3.10	4.13	4.50	4.85	4.13	4.50	4.85
Total domestic	4.02	3.40	3.62	5.24	5.68	6.05	5.24	5.68	6.05
Buckwheat No. 1	2.51	1.45	2.40	3.18	3.37	3.46	3.18	3.37	3.46
Buckwheat No. 2 (Rice)	1.10	------	------	2.35	2.52	2.63	2.35	2.52	2.63
Buckwheat No. 3 (Barley)	------	.73	------	1.68	1.78	1.89	1.68	1.78	1.89
Total steam [2]	1.08	.95	1.77	2.41	2.55	2.58	2.41	2.55	2.58
Total all sizes	2.41	1.73	3.05	4.27	4.59	4.79	4.27	4.59	4.79

[1] Quantity of Lump included is insignificant.
[2] Includes all steam sizes.

TABLE 20.—*Average value per net ton of Pennsylvania anthracite shipments, local sales, colliery fuel, and total production, 1941–42, by regions* [1]

[Note that values in this table include washery and dredge coal]

Region	1941				1942			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh	$4.45	$4.91	$2.07	$4.36	$4.67	$5.24	$2.20	$4.60
Schuylkill	3.85	2.88	1.74	3.74	4.08	2.84	1.84	3.96
Wyoming	4.79	4.60	1.23	4.58	5.09	4.72	1.37	4.85
Total, excluding Sullivan County	4.41	4.02	1.45	4.26	4.66	4.19	1.57	4.50
Sullivan County	1.73	2.88	.84	2.24	3.05	3.15	.96	3.05
Grand total	4.41	4.01	1.45	4.26	4.66	4.19	1.57	4.50

[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

A labor shortage of several thousand men developed in the Pennsylvania anthracite industry in 1942, when the average number of men employed was 82,121—a decrease of 5,933 from the total of 88,054 men employed in 1941. Many men formerly employed in the anthracite mines entered the armed forces, and others obtained employment in near-by war industries.

The employment statistics in this chapter do not include workers in "bootleg" or illicit coal mining, which is conducted in the Southern and Western Middle fields of the Pennsylvania anthracite regions. According to the Anthracite Committee, 10,762 men were working 3,006 "bootleg" holes in March 1941, and in May 1942 a comparable survey revealed 7,554 men employed in 2,029 holes. Although these workers are not included in the employment data, the coal produced by some of them was purchased by the legitimate industry for preparation and shipment to market, and coal so purchased is included in the production tables of this chapter. Complete employment data for the "bootleg" holes from which this coal was produced are not available. In calculating the output per man per day, therefore, the tons of "bootleg" coal purchased by the legitimate industry were deducted from the total tonnage reported by the operators, and the resulting legitimate production was then used to calculate the output per man per day. It is true that part of the time of the men employed at the preparation plants of the legitimate companies was used to prepare this purchased coal for market; however, on a per-ton basis this time is very small, and its omission will not detract materially from the validity of the result obtained.

See tables 21 to 23 for details on labor statistics.

TABLE 21.—*Men employed and days worked at operations producing Pennsylvania anthracite in 1942, by regions* [1]

[Includes operations of strip contractors]

Region	Average number of men employed							Average number of days plant operated	Man-days of labor	Average tons per man per day
	Underground			Surface			Grand total			
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plant	Other	Total surface			
Lehigh:										
Breaker	5,510	4,012	9,522	1,206	1,015	2,366	4,587	14,109	232	3,272,448	2.95
Washery					35	86	121	121	231	28,009	[2] 9.79
Dredge					2	6	8	8	144	1,152	8.15
Total Lehigh	5,510	4,012	9,522	1,206	1,052	2,458	4,716	14,238	232	3,301,609	3.01
Schuylkill:										
Breaker	7,827	4,831	12,658	2,616	1,773	3,139	7,528	20,186	231	4,660,336	[3] 3.30
Washery					137	533	670	670	198	132,361	[2] 12.42
Dredge					145	274	419	419	230	96,526	12.97
Total Schuylkill	7,827	4,831	12,658	2,616	2,055	3,946	8,617	21,275	230	4,889,223	3.74
Wyoming:										
Breaker	24,468	12,209	36,677	704	2,322	6,701	9,727	46,404	245	11,366,460	2.58
Washery					29	61	90	90	119	10,670	[2] 15.77
Dredge					11	6	17	17	280	4,760	5.06
Total Wyoming	24,468	12,209	36,677	704	2,362	6,768	9,834	46,511	245	11,381,890	2.59
Total, excluding Sullivan County:										
Breaker	37,805	21,052	58,857	4,526	5,110	12,206	21,842	80,699	239	19,299,244	[3] 2.81
Washery					201	680	881	881	194	171,040	[2] 12.20
Dredge					158	286	444	444	231	102,438	12.54
Total	37,805	21,052	58,857	4,526	5,469	13,172	23,167	82,024	239	19,572,722	[3] 2.95
Sullivan County: Breaker	58	11	69		13	15	28	97	209	20,236	2.38
Grand total	37,863	21,063	58,926	4,526	5,482	13,187	23,195	82,121	239	19,592,958	[3] 2.95

[1] Men employed in "bootleg" operations excluded.
[2] Represents washeries for which both production and employment were separately reported.
[3] Output per man per day calculated on legitimate tonnages only; "bootleg" purchases excluded.

TABLE 22.—*Men employed at operations producing Pennsylvania anthracite, 1941–42, by counties*

[Includes operations of strip contractors]

County	Men		County	Men	
	1941	1942		1941	1942
Carbon	5,058	4,887	Snyder, Susquehanna, and Wayne	124	74
Columbia	444	1,004	Berks, Lancaster, Northampton, Perry, and York [2]	[3] 118	95
Dauphin and Lebanon	861	[1] 603		88,054	82,121
Lackawanna	15,153	14,162			
Luzerne	42,773	38,868			
Northumberland	6,494	6,413			
Schuylkill	16,940	15,918			
Sullivan	89	97			

[1] None in Lebanon County in 1942.
[2] Counties producing dredge coal only.
[3] None in Perry County in 1941.

TABLE 23.—*Strikes, suspensions, and lock-outs in Pennsylvania anthracite region in 1942*

	Lehigh	Schuylkill	Wyoming	Total, excluding Sullivan County	Sullivan County	Grand total
Total men employed	14,238	21,275	46,511	82,024	97	82,121
Men on strike	7,886	3,222	15,523	26,631	----------	26,631
Man-days lost on account of strike	130,599	26,385	122,657	279,641	----------	279,641
Average days lost—						
Per man employed	9.2	1.2	2.6	3.4	----------	3.4
Per man on strike	16.6	8.2	7.9	10.5	----------	10.5

EQUIPMENT AND METHODS OF MINING

Mechanical loading.—The quantity of coal loaded mechanically underground increased from 13,442,000 net tons in 1941 to 14,741,000 tons in 1942. Hand-loaded tonnage amounted to 30,435,000 tons in

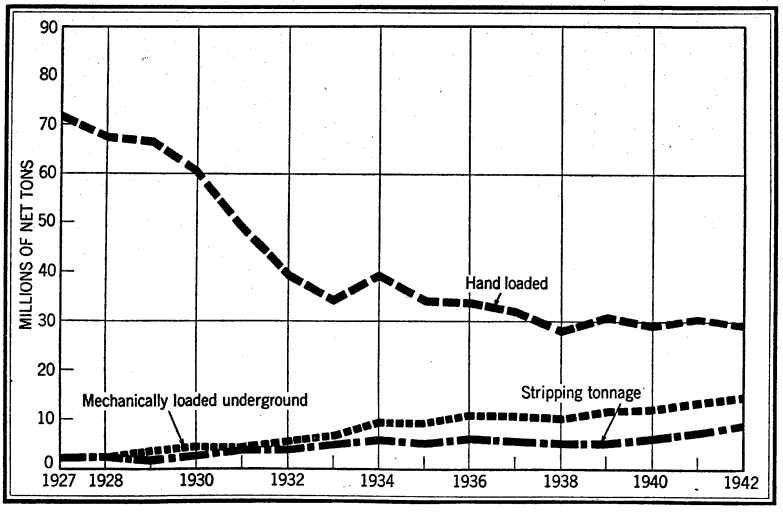

FIGURE 2.—Relative growth of mechanical loading, hand loading, and stripping of Pennsylvania anthracite, 1927–42.

1941 and increased to 30,495,000 in 1942. Details are shown in tables 24 to 26. Figure 2 illustrates graphically the relative growth of underground mechanical and hand loading and of stripping in the Pennsylvania anthracite region, 1927–42.

Cutting machines.—The quantity of anthracite cut by machines increased from 1,855,000 net tons in 1941 to 2,286,000 tons in 1942. Details are shown in table 27.

TABLE 24.—*Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1938–42*

[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
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
1941	13,442,000	7,317,000	30,435,000	605	340	43
1942	14,741,000	9,071,000	30,495,000	663	421	43

TABLE 25.—*Pennsylvania anthracite handled by mobile loaders and scrapers and by all types of conveyors in 1942, by fields, in net tons*

Field	Scraper loaders	Pit-car loaders	Hand-loaded face conveyors, all types [1]	Total mechanically loaded underground
Northern	2,311,019	267,304	9,587,364	12,165,687
Eastern Middle	202,955	270	612,729	815,954
Western Middle	356,272	21,206	1,328,876	1,706,354
Southern	1,680	30,784	21,000	53,464
	2,871,926	319,564	11,549,969	14,741,459

[1] Shaker chutes, etc., including those equipped with duckbills.

TABLE 26.—*Pennsylvania anthracite loaded mechanically underground, 1938–42*

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
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	[2] 547	[2] 2,983,792	2,189	9,342,208	2,736	12,326,000
1941	[2] 505	[2] 2,673,983	2,432	10,768,004	2,937	13,441,987
1942	[2] 524	[2] 2,871,926	2,491	11,869,533	3,015	14,741,459

[1] Includes duckbills and other self-loading conveyors, which handle only a small part of the total.
[2] Includes mobile loaders.

TABLE 27.—*Pennsylvania anthracite cut by machines, 1941–42, by regions*

Region	1941			1942		
	Cutting machines		Net tons cut by machines	Cutting machines		Net tons cut by machines
	Permissible	All other types		Permissible	All other types	
Lehigh					3	21,907
Schuylkill						
Wyoming	161	61	1,855,422	153	85	2,263,733
Total, excluding Sullivan County	161	61	1,855,422	153	88	2,285,640
Sullivan County						
Grand total	161	61	1,855,422	153	88	2,285,640

Strip-pit operations.—The demand for anthracite caused a rapid expansion of strip-pit activities, and the tonnage recovered by this method of mining increased from 7,317,000 net tons in 1941 to 9,071,000 tons in 1942. In 1942, 16.7 percent of the fresh-mined coal was recovered from strip pits compared with 14.3 percent in 1941. For details of strip pit mining see table 28. Figure 3 illustrates graphically the production of anthracite from strip pits, by regions, 1927–42.

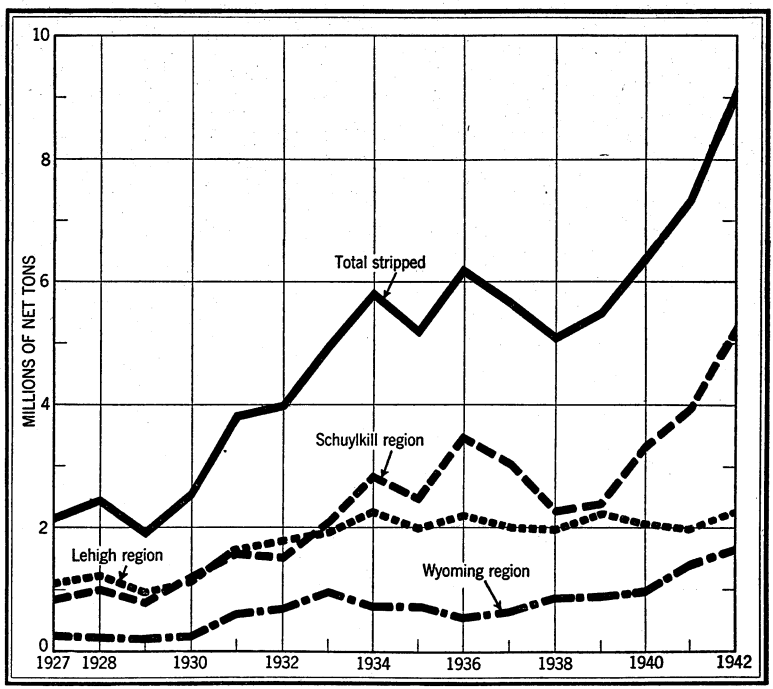

FIGURE 3.—Pennsylvania anthracite mined from strip pits, by regions, 1927–42.

Dredge operations.—Anthracite recovered from the rivers and creeks draining the anthracite fields totaled 1,285,000 net tons in 1942, a decrease from 1,518,000 tons in 1941. For detailed statistics by rivers see table 29.

TABLE 28.—*Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1939–42*

	Number of power shovels in use [1]	Net tons 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)
1939	346	5,486,479	15,857	11.4	3,924	156
1940	348	6,352,700	18,255	13.3	4,114	190
1941	(2)	7,316,574	(2)	14.3	4,609	191
1942:						
Lehigh region	(2)	2,261,370	(2)	24.7	1,206	214
Schuylkill region	(2)	5,170,562	(2)	32.1	2,616	206
Wyoming region	(2)	1,639,001	(2)	5.6	704	226
Total, 1942	(2)	9,070,933	(2)	16.7	4,526	211

[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.

TABLE 29.—*Pennsylvania anthracite produced by dredges in 1942, by rivers*

River (including tributaries)	Net tons	Value	
		Total	Average
Lehigh	9,385	$11,246	$1.20
Schuylkill	268,919	320,612	1.19
Susquehanna	1,006,729	1,146,861	1.14
	1,285,033	1,478,719	1.15

FOREIGN TRADE [2]

Anthracite exported from the United States in 1942 totaled 4,438,589 net tons compared with 3,380,189 tons in 1941. Virtually all of the exported coal was shipped to Canada where shortages of heating gas and coke created a strong demand for anthracite. The tonnage exported in 1942 was the largest since 1923 when the total exports were 5,090,000 net tons. Details of imports and exports are shown in tables 30 to 32.

Canadian market.—Coal available for consumption in Canada in 1942 (changes in stocks not considered) increased about 10.5 percent over 1941 and set an all-time high record. Increases were shown in each category—production, imports, and exports. Production of bituminous coal, subbituminous coal, and lignite increased nearly 3.4 percent; imports of anthracite 22 percent and of bituminous coal 16.5 percent. Although country of origin is not disclosed, virtually all of the anthracite and bituminous coal originated in the United States. Exports of bituminous coal increased more than 53 percent.

Although not disclosed by the Canadian records, United States Custom House statistics show that imports of coal from Canada are mainly into the Maine and New Hampshire and the Montana and

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

Idaho custom districts and that in 1942 imports into Montana and Idaho were more than 220,000 tons—an increase of 77 percent over 1941. A large part of this tonnage probably was for consumption in the State of Washington. American consuls report a marked decline in coal production in British Columbia in the first part of 1943 as compared with 1942.

See table 33 for statistics on coal and coke in Canada.

TABLE 30.—*Anthracite imported for consumption in the United States, 1941–42, by countries and customs districts, in net tons*

	1941	1942		1941	1942
Country			*Customs district*		
Canada	947	----------	Los Angeles	----------	67
United Kingdom	73,722	140,707	Maine and New Hampshire	902	62,923
U. S. S. R.	----------	67	Massachusetts	66,993	61,243
			Montana and Idaho	45	----------
	74,669	140,774	New York	----------	1,330
			Rhode Island	6,729	15,211
				74,669	140,774

TABLE 31.—*Anthracite exported from the United States, 1941–42, by countries, in net tons*

Country	1941	1942	Country	1941	1942
North America:			North America—Con.		
Bermuda	1,101	----------	West Indies—Con.		
Canada	3,360,515	4,417,689	Jamaica	----------	2,571
Iceland	----------	1,988	Other North America	155	19
Central America:			South America:		
British Honduras	1	----------	Bolivia	----------	2,836
Guatemala	40	----------	Brazil	9,624	10,210
Nicaragua	1	----------	Colombia	85	----------
Panama	22	----------	Surinam	----------	6
Mexico	114	115	Other South America	987	88
Newfoundland and Labrador	4,720	2,969	Europe:		
West Indies:			Portugal	11	----------
British	272	56	United Kingdom [1]	1,205	----------
Cuba	262	2	Asia	728	----------
Curacao (N. W. I.)	81	11	Africa	209	6
Dominican Republic	56	23		3,380,189	4,438,589

[1] United Kingdom of Great Britain and Northern Ireland.

TABLE 32.—*Anthracite exported from the United States, 1941–42, by customs districts and ports of export, in net tons*

Customs district	1941	1942	Customs district	1941	1942
North Atlantic:			Mexican border—Con.		
Connecticut	----------	45	Laredo	----------	264
Maine and New Hampshire	2,923	15,743	Pacific coast:		
Massachusetts	99	169	Alaska	575	56
New York	27,512	24,864	San Diego	40	64
Philadelphia	22,242	14,879	Washington	72	----------
South Atlantic:			Northern border:		
Maryland	----------	2,621	Buffalo	1,958,665	2,410,438
Virginia	204	----------	Dakota	106	867
Gulf coast:			Duluth and Superior	4,070	4,798
Florida	132	64	Michigan	15,832	847
Mobile	----------	2	Ohio	16,513	14,308
New Orleans	41	2,853	Rochester	366,799	317,909
Mexican border:			St. Lawrence	956,892	1,610,750
Arizona	36	4	Vermont	7,416	17,009
El Paso	20	35		3,380,189	4,438,589

TABLE 33.—*Coal and coke industry and foreign trade of Canada, 1941–42, in thousands of net tons*

	Coal								Coke from coal	
	Anthracite		Bituminous and subbituminous		Lignite		Total			
	1941	1942	1941	1942	1941	1942	1941 [1]	1942 [2]	1941 [1]	1942 [2]
Production			14,188	14,316	4,034	4,523	18,222	18,839	3,150	3,275
Imports	3,941	4,802	17,867	20,807	1		21,809	25,609	614	720
Exports			525	806	7	10	532	816	40	45
Available for consumption	3,941	4,802	31,530	34,317	4,028	4,513	39,499	43,632	3,724	3,950

[1] 1941 Quarterly Report (December) on coal and coke statistics for Canada; coal used in making coke, 4,360,583 tons, of which 2,865,274 tons imported.
[2] Monthly coal and coke statistics for Canada, December 1942; coal used in making coke, 4,537,524 tons of which 2,983,460 tons imported.

WORLD PRODUCTION

Data on world production of anthracite are incomplete because of war conditions throughout the world. Available data for 1937–42 are shown in table 34.

TABLE 34.—*World production of anthracite, 1937–42, in metric tons*

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942
Belgium	6,694,049	6,874,520	(1)	(1)	(1)	(1)
Bulgaria	2,542	4,000	6,038	8,000	(1)	(1)
China	(2)	(1)	(1)	(1)	(1)	(1)
Chosen	1,101,500	1,664,000	2,064,000	(1)	(1)	(1)
France	(2)	(1)	(1)	(1)	(1)	(1)
Germany	5,627,000	(1)	(1)	(1)	(1)	(1)
Indochina	2,264,978	2,289,832	2,534,000	2,400,000	(1)	(1)
Irish Free State	106,651	92,157	90,455	74,170	104,871	(1)
Italy	95,060	132,197	100,000	(1)	(1)	(1)
Japan [3]	(2)	(1)	(1)	(1)	(1)	(1)
Morocco, French	107,150	123,200	115,600	[4] 143,000	[4] 139,000	[4] [5] 110,000
Peru	2,918	1,500	3,514	4,500	4,600	(1)
Portugal	241,163	281,740	294,081	286,854	436,324	[6] 349,377
Rumania	3,646	3,266	(1)	(1)	(1)	(1)
Spain	407,838	440,253	506,109	1,095,875	1,170,132	[7] 713,503
Switzerland	4,000	3,000	2,500	[5] 7,000	(1)	[5] 40,000
U. S. S. R.:						
Asiatic	(2)	(1)	(1)	(1)	(1)	(1)
European	(2)	(1)	(1)	(1)	(1)	(1)
United Kingdom	6,437,465	6,378,904	(1)	(1)	(1)	(1)
United States	47,043,119	41,820,115	46,708,319	46,705,836	51,136,164	54,728,109
World total	113,171,119	(1)	(1)	(1)	(1)	(1)
Total, exclusive of United States	66,128,000	(1)	(1)	(1)	(1)	(1)

[1] Data not available.
[2] Estimate included in total.
[3] Anthracite output of Japan said to average about 225,000 tons a year. Production figures not available.
[4] Production of Djerada Basin only.
[5] Estimated.
[6] January to October, inclusive.
[7] January to July, inclusive.

COKE AND BYPRODUCTS

By J. W. Buch, J. A. De Carlo, and M. M. Otero

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SUMMARY

The year 1942 witnessed a new high coke-production record for the United States in response to the heavy demand of the expanded iron and steel industry for metallurgical fuel. The total output of byproduct and beehive coke was 70,568,944 net tons—an increase of 5,382,366 tons (8 percent) over the last previous high record in 1941. Of the amount of coke produced in 1942, byproduct ovens supplied 62,294,909 tons (88 percent) and beehive ovens 8,274,035 tons (12 percent). Byproduct-coke production increased 3,812,487 tons (7 percent) in 1942 compared with 1941, and the production of beehive coke increased 1,569,879 tons (23 percent). The average daily rate of byproduct output increased steadily throughout the year; the average daily rate of beehive remained fairly constant.

Although the 1942 output from beehive ovens represented only 12 percent of the Nation's total coke production, its contribution to the 1942 war program was noteworthy. Of the 7,309,337 tons of beehive coke produced in Pennsylvania, 6,561,085 tons (90 percent) were used in blast furnaces (table 28), mostly in the Pittsburgh district, where pig iron production would have been seriously hampered without the supply from nearby beehive-coke plants.

The total value of coke, breeze, and tar produced and of other byproducts sold in 1942 was $629,408,422 (an increase of 17 percent over 1941) and exceeded that of any previous year. The greatest increase was in the value of byproduct coke produced, which rose from $316,477,231 in 1941 to $378,011,967 in 1942—an increase of

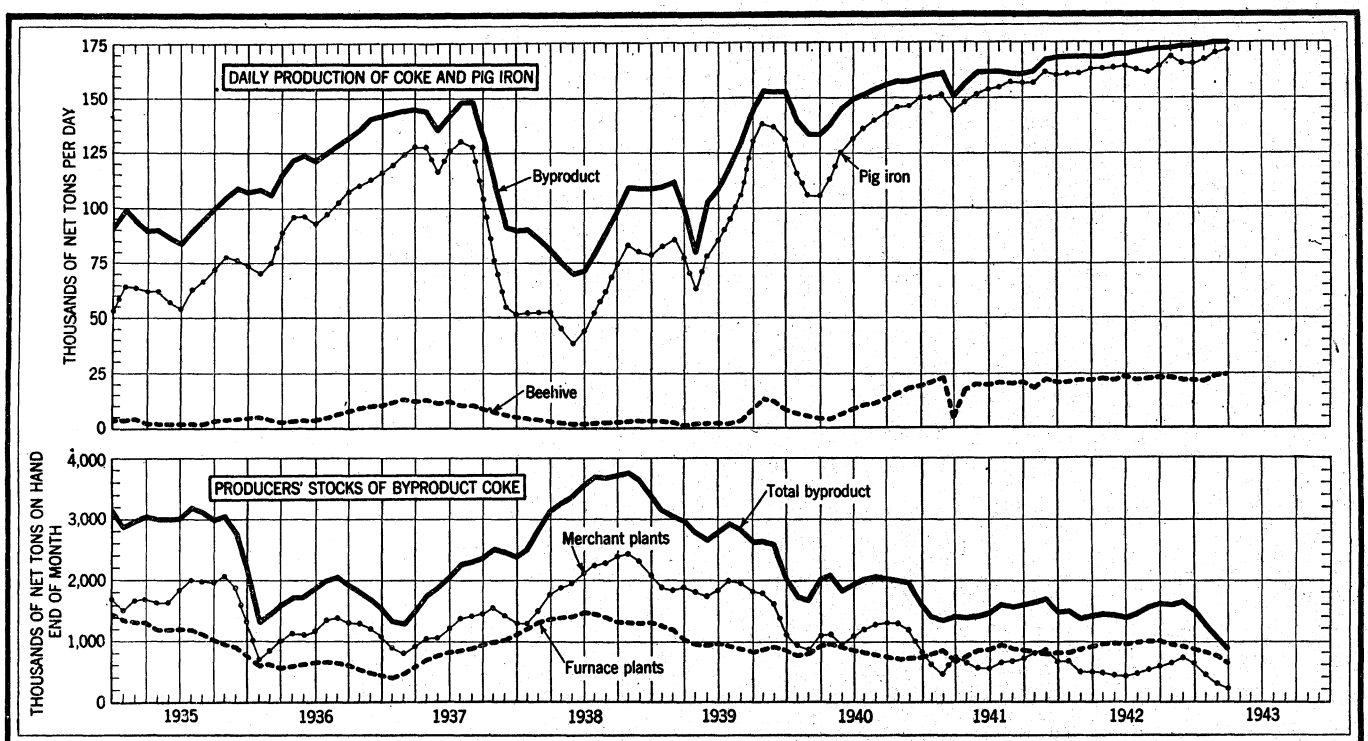

FIGURE 1.—Average daily production of beehive and byproduct coke and pig iron and producers' stocks of byproduct coke, 1935–43, by months.

19 percent; the value of byproducts sold rose from $158,809,184 to $176,932,465—an increase of 11 percent for the same period.

The production of screenings or breeze in 1942 was 4,751,683 tons and exceeded the 1941 output by 197,170 tons; the average receipts from sales of breeze increased from $2.35 a ton in 1941 to $2.63 in 1942.

The total calculated consumption of coke for all uses in the United States in 1942 was 70,107,181 tons. The principal use was in blast furnaces, and the quantity used by the producers, sold to financially affiliated corporations, or sold to other companies for blast-furnace use was 55,491,570 tons—an increase of 5,037,245 tons (10 percent) over the 1941 figure. Coke used for other purposes (in foundries, for the manufacture of producer gas and water gas, and for other industrial purposes) totaled 9,190,418 tons. Coke sold for domestic use was reported as 6,061,694 tons compared with 6,682,959 tons in 1941. The continued decrease in the quantity of coke used for domestic heating in 1942 emphasized the demand of the iron and steel industry.

Ceiling prices for coke were established by the Office of Price Administration on issuance of Maximum Price Schedules 29, 77, and 121, with subsequent amendments. The average receipts per ton of coke sold by producers in 1942 were as follows: Furnace, $6.16 per ton—an increase of $0.53 over 1941; foundry coke, $9.75—$0.40 higher than the 1941 price; coke used in the manufacture of water gas, $7.53—$0.79 higher than the price in 1941; other industrial, $6.88—an advance of $0.50 above the 1941 price; and domestic coke, $7.84—an increase of $0.91.

Total requirements in 1942 exceeded the output, and producers' stocks of coke totaled 1,489,049 tons at the end of the year—a reduction of 269,037 tons in stocks. Stocks of domestic coke decreased 344,285 tons; stocks of furnace coke increased 76,543 tons.

The accelerated rate of byproduct-coke-oven operations resulted in substantial increases in the output of gas, tar, crude light oil, and ammonia. The quantity of gas produced totaled 944,879,637 M cubic feet in 1942—a gain of 52,059,826 M cubic feet (6 percent) over the 1941 figure. Crude coal-tar output showed an increase of 36,026,151 gallons (5 percent) and reached an all-time record of 740,175,619 gallons.

Production of ammonium sulfate or equivalent increased from 1,741,503,884 pounds to 1,805,025,721 pounds (4 percent); the production of crude light oil increased from 231,358,897 gallons to 246,024,882 gallons (6 percent).

GOVERNMENT CONTROL MEASURES

The importance of coke and coke byproducts in time of war was recognized by the various war agencies, and a number of regulatory measures were established for the conservation, efficient utilization, and price control of the products derived from the carbonization of coal. A brief summary of the more important regulations follows:

Byproduct coke.—Office of Price Administration Maximum Price Schedule 29, issued August 30, 1941, effective October 1, 1941, froze prices of byproduct-foundry and byproduct-furnace coke at the levels prevailing October 1, 1941. Amendment 1, issued February 4, 1942, and effective February 7, equalized regional prices not covered in the original order; Amendment 2, issued January 28, 1943, retroactive to December 1, 1942, allowed the transportation-tax charge

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of not more than 4 cents per ton of coke to be passed on to consumers, provided that the producers had paid a similar tax on the coal used to produce the coke.

Beehive coke.—Maximum Price Schedule 77, effective January 26, 1942, established a $6.00 per ton price on all beehive-furnace coke produced in Pennsylvania. Amendment 1 to revised Price Schedule 77, effective April 11, 1942, established a provision in which adjustments and exceptions could be presented; Amendment 2, effective August 12, raised the price to $6.50 for hand-drawn coke, where coal was trucked; Amendment 3 allowed the transportation-tax charge of not more than 4 cents per ton of coke to be passed on to consumers, provided that the coke-plant operator had paid a similar tax on coal charged into ovens.

In order that ceiling prices on all other coke produced not covered by Schedules 29 and 77 could be established, Maximum Price Schedule 121 was issued, effective May 18, 1942, which established maximum prices upon the basis of average prices over the period from December 15 to 31, 1941.

Benzol.—War Production Board General Preference Order M–137, issued April 20, 1942, effective June 1, placed benzol under complete allocation. This order was amended July 1, and deliveries and acceptances were placed under the supervision of the Director General for Operations. In December 1941 quotations on benzol, toluol, and xylol were stablized at not more than 1 cent a gallon above the average for the last quarter of 1941 at the request of the Office of Price Administration, and on March 11 this request was extended to keep current quotations in effect at least until July 1, 1942. In June 1942 the Office of Price Administration announced that quotations on light-oil derivatives would remain unchanged to December 31, 1942.

Toluol.—General Preference Order M–34, issued August 8, 1941, effective August 28, 1941, placed toluol under allocation. Amendments effective December 30, 1941, and May 22, 1942, further restricted uses and increased regulations, and beginning early in January 1942 no toluol could be exported without authorization from the Director of Priorities.

Xylol.—Xylol and xylol-range aromatic materials derived from coal tar were brought under General Preference Order M–150 by the issuance, in July 1942, of Amendment 1. This amendment restricted sales and deliveries of xylol and xylol-range aromatic materials to orders with a preference rating of A–2 or higher.

Ammonium sulfate.—This byproduct was placed under allocation by the War Production Board on June 1, 1942, through the issuance of General Preference Order M–163. Maximum prices for ammonium sulfate were governed by Maximum Price Schedule 205, issued by the Office of Price Administration, effective August 22.

Pyridine.—Production and distribution of pyridine were placed under complete allocation by the War Production Board through Conservation Order M–185, effective September 1. In addition to its use in the manufacture of sulfa drugs, pyridine is employed in manufacturing a water repellant.

TECHNOLOGIC DEVELOPMENTS

War activities in 1942 augmented the demand for metallurgical coke. Iron-production requirements emphasized the need for the

best possible grade of coke for blast-furnace use. The Bureau of Mines undertook investigations to assist the coke producers to meet the needs of blast furnaces as to available supply and quality. An industry committee, working in cooperation with the Office of Solid Fuels Coordinator for War, the War Production Board, and the Bureau of Mines, advises the investigators of the most pressing needs and through cooperation and advice facilitates the research work to be done.[1]

The addition of 4 percent of anthracite fines (No. 5 Buckwheat) to the coking-coal mix was practiced at the Laclede Gas Light Co., St. Louis, Mo., in 1942. It was reported that the quantity of large-size foundry coke produced doubled and that it was possible to carbonize 13 percent more coal per day because the coking time normally required for foundry coke was reduced from 26 hours to 18⅔.[2]

Extensive research work was done in 1942 by the Koppers Co. concerning new methods of heating Koppers-Becker coke ovens The new heating methods were radical in departure from methods used in former years by this company, and it is reported that the research resulted in a coke-oven design that not only improved coke quality but also permitted more efficient economics of oven operation by simplifying operating technique.[3]

TABLE 1.—*Salient statistics of the coke industry in 1942*

	Byproduct	Beehive	Total
Coke produced—			
At merchant plants:			
Quantity—net tons	15,134,866		15,134,866
Value	$114,723,148		$114,723,148
At furnace plants:			
Quantity—net tons	47,160,043		47,160,043
Value	$263,288,819		$263,288,819
Total:			
Quantity—net tons	62,294,909	8,274,035	70,568,944
Value	$378,011,967	$47,601,777	$425,613,744
Screenings or breeze produced:			
Quantity—net tons	4,600,030	151,653	4,751,683
Value	$10,897,121	$151,210	$11,048,331
Coal charged into ovens:			
Quantity—net tons	87,973,821	12,875,812	100,849,633
Value	$385,007,197	$32,458,011	$417,465,208
Average value per ton	$4.38	$2.52	$4.14
Average yield in percent of coal charged:			
Coke	70.81	64.26	69.97
Breeze (at plants actually recovering)	5.30	2.46	5.11
Ovens:			
In existence January 1	13,016	18,669	31,685
In existence December 31	13,303	[1] 16,295	29,598
Dismantled during year	136	1,486	1,622
In course of construction December 31	1,327		1,327
Annual capacity of ovens December 31—net tons	64,554,972	10,408,595	74,963,567
Coke used by producer—			
In blast furnaces:			
Quantity—net tons	41,602,950	701,830	42,304,780
Value	$230,691,580	$4,028,121	$234,719,701
To make producer gas:			
Quantity—net tons	810,492		810,492
Value	$5,138,252		$5,138,252
To make water gas:			
Quantity—net tons	1,527,191		1,527,191
Value	$8,440,530		$8,440,530
For other purposes:			
Quantity—net tons	414,009	2,305	416,314
Value	$2,504,247	$12,420	$2,516,667

[1] Number of ovens in existence at plants that operated in 1942 as reported by operators.

[1] Schmidt, L. D., Schroeder, W. C., and Fieldner, A. C., Increased Pig Iron Output Through Improved Coke: Bureau of Mines Rept. of Investigations 3711, 1943, 58 pp.
[2] Roberts, I. M., Anthracite as a Coke Ingredient: Coal Age, vol. 47, No. 11, November 1942, p. 96.
[3] Rueckel, W. C., New Principles in Heating Koppers-Becker Coke Ovens: Blast Furnace and Steel Plant, vol. 30, No. 3, March 1942, pp. 331-337, and vol. 30, No. 4, April 1942, pp. 431-436.

TABLE 1.—*Salient statistics of the coke industry in 1942*—Continued

	Byproduct	Beehive	Total
Disposal of coke:			
Sold to financially affiliated corporations—			
For blast-furnace use:			
Quantity—net tons	3,515,351	1,542,503	5,057,854
Value	$19,373,565	$7,570,393	$26,943,958
For other purposes:			
Quantity—net tons	729,619	452	730,071
Value	$4,638,839	$2,179	$4,641,018
Sold to other consumers—			
For blast-furnace use:			
Quantity—net tons	3,242,612	4,886,324	8,128,936
Value	$21,337,174	$28,714,727	$50,051,901
For foundry use:			
Quantity—net tons	2,250,564	341,012	2,591,576
Value	$22,853,858	$2,403,220	$25,257,078
For manufacture of water gas:			
Quantity—net tons	657,761	115,265	773,026
Value	$5,131,790	$691,508	$5,823,298
For other industrial use:			
Quantity—net tons	1,746,562	595,186	2,341,748
Value	$12,427,915	$3,688,452	$16,116,367
For domestic use:			
Quantity—net tons	5,963,474	98,220	6,061,694
Value	$46,967,968	$544,530	$47,512,498
Disposal of screenings or breeze:			
Used by producer—			
For raising steam:			
Quantity—net tons	3,123,066	30,029	3,153,095
Value	$7,008,139	$40,144	$7,048,283
To make producer or water gas:			
Quantity—net tons	46,769		46,769
Value	$247,952		$247,952
For other purposes:			
Quantity—net tons	509,921	5,741	515,662
Value	$1,054,913	$6,979	$1,061,892
Sold:			
Quantity—net tons	932,122	62,237	994,359
Value	$2,555,985	$58,200	$2,614,185
Average receipts per ton sold:			
Furnace coke (merchant sales)	$6.58	$5.88	$6.16
Foundry coke	$10.15	$7.05	$9.75
For manufacture of water gas	$7.80	$6.00	$7.53
Other industrial coke	$7.12	$6.20	$6.88
Domestic coke	$7.88	$5.54	$7.84
Screenings or breeze	$2.74	$0.94	$2.63
Stocks on hand January 1, 1943:			
Furnace—net tons	770,135	24,617	794,752
Foundry—do	21,937	2,203	24,140
Domestic and other—do	661,401	8,756	670,157
Screenings or breeze—do	655,175	4,956	660,131
Exports—do			839,582
Imports—do			108,782
Calculated consumption—do			70,107,181
Byproducts produced:			
Gas—M cubic feet	944,879,637		944,879,637
Wasted—percent	1.59		1.59
Burned in coking process—do	36.45		36.45
Surplus sold or used—do	61.96		61.96
Tar—gallons	740,175,619		740,175,619
Ammonium sulfate or equivalent—pounds	1,805,025,721		1,805,025,721
Crude light oil—gallons	246,024,882		246,024,882
Yield of byproducts per ton of coal:			
Gas—M cubic feet	10.74		10.74
Tar—gallons	8.41		8.41
Ammonium sulfate or equivalent—pounds	20.85		20.85
Crude light oil—gallons	2.88		2.88
Value of byproducts sold:			
Gas (surplus)	$88,823,807		$88,823,807
Tar:			
Sold	$24,155,601		$24,155,601
Used by producer	$15,813,882		$15,813,882
Ammonium sulfate or equivalent	$21,698,572		$21,698,572
Crude light oil and derivatives	$29,293,280		$29,293,280
Other byproducts [2]	$12,961,205		$12,961,205
Total value of coke and breeze produced and byproducts sold [3]	$581,655,435	$47,752,987	$629,408,422

[2] Includes naphthalene and tar derivatives.
[3] Includes value of tar used by producer.

TABLE 2.—*Statistical trends of the coke industry in the United States, 1923 and 1939–42*

	1923	1939	1940	1941	1942
Coke produced:					
Beehive net tons	19,379,870	1,444,328	3,057,825	6,704,156	8,274,035
Byproduct do	37,597,664	42,882,313	54,014,309	58,482,422	62,294,909
Total do	56,977,534	44,326,641	57,072,134	65,186,578	70,568,944
Percent of total from byproduct ovens	66.0	96.7	94.6	89.7	88.3
Producers' stocks of coke, end of year net tons	[1] 1,221,737	2,602,099	1,956,442	1,758,086	1,489,049
Exports, all coke do	1,237,342	589,925	804,095	708,971	839,582
Imports, all coke [2] do	85,002	141,911	112,550	267,886	108,782
Consumption, calculated, all coke do	55,173,457	44,953,082	57,026,246	64,943,849	70,107,181
Disposal of coke, all coke sold or used:					
Furnace coke net tons	47,774,408	31,498,557	42,483,624	50,454,325	55,491,570
Foundry coke do	3,600,719	1,682,200	2,089,962	2,846,459	2,591,576
Other industrial (including producer and water gas) net tons	[3] 2,283,888	3,193,068	3,581,676	4,224,597	5,452,457
Domestic coke do	2,733,414	7,638,141	8,231,013	6,682,959	6,061,694
For all other purposes do	[3]	1,311,559	1,458,435	1,165,526	1,146,385
Ovens:					
Beehive, in existence, end of year	62,349	10,934	15,150	18,669	[4] 16,295
Byproduct, in existence, end of year	11,156	12,732	12,734	13,016	13,303
Byproduct under construction, end of year	629	----------	492	181	1,327
Cost of coal charged, byproduct ovens, average per ton	$4.76	$3.75	$3.68	$3.92	$4.38
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens	$5.33	$4.09	$4.42	$5.92	$6.01
Average realization on byproduct coke sold:					
Furnace coke (merchant sales)	$6.74	$4.38	$4.55	$5.70	$6.58
Foundry coke	$10.54	$8.15	$8.67	$9.76	$10.15
Other industrial (including water gas)	$9.06	$5.64	$5.86	$6.68	$7.30
Domestic	$9.05	$5.90	$6.03	$6.96	$7.88
Yield of byproducts per ton of coal charged:					
Tar gallons	8.1	9.06	8.79	8.52	8.41
Ammonium sulfate or equivalent pounds	21.2	22.33	22.00	21.34	20.85
Light oil gallons	2.7	2.99	2.93	2.90	2.88
Surplus gas sold or used M cubic feet	5.9	7.08	6.84	6.71	6.65
Average gross receipts for byproducts, per ton of coke produced:					
Tar sold and used	$0.51	$0.622	$0.571	$0.566	$0.642
Ammonia and its compounds	$0.84	$0.341	$0.364	$0.371	$0.348
Light oil and its derivatives (including naphthalene)	$0.51	$0.414	$0.421	$0.431	$0.501
Surplus gas sold or used	$1.37	$1.676	$1.507	$1.454	$1.426
Total byproducts, including breeze	$3.48	$3.315	$3.117	$3.130	$3.269

[1] Furnace and foundry coke only.
[2] Before 1934, figures represent general imports; beginning with 1934, they represent imports for consumption only.
[3] "For all other purposes" included under "Other industrial (including producer and water gas)."
[4] Number of ovens in existence at plants that operated in 1942 as reported by operators.

SCOPE OF REPORT

This report presents final statistics of the byproduct- and beehive-coke industry in 1942. In addition to the customary annual data, the results of a survey covering operations of coal-gas plants in 1942, made by the Bureau of Mines for the first time, are presented in this chapter.

In the United States coke is produced by a group of four different industries. In addition to that manufactured in the familiar byproduct and beehive ovens, coke is obtained in the refining of petroleum and of tar and in the manufacture of coal gas. The coke produced by each of these processes, however, differs greatly in character, and the problems affecting each are separate and distinct.

In 1942, 1,338,000 tons of petroleum coke and 117,714 tons of coal-tar-pitch coke were produced, compared with 1,648,000 and 91,800 tons, respectively, in 1941. The decrease in output of petroleum coke in 1942, in spite of increased requirements, was due to fuel-oil shortages, which forced several large refineries to eliminate coke production.

Since, in general, only coke from byproduct and beehive ovens is adapted to blast-furnace and foundry use and since most of all coke produced is directed to these uses, the coke trade is concerned more especially with byproduct and beehive coke; hence the statistics of this report relate especially to these two coke-manufacturing processes.

The standard unit of measurement in the coke industry is the short or net ton of 2,000 pounds, and unless otherwise specified that unit is employed throughout this report.

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

Figures for monthly and weekly production of coke are given in tables 3 to 7. The monthly and weekly production of byproduct coke is based upon reports from operators. In February 1942 the Bureau of Mines renewed the collection of weekly production data from the byproduct-coke industry—the first time since 1918. This canvass was undertaken at the request of the Office of Solid Fuels Coordinator [4] for War in order that weekly production trends in the byproduct-coke industry could be ascertained. The demand for coke was so great in 1942 that maximum output was necessary to meet the increased requirements of the war industries, and the daily rate of production rose steadily throughout the year.

The current weekly statistics of beehive coke, shown in table 6, are estimates based upon weekly carloadings on the principal coke-carrying railroads, on shipments over private railroads, and on amounts known to have been consumed by associated steel works close to the producing ovens. As beehive coke seldom is stored at the ovens in any great quantity, shipments are a good barometer of weekly production. The collection of monthly data from beehive-coke-plant operators was begun by the Bureau of Mines in March 1942. Figures for January and February production are based upon operators' reports of sales of beehive coke.

[4] The Office of Solid Fuels Coordinator for War was changed by Executive order issued April 19, 1943, effective May 4, to Solid Fuels Administration for War.

TABLE 3.—*Byproduct, beehive, and total coke produced in the United States, 1939–42, by months and average per day, in net tons*

Month	1939		1940		1941		1942	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average[1]
Byproduct:								
January	3,355,200	108,200	4,720,600	152,300	4,938,800	159,300	5,228,900	168,700
February	3,066,800	109,500	4,028,300	138,900	4,507,400	161,000	4,720,300	168,600
March	3,425,700	110,500	4,136,600	133,400	5,005,200	161,500	5,230,700	168,700
April	2,903,800	96,800	3,995,800	133,200	4,479,600	149,300	5,060,400	168,700
May	2,387,100	77,000	4,256,000	137,300	4,851,600	156,500	5,265,600	169,900
June	3,078,500	102,600	4,387,200	146,200	4,841,700	161,400	5,104,600	170,200
July	3,354,100	108,200	4,632,400	149,400	5,019,600	161,900	5,282,800	170,400
August	3,652,900	117,800	4,695,500	151,500	5,018,900	161,900	5,320,000	171,600
September	3,890,600	129,700	4,640,700	154,700	4,811,400	160,400	5,168,400	172,300
October	4,512,300	145,600	4,853,600	156,600	4,976,500	160,500	5,343,800	172,400
November	4,551,900	151,700	4,763,500	158,800	4,839,200	161,300	5,196,000	173,200
December	4,703,400	151,700	4,904,100	158,200	5,192,500	167,500	5,373,400	173,300
	42,882,300	117,500	54,014,300	147,600	58,482,400	160,200	62,294,900	170,700
Beehive:								
January	78,400	3,000	252,300	9,300	542,500	17,500	675,400	21,800
February	72,000	3,000	164,400	6,600	523,900	18,700	635,500	22,700
March	69,600	2,600	143,100	5,500	618,100	19,900	694,400	22,400
April	20,000	800	108,400	4,200	98,200	3,300	686,600	22,900
May	24,700	900	112,300	4,200	571,200	18,400	700,200	22,600
June	52,300	2,000	159,800	6,400	595,400	19,800	719,000	24,000
July	47,100	1,900	244,400	9,400	610,400	19,700	692,800	22,300
August	44,900	1,700	294,200	10,900	644,500	20,800	696,700	22,500
September	77,000	3,000	287,800	11,500	605,800	20,200	697,600	23,300
October	266,800	10,300	384,200	14,200	646,800	20,900	722,100	23,300
November	362,700	14,000	416,800	16,000	561,300	18,700	667,400	22,200
December	328,800	13,200	490,100	19,600	686,100	22,100	686,300	22,100
	1,444,300	4,700	3,057,800	9,800	6,704,200	18,400	8,274,000	22,700
Total coke:								
January	3,433,600	111,200	4,972,900	161,600	5,481,300	176,800	5,904,300	190,500
February	3,138,800	112,500	4,192,700	145,500	5,031,300	179,700	5,355,800	191,300
March	3,495,300	113,100	4,279,700	138,900	5,623,300	181,400	5,925,100	191,100
April	2,923,800	97,600	4,104,200	137,400	4,577,800	152,600	5,747,000	191,600
May	2,411,800	77,900	4,368,300	141,500	5,422,800	174,900	5,965,800	192,500
June	3,130,800	104,600	4,547,000	152,600	5,437,100	181,200	5,823,600	194,200
July	3,401,200	110,100	4,876,800	158,800	5,630,000	181,600	5,975,600	192,700
August	3,697,800	119,500	4,989,700	162,400	5,663,400	182,700	6,016,700	194,100
September	3,967,600	132,700	4,928,500	166,200	5,417,200	180,600	5,866,000	195,600
October	4,779,100	155,900	5,237,800	170,800	5,623,300	181,400	6,065,900	195,700
November	4,914,600	165,700	5,180,300	174,800	5,400,500	180,000	5,863,400	195,400
December	5,032,200	164,900	5,394,200	177,800	5,878,600	189,600	6,059,700	195,400
	44,326,600	122,200	57,072,100	157,400	65,186,600	178,600	70,568,900	193,400

[1] Daily average production of beehive coke prior to 1941 was calculated by subtracting Sundays and holidays in each month: 1941 and 1942 daily average has been calculated by dividing the total monthly production by the total number of days in the month.

TABLE 4.—*Byproduct coke produced in the United States in 1942, by weeks*

[Based upon reports from all producers]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
January 1–31[1]	5,228,900	May 30	1,193,900	September 26	1,210,000
February 7	1,176,700	June 6	1,198,300	October 3	1,210,200
14	1,171,000	13	1,187,800	10	1,213,700
21	1,172,900	20	1,186,700	17	1,211,000
28	1,164,200	27	1,189,100	24	1,207,600
March 7	1,167,500	July 4	1,193,900	31	1,211,200
14	1,170,000	11	1,191,200	November 7	1,223,400
21	1,173,300	18	1,192,000	14	1,211,200
28	1,165,800	25	1,199,600	21	1,213,800
April 4	1,173,500	August 1	1,204,500	28	1,211,500
11	1,162,500	8	1,206,600	December 5	1,205,700
18	1,169,000	15	1,218,800	12	1,219,200
25	1,173,900	22	1,213,800	19	1,228,400
May 2	1,175,400	29	1,220,100	26	1,223,600
9	1,186,900	September 5	1,215,500	27–31	[2] 855,900
16	1,185,300	12	1,217,400		62,294,900
23	1,182,900	19	1,209,600		

[1] Weekly statistics of byproduct-coke production were not collected until the week ended February 7, 1942.
[2] 5 days only.

TABLE 5.—*Byproduct coke produced in the United States in 1942, by months and States, in net tons*

[Based upon reports from all producers]

State	January	February	March	April	May	June	July
Alabama	483,200	435,100	484,000	468,000	479,800	464,200	474,600
Colorado	55,300	51,400	56,100	54,500	57,200	56,200	59,200
Illinois	317,300	289,600	315,100	306,600	319,200	308,700	316,700
Indiana	625,900	554,600	615,400	588,700	604,400	580,600	609,100
Maryland	177,600	158,200	178,000	171,900	177,500	172,400	176,800
Massachusetts	101,400	91,100	99,900	96,800	101,200	96,800	97,900
Michigan	268,300	243,600	270,200	261,800	271,300	257,900	263,000
Minnesota	79,400	69,700	77,900	73,700	78,400	78,900	84,000
New Jersey	91,200	80,800	88,900	85,100	89,400	85,100	87,000
New York	448,300	407,900	448,200	434,700	448,200	434,700	440,600
Ohio	835,900	758,100	831,700	810,300	835,700	805,900	836,600
Pennsylvania	1,336,700	1,209,600	1,348,000	1,299,200	1,356,800	1,325,500	1,385,800
Tennessee	18,300	17,200	19,300	18,000	19,400	19,000	19,500
Utah	18,600	16,600	21,500	21,100	21,600	20,900	21,000
West Virginia	177,800	162,400	182,200	183,400	212,300	209,200	219,200
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	193,700	174,400	194,300	186,600	193,200	188,600	191,800
	5,228,900	4,720,300	5,230,700	5,060,400	5,265,600	5,104,600	5,282,800
At merchant plants	1,259,300	1,142,000	1,268,300	1,226,200	1,280,300	1,246,200	1,286,400
At furnace plants	3,969,600	3,578,300	3,962,400	3,834,200	3,985,300	3,858,400	3,996,400

State	August	September	October	November	December	Total
Alabama	470,400	451,900	462,400	448,500	457,400	5,579,500
Colorado	59,000	56,300	57,200	56,000	57,800	676,200
Illinois	311,100	297,800	310,900	297,800	299,300	3,690,100
Indiana	625,000	619,900	634,200	615,800	663,900	7,337,500
Maryland	177,700	174,500	180,500	177,100	181,500	2,103,700
Massachusetts	98,700	97,800	100,800	95,700	98,300	1,176,400
Michigan	264,200	254,600	263,200	256,200	264,800	3,139,100
Minnesota	83,900	79,600	83,700	82,400	83,700	955,300
New Jersey	86,200	85,500	86,200	85,400	87,700	1,038,500
New York	430,800	414,000	423,000	420,900	429,100	5,180,400
Ohio	846,200	824,900	854,500	822,800	850,200	9,912,800
Pennsylvania	1,412,100	1,369,000	1,425,200	1,396,000	1,446,300	16,310,200
Tennessee	19,400	20,500	21,500	20,800	21,600	234,500
Utah	20,000	19,600	21,100	19,900	20,600	242,500
West Virginia	224,100	216,500	225,400	213,300	218,600	2,444,400
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	191,200	186,000	194,000	187,400	192,600	2,273,800
	5,320,000	5,168,400	5,343,800	5,196,000	5,373,400	62,294,900
At merchant plants	1,289,300	1,256,400	1,294,400	1,278,600	1,307,500	15,134,900
At furnace plants	4,030,700	3,912,000	4,049,400	3,917,400	4,065,900	47,160,000

TABLE 6.—*Beehive coke produced in the United States in 1942, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
January 3	[1] 67,400	May 9	151,300	September 12	145,200
10	141,900	16	176,100	19	164,300
17	14b,600	23	186,400	26	167,900
24	152,700	30	153,100	October 3	173,400
31	162,700	June 6	155,700	10	166,600
February 7	158,000	13	156,500	17	161,400
14	168,600	20	179,900	24	165,100
21	147,500	27	179,800	31	167,200
28	164,200	July 4	132,200	November 7	160,700
March 7	158,900	11	162,100	14	149,100
14	138,900	18	155,900	21	170,400
21	156,400	25	159,700	28	150,000
28	161,700	August 1	162,400	December 5	161,100
April 4	155,700	8	157,300	12	168,200
11	159,300	15	142,500	19	162,100
18	160,200	22	157,200	26	137,500
25	168,800	29	158,800	27-31	[2] 86,900
May 2	152,400	September 5	169,100		8,274,000

[1] 3 days only. [2] 5 days only.

TABLE 7.—*Beehive coke produced in the United States in 1942, by months and States in net tons*

[Based upon reports from producers]

State	January	February	March	April	May	June
Alabama	13,300	12,100	13,200	12,900	11,400	4,700
Colorado and Utah	8,500	7,100	8,900	9,100	7,200	9,300
Kentucky and Tennessee	5,200	3,400	8,400	8,000	7,500	7,500
Pennsylvania	594,800	560,900	616,800	602,400	619,400	639,100
Virginia	29,200	27,500	31,600	29,300	28,400	29,500
West Virginia	24,400	24,500	15,500	24,900	26,300	28,900
	675,400	635,500	694,400	686,600	700,200	719,000

State	July	August	September	October	November	December	Total
Alabama	5,100	4,600	4,700	4,800	4,200	4,400	95,400
Colorado and Utah	8,800	9,600	10,500	10,800	9,800	10,200	109,800
Kentucky and Tennessee	7,400	6,100	4,600	5,000	5,600	5,000	73,700
Pennsylvania	613,000	613,900	616,400	639,400	587,600	605,700	7,309,400
Virginia	29,500	30,100	29,600	28,900	28,300	28,600	350,500
West Virginia	29,000	32,400	31,800	33,200	31,900	32,400	335,200
	692,800	696,700	697,600	722,100	667,400	686,300	8,274,000

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

Tables 8 and 9 give the production of byproduct coke by plants associated with iron furnaces and by other plants.

The terms "furnace" and "merchant" plants originated in the Connellsville beehive-coke trade. In this report the distinction is applied to byproduct plants only. A "furnace" plant is defined as one that produces, primarily, furnace coke and has an assured outlet for this coke either through financial affiliations with or direct ownership by an iron works or through long-time contracts. The class of "other plants" includes a few plants that are affiliated with local iron furnaces but produce much more coke than the furnaces can absorb and therefore depend chiefly on the foundry and domestic trade or on merchant sales of furnace coke for disposal of the output. The classification of "other plants" also includes merchant producers of furnace coke who sell their entire output on the open market, plants affiliated with alkali works, low-temperature carbonization plants, plants that operate as gas utilities, and a number of plants that, although not public utilities, were constructed primarily to supply city gas and to sell their coke for domestic, industrial, or metallurgical uses. Because of the miscellaneous character of this group of plants, they are not designated as "merchant" but as "nonfurnace" or "other plants." From time to time it may be necessary to change the classification of a given plant because of a change in ownership or market connections.

The activity of "furnace plants" depends principally on the activity of the iron and steel industry, therefore the output of furnace coke follows closely the trend of that industry. In 1942 furnace plants contributed 76 percent of the total byproduct-coke output compared with 77 percent in 1941 and 77 percent in 1940. The relative proportions of "furnace" and "nonfurnace" coke have been remarkably constant during the past 3 years. The relative constancy of this production ratio between the two types of plants illustrates that the demands of industries other than the iron and steel industry affect the market sufficiently for the output of the nonfurnace group to follow, in general, the pattern established by the furnace group.

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 1940–42*

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
1940	45	40	41,465,177	12,549,132	76.8	23.2
1941	45	42	44,987,913	13,494,509	76.9	23.1
1942	46	42	47,160,043	15,134,866	75.7	24.3

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, 1940–42, in net tons*

Month	1940		1941		1942	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	3,644,300	1,076,300	3,825,200	1,113,600	3,969,600	1,259,300
February	3,038,200	990,100	3,468,200	1,039,200	3,578,300	1,142,000
March	3,082,700	1,053,900	3,850,400	1,154,800	3,962,400	1,268,300
April	2,985,700	1,010,100	3,423,700	1,055,900	3,834,200	1,226,200
May	3,248,200	1,007,800	3,731,800	1,119,800	3,985,300	1,280,300
June	3,395,800	991,400	3,728,500	1,113,200	3,858,400	1,246,200
July	3,599,800	1,032,600	3,875,600	1,144,000	3,996,400	1,286,400
August	3,658,800	1,036,700	3,875,500	1,143,400	4,030,700	1,289,300
September	3,596,900	1,043,800	3,708,400	1,103,000	3,912,000	1,256,400
October	3,750,800	1,102,800	3,827,900	1,148,600	4,049,400	1,294,400
November	3,674,700	1,088,800	3,694,800	1,144,400	3,917,400	1,278,600
December	3,789,300	1,114,800	3,977,900	1,214,600	4,065,900	1,307,500
	41,465,200	12,549,100	44,987,900	13,494,500	47,160,000	15,134,900
Average daily production:						
January	117,600	34,700	123,400	35,900	128,100	40,600
February	104,800	34,100	123,900	37,100	127,800	40,800
March	99,400	34,000	124,200	37,300	127,800	40,900
April	99,500	33,700	114,100	35,200	127,800	40,900
May	104,800	32,500	120,400	36,100	128,600	41,300
June	113,200	33,000	124,300	37,100	128,600	41,600
July	116,100	33,300	125,000	36,900	128,900	41,500
August	118,000	33,500	125,000	36,900	130,000	41,600
September	119,900	34,800	123,600	36,800	130,400	41,900
October	121,000	35,600	123,500	37,000	130,600	41,800
November	122,500	36,300	123,200	38,100	130,600	42,600
December	122,200	36,000	128,300	39,200	131,100	42,200
Average	113,300	34,300	123,200	37,000	129,200	41,500

PRODUCTION BY STATES AND DISTRICTS

The intense activity in the coke industry during 1942 resulted in an increased output in 19 of the 20 States that produced byproduct coke. The average increase for the industry as a whole was 7 percent over the 1941 figure. The only State that did not increase its 1942 output was Indiana, because of the inactivity of 140 ovens at Gary, which were undergoing major repairs. These rebuilt ovens were completed and placed in operation by December 1942.

Pennsylvania led all States in the output of byproduct coke, and its 16,310,167 tons represented 26 percent of the total United States production. This was an increase of 677,813 tons (4 percent) over the output in 1941 and 5,315,913 tons (48 percent) over 1939. The statis-

tics of coke production alone fail to do justice to the importance of this State in the coke industry for, in addition to coke, it supplies much of the raw coal required by the byproduct ovens in adjoining States.

Compared with 1941 Alabama led all States in increased tonnage production of byproduct coke, with 819,649 tons, followed by Pennsylvania with 677,813 tons, Ohio with 628,589, and West Virginia with 460,749 tons. The States that showed the largest percentage of increase were Tennessee with 111 percent, Minnesota with 39 percent, West Virginia with 23 percent, and Maryland with 20 percent over the 1941 output.

The production of beehive coke in 1942 was 8,274,035 tons, of which 7,309,337 tons (88 percent) were produced in Pennsylvania; Virginia and West Virginia each contributed 4 percent. All States that produced beehive coke in 1941, except Kentucky, increased their output in 1942. The State showing the greatest increase was Utah, with 119 percent, followed in order by Tennessee 86 percent, West Virginia 28 percent, and Pennsylvania 24 percent.

TABLE 10.—*Byproduct and beehive coke produced in the United States, 1918 and 1939–42, by States, in net tons*

[Exclusive of screenings or breeze]

State	1918	1939	1940	1941	1942
Byproduct:					
Alabama	2,634,451	3,854,505	4,727,378	4,759,862	5,579,511
Colorado	230,663	398,033	543,548	622,807	676,209
Connecticut		(1)	(1)	(1)	(1)
Illinois	2,285,610	1,884,240	3,014,840	3,660,878	3,690,155
Indiana	3,898,215	4,878,033	6,412,716	7,406,724	7,337,512
Kentucky	517,749	(1)	(1)	(1)	(1)
Maryland	474,368	1,578,973	1,682,701	1,752,538	2,103,664
Massachusetts	556,397	1,057,158	1,130,311	1,161,732	1,176,359
Michigan	(1)	2,430,688	2,872,026	2,863,563	3,139,137
Minnesota	784,065	497,079	524,360	685,873	955,301
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682,148	1,003,197	1,016,481	1,031,569	1,038,461
New York	1,063,587	4,468,437	5,080,403	5,116,308	5,180,384
Ohio	5,226,334	6,135,849	7,897,929	9,284,194	9,912,783
Pennsylvania	4,586,981	10,994,254	14,861,657	15,632,354	16,310,167
Rhode Island		(1)	(1)	(1)	(1)
Tennessee	124,469	79,448	94,454	111,310	234,529
Utah		189,194	218,949	236,607	242,531
Washington	30,129				
West Virginia	603,393	1,598,198	1,899,849	1,983,619	2,444,368
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2,293,021	1,834,927	2,036,707	2,172,484	2,273,838
	25,997,580	42,882,313	54,014,309	58,482,422	62,294,909
Beehive:					
Alabama	1,717,721			95,200	95,428
Colorado	758,784	56,836	62,417	80,196	87,447
Georgia	22,048				
Kentucky	301,036		(1)	2,054	1,138
New Mexico	597,072				
Ohio	138,909				
Oklahoma	(1)				
Pennsylvania	22,136,664	1,125,971	2,550,367	5,891,118	7,309,337
Tennessee	302,637		5,251	39,083	72,541
Utah	(1)	8,332	7,398	16,244	22,402
Virginia	1,234,256	165,317	198,379	324,573	350,521
Washington	93,659		(1)		
West Virginia	2,716,613	87,872	233,154	261,688	335,221
Combined States	461,393		859		
	30,480,792	1,444,328	3,057,825	6,704,156	8,274,035
Grand total	56,478,372	44,326,641	57,072,134	65,186,578	70,568,944

[1] Included under "Combined States."

TABLE 11.—*Coke produced, value, number of ovens, coal charged, and average yield in 1942, by States*

[Exclusive of screenings or breeze]

State	Byproduct							Beehive						Total	
	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
						Total	Per ton					Total	Per ton		
Alabama	8	1,352	7,780,673	71.71	5,579,511	$26,359,204	$4.72	394	155,290	61.45	95,428	$591,646	$6.20	5,674,939	$26,950,850
Colorado	1	188	1,020,797	66.24	676,209	(1)	(1)	260	136,905	63.87	87,447	(1)	(1)	763,656	(1)
Illinois	9	915	5,224,824	70.63	3,690,155	27,364,122	7.42							3,690,155	27,364,122
Indiana	5	1,592	10,147,475	72.31	7,337,512	52,848,043	7.20							7,337,512	52,848,043
Maryland	1	422	2,904,798	72.42	2,103,664	(1)	(1)							2,103,664	(1)
Massachusetts	2	215	1,668,918	70.49	1,176,359	(1)	(1)							1,176,359	(1)
Michigan	7	641	4,359,802	72.00	3,139,137	21,793,813	6.94							3,139,137	21,793,813
Minnesota	3	196	1,270,855	75.17	955,301	7,507,413	7.86							955,301	7,507,413
New Jersey	2	228	1,439,043	72.16	1,038,461	(1)	(1)							1,038,461	(1)
New York	8	1,054	7,255,819	71.40	5,180,384	37,660,727	7.27							5,180,384	37,660,727
Ohio	15	1,963	13,733,261	72.18	9,912,783	59,087,481	5.96							9,912,783	59,087,481
Pennsylvania	14	3,417	23,889,180	68.27	16,310,167	77,293,489	4.74	13,037	11,292,336	64.73	7,309,337	41,263,580	5.65	23,619,504	118,557,069
Tennessee	1	44	329,867	71.10	234,529	(1)	(1)	240	122,940	59.01	72,541	(1)	(1)	307,070	(1)
Utah	1	56	405,128	59.87	242,531	(1)	(1)	297	43,865	51.07	22,402	(1)	(1)	264,933	(1)
Virginia								753	584,620	59.96	350,521	2,281,289	6.51	350,521	2,281,289
Washington								160							
West Virginia	5	506	3,502,958	69.78	2,444,368	9,103,440	3.72	1,140	537,959	62.31	335,221	2,066,217	6.16	2,779,589	11,169,657
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	514	3,040,423	74.79	2,273,838	17,935,380	7.89	14	1,897	60.00	1,138	6,225	5.47	2,274,976	17,941,605
Undistributed						41,058,855	7.50					1,392,820	7.64		42,451,675
Total: 1942	88	13,303	87,973,821	70.81	62,294,909	378,011,967	6.07	[2] 16,295	12,875,812	64.26	8,274,035	47,601,777	5.75	70,568,944	425,613,744
1941	87	13,016	82,608,837	70.79	58,482,422	316,477,231	5.41	18,669	10,529,316	63.67	6,704,156	36,490,006	5.44	65,186,578	352,967,237

[1] Included under "Undistributed."

[2] Number of ovens in existence at plants that operated in 1942 as reported by operators.

NUMBER AND TYPE OF OVENS

Byproduct ovens.—At the end of 1942 there were 13,303 byproduct ovens of all types in the United States. This represented an addition of 287 ovens to the 13,016 reported at the end of 1941. The continued expansion of the iron and steel industry at the end of 1942 found the byproduct-coke producers busy replacing old ovens and building new batteries to meet the anticipated needs for metallurgical fuel. At the close of the year, 1,327 new ovens with an annual coke capacity of 6,775,000 tons were reported under construction. The number of byproduct ovens in the United States at the end of 1942, by types, is given in table 14, by States. The majority of the ovens in the byproduct-coke industry are of Koppers and Koppers-Becker types, and of the 13,303 in existence at the end of 1942, 10,263 (77 percent) were of these two types.

Beehive ovens.—The total ovens in existence, as reported by operators, dropped from 18,669 in 1941 to 16,295 in 1942. This change is not significant, however, as operators may consider certain ovens serviceable one year and not serviceable the next, according to general conditions. Some operators do not report any ovens in existence at plants operated by them that are not leased by them from the owners; as plants change management from time to time, different reports are received as to the total ovens in existence at the various plants at various times.

TABLE 12.—*Coke ovens completed and abandoned in the United States in 1942 and total number in existence at the end of year, by States*

State	Plants in existence Dec. 31, 1942	Ovens						
		In existence Dec. 31, 1942		New		Abandoned during year	Under construction Dec. 31, 1942	
		Number	Annual capacity (net tons of coke)	Number	Annual capacity (net tons of coke)		Number	Annual capacity (net tons of coke)
Byproduct:								
Alabama	8	1,352	5,770,950				138	(1)
California							90	(1)
Colorado	1	188	645,300					
Connecticut	1	70	(1)					
Illinois	9	915	4,099,100				124	(1)
Indiana	5	1,592	7,999,600	[2] 140	(1)		264	1,346,000
Kentucky	1	120	(1)					
Maryland	1	422	2,124,000					
Massachusetts	2	215	1,165,880					
Michigan	7	641	3,219,658			19		
Minnesota	3	196	966,000					
Missouri	1	64	(1)					
New Jersey	2	228	1,033,000			11		
New York	8	1,054	5,507,699				76	(1)
Ohio	15	1,963	9,411,800				136	(1)
Pennsylvania	14	3,417	17,129,900	201	1,057,500	106	105	(1)
Rhode Island	1	65	(1)					
Tennessee	1	44	(1)					
Texas							125	(1)
Utah	1	56	238,710				252	(1)
Washington							17	(1)
West Virginia	5	506	2,681,250	82	(1)			
Wisconsin	2	195	(1)					
Undistributed			2,562,125		1,269,300			5,429,000
	88	13,303	64,554,972	423	2,326,800	136	1,327	6,775,000
At merchant plants	42	3,581	15,749,788	62	308,300	30	58	221,000
At furnace plants	46	9,722	48,805,184	361	2,018,500	106	1,269	6,554,000

See footnotes at end of table.

TABLE 12.—*Coke ovens completed and abandoned in the United States in 1942 and total number in existence at end of year, by States*—Continued

State	Plants in existence Dec. 31, 1942	Ovens						
		In existence Dec. 31, 1942		New		Abandoned during year	Under construction Dec. 31, 1942	
		Number	Annual capacity (net tons of coke)	Number	Annual capacity (net tons of coke)		Number	Annual capacity (net tons of coke)
Beehive:								
Alabama	4	394	231,400			151		
Colorado	1	260	(1)					
Kentucky	1	14	(1)					
Pennsylvania	84	13,037	8,762,625			186		
Tennessee	2	240	85,000					
Utah	1	297	(1)			520		
Virginia	5	753	401,074			553		
Washington	1	160	(1)					
West Virginia	9	1,140	544,500			76		
Undistributed			383,996					
	108	[3] 16,295	10,408,595			1,486		

[1] Included under "Undistributed."
[2] Reconstructed ovens.
[3] Number of ovens in existence at plants that operated in 1942, as reported by operators.

TABLE 13.—*Average number of beehive ovens active in the United States in 1942, by months*

Month	Number	Month	Number	Month	Number
January	12,515	May	12,797	September	12,782
February	12,516	June	12,658	October	12,780
March	12,521	July	12,741	November	12,900
April	12,680	August	12,845	December	12,834

TABLE 14.—*Byproduct ovens of each type in the United States at end of 1942, b States*

State	Koppers	Koppers Becker	Semet-Solvay	Wilputte	Cambria	American Foundation	All others[1]	Total
Alabama	459	413	420	60				1,352
Colorado	116	72						188
Connecticut		70						70
Illinois	379	282	120	88			46	915
Indiana	824	248	120	400				1,592
Kentucky			120					120
Maryland	300	122						422
Massachusetts		160		55				215
Michigan		295	346					641
Minnesota	155	41						196
Missouri	56						8	64
New Jersey	191	37						228
New York	150	593	180	76		55		1,054
Ohio	1,238	356	369					1,963
Pennsylvania	1,550	1,559	88	97	120		3	3,417
Rhode Island	40	25						65
Tennessee			24	20				44
Utah		56						56
West Virginia	154	207		145				506
Wisconsin	100	15	80					195
	5,712	4,551	1,867	941	120	55	57	13,303
At merchant plants	771	1,217	1,141	340		55	57	3,581
At furnace plants	4,941	3,334	726	601	120			9,722

[1] Includes 46 Curran-Knowles, 8 Piette, and 3 Disco ovens in 1942.

CAPACITY OF BYPRODUCT PLANTS

The potential maximum capacity of the 13,303 byproduct-coke ovens in existence at the end of 1942 was 176,863 tons a day and that of the 1,327 new ovens under construction at the end of the year 18,562 tons a day. Capacity, as thus stated, is defined as the total quantity of coke of the grade the operator aims to produce that can be obtained in a 24-hour period with all conditions favorable and all ovens active. This capacity depends not only on the amount of coal placed in the ovens but on many other factors, including the temperature that can be maintained in the walls of the ovens, which is limited by the character of the refractory materials of these walls; the character and quality of the coal charged; and the width of the oven chamber. Therefore, the potential maximum capacity of the ovens as estimated by the operators is subject to change from year to year according to changes in coking time, coal mixtures, or other variables.

Table 15 shows the relationship between the production of byproduct coke and the potential maximum capacity for each month in 1929 and 1939–42. The operating ratio of the plants has fluctuated with the demand for coke, as noted in the continual rise from 1939, when plants operated at 68.9 percent of the potential maximum capacity, to the all-time high ratio of 96.9 percent in 1942. This figure was 5 percent higher than the hitherto all-time high performance of 1941 and is a credit to the operators, when it is known that more than 50 percent of the ovens in operation in 1942 were more than 20 years old. The 46 furnace plants operated at 97.5 percent and the 42 nonfurnace plants at 95.1 percent of their potential maximum capacity.

TABLE 15.—*Relationship of production to potential maximum capacity* [1] *at byproduct-coke plants in the United States, 1929 and 1939–42, by months, in percent*

Month	1929	1939	1940	1941	1942	Month	1929	1939	1940	1941	1942
January	88.6	62.8	89.2	92.0	94.3	August	93.6	70.2	87.3	93.4	98.0
February	91.3	63.5	81.3	92.9	94.2	September	91.9	77.2	89.2	91.9	98.4
March	93.0	64.1	78.1	93.2	94.3	October	92.3	86.6	90.2	92.0	98.4
April	92.8	56.2	78.0	86.4	94.3	November	89.0	90.3	91.5	92.1	98.9
May	94.0	44.4	80.4	90.6	98.1	December	83.1	89.7	91.2	94.8	98.4
June	93.9	59.2	85.6	93.3	98.3						
July	93.0	64.4	86.1	93.7	97.6	The year	91.4	68.9	85.7	92.2	96.9

[1] Capacity of all ovens in existence, whether active or idle, based upon maximum daily capacity times days in month.

QUANTITY AND COST OF COAL CHARGED

The quantity of coal used in the manufacture of coke increased 8 percent in 1942 compared with 1941, but the percentage of the total output of bituminous coal carbonized remained about the same and represented 17 percent of the bituminous-coal production. The total quantity of coal used in making coke in 1942 was 100,849,600 tons, of which 87,973,800 tons (87 percent) were used in byproduct ovens and 12,875,800 tons (13 percent) in beehive ovens.

The average cost of the coal per ton laid down at the ovens was $4.38 for byproduct plants and $2.52 for beehive plants as against $3.92 and $2.33 in 1941. The total cost of coal used in the byproduct and beehive industry in the manufacture of coke was $417,465,208 compared with $348,072,043 in 1941 and represented an increase of 20 percent.

However, not all of this figure represented revenue to the coal producers; for most byproduct plants it included the freight rate from mine to ovens. The average cost of coal charged into byproduct ovens in 1942 ranged from $2.92 in West Virginia to $5.64 in Minnesota, where it includes freight rates from distant mines. The average cost of coal for beehive ovens is much less than that for byproduct ovens, as the former are usually built at or near the producing mines and therefore benefit from the savings in transportation charges. West Virginia, with an average cost of $2.18 per ton, was low among the beehive-producing States, and the costs ranged to $3.90 per ton for Colorado and Utah.

The prices of bituminous coal used in making coke in 1942 were governed by Office of Price Administration General Maximum Price Regulation 120, effective May 18, 1942. This regulation was based upon the price of October 1 to 15, 1941, and at the same time took into account the increased costs of production and allowed the producers a somewhat higher price for bituminous coal sold at mines or preparation plants than that during the base period.

TABLE 16.—*Coal consumed in coke ovens in the United States, 1940–42, by months, in net tons*

Month	1940			1941			1942		
	By-product	Beehive	Total	By-product	Beehive	Total	By-product	Beehive	Total
January	6,648,600	390,700	7,039,300	7,021,300	860,000	7,881,300	7,400,800	1,051,000	8,451,800
February	5,671,400	254,700	5,926,100	6,408,900	830,600	7,239,500	6,681,700	988,700	7,670,400
March	5,824,900	221,600	6,046,500	7,116,400	979,800	8,096,200	7,405,400	1,080,700	8,486,100
April	5,627,800	167,800	5,795,600	6,367,800	155,600	6,523,400	7,164,600	1,068,900	8,233,500
May	5,995,000	173,900	6,168,900	6,832,500	894,100	7,726,600	7,425,900	1,089,700	8,515,600
June	6,179,500	252,100	6,431,600	6,816,700	931,900	7,748,600	7,199,700	1,118,300	8,318,000
July	6,608,300	385,700	6,994,000	7,067,100	955,400	8,022,500	7,451,800	1,077,900	8,529,700
August	6,697,900	464,500	7,162,400	7,067,700	1,008,700	8,076,400	7,504,900	1,084,100	8,589,000
September	6,619,200	454,300	7,073,500	6,775,400	948,300	7,723,700	7,290,300	1,085,700	8,376,000
October	6,922,500	606,400	7,528,900	7,010,200	1,012,400	8,022,600	7,538,600	1,123,700	8,662,300
November	6,793,800	657,700	7,451,500	6,814,600	878,600	7,693,200	7,330,400	1,038,800	8,369,200
December	6,993,900	773,600	7,767,500	7,310,300	1,073,900	8,384,200	7,579,700	1,068,300	8,648,000
	76,582,800	4,803,000	81,385,800	82,608,900	10,529,300	93,138,200	87,973,800	12,875,800	100,849,600

TABLE 17.—*Total quantity and value at ovens of coal used in manufacturing coke in the United States in 1942, by States*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Average	Net tons	Cost
Byproduct plants:					
Alabama	7,780,673	$24,323,343	$3.13	1.39	$4.35
Colorado	1,020,797	(1)	(1)	1.51	(1)
Illinois	5,224,824	27,594,391	5.28	1.42	7.50
Indiana	10,147,475	55,770,928	5.50	1.38	7.59
Maryland	2,904,798	(1)	(1)	1.38	(1)
Massachusetts	1,668,918	(1)	(1)	1.42	(1)
Michigan	4,359,802	21,247,723	4.87	1.39	6.77
Minnesota	1,270,855	7,168,467	5.64	1.33	7.50
New Jersey	1,439,043	(1)	(1)	1.39	(1)
New York	7,255,819	38,971,369	5.37	1.40	7.52
Ohio	13,733,261	60,571,869	4.41	1.39	6.13
Pennsylvania	23,889,180	82,270,214	3.44	1.46	5.02
Tennessee	329,867	(1)	(1)	1.41	(1)
Utah	405,128	(1)	(1)	1.67	(1)
West Virginia	3,502,958	10,230,029	2.92	1.43	4.18
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	3,040,423	15,768,592	5.19	1.34	6.95

[1] Included under "Undistributed."

TABLE 17.—*Total quantity and value at ovens of coal used in manufacturing coke in the United States in 1942, by States*—Continued

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Average	Net tons	Cost
Byproduct plants—Continued.					
Undistributed		$41,090,272	$5.29		$7.51
	87,973,821	385,007,197	4.38	1.41	6.18
At merchant plants	20,944,947	104,288,233	4.98	1.38	6.87
At furnace plants	67,028,874	280,718,964	4.19	1.42	5.95
Beehive plants:					
Alabama	155,290	402,795	2.59	1.63	4.22
Colorado and Utah	180,770	704,603	3.90	1.65	6.44
Kentucky and Tennessee	124,837	369,966	2.96	1.69	5.00
Pennsylvania	11,292,336	28,368,972	2.51	1.54	3.87
Virginia	584,620	1,437,888	2.46	1.67	4.11
West Virginia	537,959	1,173,787	2.18	1.60	3.49
	12,875,812	32,458,011	2.52	1.56	3.93

TABLE 18.—*Average cost per net ton of coal charged into byproduct-coke ovens in the United States, 1929 and 1939–42, by States*

State	1929	1939	1940	1941	1942	State	1929	1939	1940	1941	1942
Alabama	$2.49	$2.39	$2.41	$2.79	$3.13	Tennessee	$3.02	$3.50	$3.46	$3.67	(1)
Illinois	4.29	4.55	4.57	4.92	5.28	Washington	5.26				
Indiana	4.61	4.68	4.72	5.16	5.50	West Virginia	2.41	2.33	2.39	2.63	$2.92
Massachusetts	4.70	(1)	(1)	(1)	(1)						
Michigan	4.29	4.08	3.99	4.35	4.87	United States average	3.50	3.75	3.68	3.92	4.38
Minnesota	5.04	5.49	5.16	5.19	5.64						
New York	4.22	4.61	4.56	4.87	5.37	Cost of coal per ton of coke	5.04	5.36	5.23	5.53	6.18
Ohio	3.31	3.81	3.78	4.13	4.41						
Pennsylvania	2.73	2.93	2.84	2.69	3.44						

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

PREPARATION AND SOURCE OF COAL

Washed and unwashed.—The preparation of coal used in making coke is very important to many coke producers. Coals available for coke manufacture that contain an undue proportion of ash or sulfur are usually cleaned before being charged into ovens. Both pneumatic cleaning and wet-washing methods are employed. Some coal is cleaned or washed at the mines, and some byproduct-coke plants have washeries adjacent to the ovens. In 1942, 24 coke plants used coal that had been washed at mines, and 7 byproduct-coke plants charged into their ovens coal that was cleaned at the ovens. Table 19 shows the quantity of washed and unwashed coal consumed in the coke ovens of each State. Of the 87,973,821 tons of coal charged into byproduct ovens in 1942, 23,452,747 tons (27 percent) were washed, and in beehive ovens 1,824,619 tons (14 percent) were washed. In Colorado and Tennessee all the coal used for byproduct-coke manufacture in 1942 was washed; also most of that used in Alabama and mined within the State and about half of that used in Pennsylvania.

Sources.—Sources of coking coals have been brought into sharper focus in 1942 because of the close relationship of the coke industry to the iron and steel industry.[5] Pennsylvania and West Virginia are the leading sources of coal used in byproduct-coke manufacture, and these two States supplied more than 75 percent of the bituminous coal so used in 1942. Of the 90,401,393 tons of coking coal purchased by byproduct-coke producers, Pennsylvania supplied 35,636,227 tons (39 percent), followed in order by West Virginia with 32,407,634 tons

[5] Chapman, H. M., Coking Coals and Their Importance in Winning the War: Blast Furnace and Steel Plant, vol. 30, No. 12, December 1942, pp. 1378–1379.

(36 percent); Kentucky with 10,541,692 tons (12 percent); and Alabama with 7,980,529 tons (9 percent). Other States that supplied appreciable tonnages were Virginia, Colorado, Utah, Illinois, and Tennessee.

Blending coals.—Many operators of byproduct-coke ovens have found that mixing or blending various types of coking coals before charging into ovens will improve the quality of the coke and increase the yield per ton of coal. Operators agree in general that a mixture of low- and high-volatile coals attains this result. However, low-volatile coals with many satisfactory coking qualities expand when coked, and their use alone would cause difficulty in discharging the coke from the oven and injure the byproduct-oven walls. For this reason, it is customary to mix such coals with high-volatile coals, which shrink when coked. This practice also permits the use of coals that have good coking qualities but have objectionable impurities such as high content of ash, sulfur, and phosphorus and for this reason could not be used as 100-percent charge into the ovens to produce coke to conform with specifications upon this basis. Thus, coal mixing, in addition to producing a superior coke, enables the coke industry to utilize coals that in an unmixed condition would not be suitable for coke manufacture.

In 1942, 64 of the 88 active byproduct plants purchased coal of different volatile content. Of these, 40 plants purchased high- and low-volatile coal; 20 plants high-, medium-, and low-volatile; and 4 plants high- and medium-volatile.

Of the 90,401,393 tons of coal purchased, 58,249,586 tons (65 percent) were high-volatile (32 percent and over volatile matter), 19,228,466 tons (21 percent) were low-volatile (14 to 22 percent volatile matter), and 12,923,341 tons (14 percent) were medium-volatile (23 to 31 percent volatile matter).

TABLE 19.—*Washed and unwashed coal used in manufacturing coke in the United States in 1942, by States in which used, in net tons*

State	Washed	Unwashed	Total
Byproduct plants:			
Alabama	6,957,574	823,099	7,780,673
Colorado	1,020,797		1,020,797
Illinois	459,184	4,765,640	5,224,824
Indiana		10,147,475	10,147,475
Maryland		2,904,798	2,904,798
Massachusetts		1,668,918	1,668,918
Michigan	199,040	4,160,762	4,359,802
Minnesota	56,200	1,214,655	1,270,855
New Jersey		1,439,043	1,439,043
New York	728,907	6,526,912	7,255,819
Ohio	2,588,105	11,145,156	13,733,261
Pennsylvania	9,955,917	13,933,263	23,889,180
Tennessee	329,867		329,867
Utah		405,128	405,128
West Virginia	1,135,206	2,367,752	3,502,958
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	21,950	3,018,473	3,040,423
	23,452,747	64,521,074	87,973,821
At merchant plants	2,137,637	18,807,310	20,944,947
At furnace plants	21,315,110	45,713,764	67,028,874
Beehive plants:			
Alabama	135,418	19,872	155,290
Colorado and Utah	136,905	43,865	180,770
Kentucky and Tennessee	104,041	20,796	124,837
Pennsylvania	1,448,255	9,844,081	11,292,336
Virginia		584,620	584,620
West Virginia		537,959	537,959
	1,824,619	11,051,193	12,875,812

TABLE 20.—*Coal purchased for manufacture of byproduct coke in the United States in 1942, 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, 16, etc., is due to change in stock, loss of weight in handling, and the fact that these represent purchases during the year rather than actual consumption]

State and district where coal was produced	Total purchased	States where coal was consumed—in order of importance
Alabama	7,980,529	Alabama.
Colorado	930,642	Colorado.
Georgia	17,188	Tennessee.
Illinois	355,687	Illinois and Indiana.
Indiana	80,929	Illinois.
Kentucky, Eastern:		
Elkhorn (including Hazard)	2,679,567	Indiana, Ohio, Michigan, New York, Illinois, New Jersey, Minnesota, and Wisconsin.
Harlan	4,232,317	Indiana, Ohio, Illinois, Minnesota, Michigan, and New York.
Kenova-Thacker	1,755,991	Michigan, Ohio, Wisconsin, and Illinois.
Miscellaneous	1,873,817	Indiana, Illinois, and Ohio.
New Mexico	214,347	Colorado.
Pennsylvania:		
Central Pennsylvania:		
Medium-volatile	407,148	New York and Maryland.
Low-volatile	2,917,834	Pennsylvania, New York, Ohio, and Minnesota.
Connellsville	17,069,335	Pennsylvania, Ohio, West Virginia, New York, Illinois, and New Jersey.
Freeport	1,629,956	West Virginia, Ohio, Michigan, and New York.
Pittsburgh	12,559,474	Pennsylvania, New York, Ohio, Michigan, Illinois, New Jersey, Wisconsin, and Connecticut.
Somerset	544,991	Pennsylvania, West Virginia, and New York.
Westmoreland	438,866	Pennsylvania, Maryland, Minnesota, and Connecticut.
Miscellaneous	68,623	New York, Pennsylvania, and Missouri.
Tennessee	320,500	Tennessee.
Utah	392,683	Utah.
Virginia	819,340	Michigan, New Jersey, Ohio, New York, Massachusetts, Illinois, and Pennsylvania.
West Virginia:		
Coal and Coke	122,137	Pennsylvania.
Kanawha-Logan	9,862,242	Ohio, Indiana, Massachusetts, Illinois, West Virginia, Kentucky, Michigan, Wisconsin, New York, Connecticut, Pennsylvania, New Jersey, Rhode Island, Missouri and Minnesota.
New River:		
High-volatile	1,360,890	New York, New Jersey, Pennsylvania, Massachusetts and Michigan.
Low-volatile (including Winding Gulf).	2,281,469	New York, New Jersey, Massachusetts, Michigan, Maryland, Rhode Island, Ohio, Illinois, Wisconsin, Minnesota, West Virginia, and Kentucky.
Northern	5,316,583	Maryland, Pennsylvania, West Virginia, Ohio, Michigan, and Illinois.
Pocahontas[1]	13,415,549	Indiana, Ohio, Illinois, Michigan, Maryland, Pennsylvania, Minnesota, New York, Kentucky, Wisconsin, Missouri, Connecticut, Alabama, and West Virginia.
Webster-Gauley	460,044	New York, Pennsylvania, and New Jersey.
Williamson	292,715	Ohio, Massachusetts, and Michigan.
	90,401,393	

[1]Includes 703,995 tons of Pocahontas coal produced in Virginia.

TABLE 21.—*Coal purchased for manufacture of byproduct coke in the United States in 1942, 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	Indiana	Kentucky	New Mexico	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
Alabama: Merchant plants	1,751,407											112,352	1,863,759
Furnace plants	6,229,122											10,023	6,239,145
Total Alabama	7,980,529											122,375	8,102,904
Colorado: Furnace plant		930,642					214,347						1,144,989
Illinois: Merchant plants				227,197		187,107		69,754			13,050	1,729,954	2,227,062
Furnace plants					80,929	1,336,112		241,311				1,469,704	3,128,056
Total Illinois				227,197	80,929	1,523,219		311,065			13,050	3,199,658	5,355,118
Indiana: Merchant plants												930,090	930,090
Furnace plants				128,490		4,508,928					703,995	4,168,831	9,510,244
Total Indiana				128,490		4,508,928					703,995	5,098,921	10,440,334
Maryland: Furnace plant								78,864				2,829,938	2,908,802
Massachusetts: Merchant plants											17,823	1,643,635	1,661,458
Michigan: Merchant plants						202,400		204,809			155,104	868,346	1,430,659
Furnace plants						1,420,599		203,643			243,024	1,024,228	2,891,494
Total Michigan						1,622,999		408,452			398,128	1,892,574	4,322,153
Minnesota: Merchant plants						55,531		65,065				292,470	413,066
Furnace plants						462,951						390,066	853,017
Total Minnesota						518,482		65,065				682,536	1,266,083
New Jersey: Merchant plants						101,526		69,750			177,812	1,173,384	1,522,472
New York: Merchant plants						281,887		2,054,540			98,313	1,828,121	4,262,861
Furnace plants								2,537,877				363,006	2,900,883
Total New York						281,887		4,592,417			98,313	2,191,127	7,163,744
Ohio: Merchant plants											107,357	1,430,704	1,538,061
Furnace plants						1,932,710		6,320,353			1,595	4,851,591	13,106,249
Total Ohio						1,932,710		6,320,353			108,952	6,282,295	14,644,310

Pennsylvania: Merchant plants								179,349				807,672	987,021
Furnace plants								21,458,862			5,262	1,931,317	23,395,441
Total Pennsylvania								21,638,211			5,262	2,738,989	24,382,462
Tennessee: Merchant plant			17,188						320,500				337,688
Utah: Furnace plant										392,683			392,683
West Virginia: Merchant plants								9,350				1,526,334	1,535,684
Furnace plants								2,079,460				1,006	2,080,466
Total West Virginia								2,088,810				1,527,340	3,616,150
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants						51,941		63,240				3,024,862	3,140,043
	7,980,529	930,642	17,188	355,687	80,929	10,541,692	214,347	35,636,227	320,500	392,683	1,523,335	32,407,634	90,401,393
At merchant plants	1,751,407		17,188	227,197		880,392		2,715,857	320,500		569,459	15,367,924	21,849,924
At furnace plants	6,229,122	930,642		128,490	80,929	9,661,300	214,347	32,920,370		392,683	953,876	17,039,710	68,551,469

TABLE 22.—*Coal purchased for manufacture of byproduct coke in the United States in 1942, by States where consumed and by volatile content* [1]

State where coal was consumed	Low-volatile		Medium-volatile		High-volatile		Total coal purchased (net tons)
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	
Alabama: Merchant plants	112,352	6.0	1,620,092	86.9	131,315	7.1	1,863,759
Furnace plants	10,023	.2	6,092,661	97.6	136,461	2.2	6,239,145
Total Alabama	122,375	1.5	7,712,753	95.2	267,776	3.3	8,102,904
Colorado: Furnace plant					1,144,989	100.0	1,144,989
Illinois: Merchant plants	627,312	28.2	976,184	43.8	623,566	28.0	2,227,062
Furnace plants	1,277,946	40.9			1,850,110	59.1	3,128,056
Total Illinois	1,905,258	35.6	976,184	18.2	2,473,676	46.2	5,355,118
Indiana: Merchant plants	397,753	42.8	532,337	57.2			930,090
Furnace plants	4,168,835	43.8			5,341,409	56.2	9,510,244
Total Indiana	4,566,588	43.7	532,337	5.1	5,341,409	51.2	10,440,334
Maryland: Furnace plant	709,839	24.4			2,198,963	75.6	2,908,802
Massachusetts: Merchant plants	338,823	20.4	461,844	27.8	860,791	51.8	1,661,458
Michigan: Merchant plants	436,677	30.5			993,982	69.5	1,430,659
Furnace plants	652,512	22.6			2,238,982	77.4	2,891,494
Total Michigan	1,089,189	25.2			3,232,964	74.8	4,322,153
Minnesota: Merchant plants	108,456	26.3	52,773	12.8	251,837	60.9	413,066
Furnace plants	390,066	45.7			462,951	54.3	853,017
Total Minnesota	498,522	39.4	52,773	4.2	714,788	56.4	1,266,083
New Jersey: Merchant plants	346,153	22.7			1,176,319	77.3	1,522,472
New York: Merchant plants	608,738	14.3	743,433	17.4	2,910,690	68.3	4,262,861
Furnace plants	610,736	21.1	503,595	17.4	1,786,552	61.5	2,900,883
Total New York	1,219,474	17.0	1,247,028	17.4	4,697,242	65.6	7,163,744
Ohio: Merchant plants	462,025	30.0	245,720	16.0	830,316	54.0	1,538,061
Furnace plants	3,802,710	29.0	905,830	6.9	8,397.709	64.1	13,106,249
Total Ohio	4,264,735	29.1	1,151,550	7.9	9,228,025	63.0	14,644,310
Pennsylvania: Merchant plants	187,559	19.0	203,341	20.6	596,121	60.4	987,021
Furnace plants	2,808,851	12.0	24,625	.1	20,561,965	87.9	23,395,441
Total Pennsylvania	2,996,410	12.3	227,966	.9	21,158,086	86.8	24,382,462
Tennessee: Merchant plant			337,688	100.0			337,688
Utah: Furnace plant					392,683	100.0	392,683
West Virginia: Merchant plants	77,708	5.1	9,350	.6	1,448,626	94.3	1,535,684
Furnace plants	183,724	8.8			1,896,742	91.2	2,080,466
Total West Virginia	261,432	7.2	9,350	.3	3,345,368	92.5	3,616,150
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants	909,668	29.0	213,868	6.8	2,016,507	64.2	3,140,043
	19,228,466	21.3	12,923,341	14.3	58,249,586	64.4	90,401,393
At merchant plants	4,613,224	21.1	5,396,630	24.7	11,840,070	54.2	21,849,924
At furnace plants	14,615,242	21.3	7,526,711	11.0	46,409,516	67.7	68,551,469

[1] Low-volatile coals range from 14 to 22 percent volatile matter; medium-volatile, from 23 to 31 percent; and high-volatile, 32 percent and over.

YIELD OF COKE PER TON OF COAL

TABLE 23.—*Yield of coke from coal in byproduct and beehive ovens in the United States, 1939–42, by States, in percent*

State	1939		1940		1941		1942	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama	71.01		71.03		71.51	60.66	71.71	61.45
Colorado	66.03	65.41	63.95	65.20	65.13	64.57	66.24	63.87
Illinois	68.12		70.56		71.20		70.63	
Indiana	70.26		73.24		73.31		72.31	
Maryland	72.88		72.33		72.60		72.42	
Massachusetts	70.72		71.11		70.36		70.49	
Michigan	69.34		70.06		71.31		72.00	
Minnesota	69.92		70.50		72.13		75.17	
New Jersey	71.05		71.67		71.65		72.16	
New York	71.16		71.34		71.39		71.40	
Ohio	71.09		71.48		71.64		72.18	
Pennsylvania	68.71	63.42	68.43	63.80	68.41	64.06	68.27	64.73
Tennessee	73.00		70.51	59.55	71.94	59.19	71.10	59.01
Utah	58.38	60.27	59.31	50.89	59.58	50.95	59.87	51.07
Virginia		56.87		59.97		60.02		59.96
Washington				60.20				
West Virginia	68.12	67.04	69.05	65.79	69.07	62.09	69.78	62.31
United States average	70.05	62.86	70.53	63.66	70.79	63.67	70.81	64.26

COKE BREEZE

TABLE 24.—*Coke breeze recovered at coke plants in the United States in 1942, by States*

State	Yield per ton of coal (percent) [1]	Produced		Used by producer				Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
				For steam raising		For other purposes, including water gas					
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
Byproduct ovens:											
Alabama	4.86	377,837	$957,090	153,275	$290,886	44,398	$101,175	146,744	$488,890		61,840
Colorado	9.94	101,508	(2)	27,768	(2)	16,597	(2)	56,592	(2)		711
Illinois	6.14	321,018	749,344	169,974	416,585	29,461	60,453	130,469	313,645		73,119
Indiana	4.72	478,933	940,450	273,627	558,728	124,021	240,895	106,119	180,800		26,815
Maryland	4.59	133,417	(2)	79,698	(2)	28,233	(2)	29,190	(2)		81,464
Massachusetts	6.52	108,766	(2)	100,113	(2)	4,901	(2)	3,877	(2)		5,521
Michigan	4.60	200,384	1,022,181	135,913	739,800	12,632	43,676	49,267	220,506		35,791
Minnesota	4.51	57,294	201,276	24,830	73,672	5,259	21,891	24,033	88,168		21,633
New Jersey	6.24	89,848	(2)	89,050	(2)			533	(2)		1,982
New York	4.51	327,095	1,057,510	255,733	691,531	49,550	249,643	54,762	219,189		79,829
Ohio	5.08	697,708	1,551,357	439,711	931,565	157,613	340,863	102,988	224,895	2,261	148,144
Pennsylvania	5.85	1,392,107	2,402,815	1,183,130	2,043,503	59,010	91,191	126,395	227,832		79,761
Tennessee	4.29	14,142	(2)			3,553	(2)	9,492	(2)		1,525
Utah	5.29	21,421	(2)			6,043	(2)	22,127	(2)		686
West Virginia	4.90	119,707	252,193	87,162	166,571	15,163	25,725	27,252	79,175		11,550
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5.22	158,845	532,333	103,082	336,615	256	559	42,282	156,990		24,804
Undistributed			1,230,572		758,683		126,794		355,895		
Total byproduct, 1942	5.30	4,600,030	10,897,121	3,123,066	7,008,139	556,690	1,302,865	932,122	2,555,985	2,261	655,175
At merchant plants	5.31	1,050,991	3,304,187	674,571	1,898,581	52,709	239,753	309,150	1,077,621	2,261	166,443
At furnace plants	5.29	3,549,039	7,592,934	2,448,495	5,109,558	503,981	1,063,112	622,972	1,478,364		488,732
Total byproduct, 1941	5.41	4,432,864	9,530,433	3,335,705	6,962,011	428,058	882,146	836,159	2,014,560	2,505	443,366
Beehive ovens:											
Alabama	5.34	8,126	12,547	7,397	11,673			729	874		
Colorado and Utah	3.29	5,952	6,655			5,542	6,040	2,493	3,738		102
Kentucky and Tennessee											
Pennsylvania	2.60	131,540	121,209	22,632	28,471	55	102	58,000	49,916	47,258	4,834
Virginia	.22	803	4,050			144	837	659	3,213		20
West Virginia	1.30	5,232	6,749					356	459	4,876	
Total beehive, 1942	2.46	151,653	151,210	30,029	40,144	5,741	6,979	62,237	58,200	[3] 52,134	4,956

[1] Yield computed by dividing production of breeze by coal charged at 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

The indicated consumption of coke in the United States in 1942 was 70,107,181 net tons—an 8-percent increase over the 1941 figure. Unusually heavy requirements resulted in the consumption of 54,694,746 tons of furnace coke. This tonnage represented 78 percent of the total requirements; and the remainder—22 percent—was used in foundries, in smelting the nonferrous metals, in the manufacture of water gas, in miscellaneous industries as a chemical reagent, and in domestic heating.

Table 26 shows the coke and coking coal consumed per net ton of pig iron produced in the United States in 1913, 1918, and 1939–42. There was an increase in the 1942 consumption ratio of coke to pig iron, and the coke consumed per ton of pig iron and ferromanganese produced rose from 1,767.8 pounds in 1941 to 1,822.8 pounds in 1942—an increase of 55 pounds (3 percent). Because of this increase, it is indicated that the additional coke required to supply the needs of blast furnaces in 1942 amounted to approximately 1,800,000 tons more than if the furnaces had operated at the 1941 rate of coke consumption per ton of furnace output.

TABLE 25.—*Coke consumed in manufacture of pig iron and for other purposes in the United States, 1913, 1918, and 1939–42, in net tons*

Year	Total production	Imports	Exports	Net change in stocks	Indicated United States consumption [1]	Consumed by iron furnaces [2]		Remainder consumed in other ways	
						Quantity	Percent	Quantity	Percent
1913	46,299,530	101,212	987,395	([3])	45,413,347	37,192,287	81.9	8,221,060	18.1
1918	56,478,372	30,168	1,687,824	([3])	54,820,716	45,703,594	83.4	9,117,122	16.6
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
1941	65,186,578	267,886	708,971	−198,356	64,943,849	49,469,972	76.2	15,473,877	23.8
1942	70,568,944	108,782	839,582	−269,037	70,107,181	54,694,746	78.0	15,412,435	22.0

[1] Production plus imports minus exports, plus or minus decrease or increase, respectively, of net changes in stocks.
[2] From Report of American Iron and Steel Institute. Figures include coke consumed in manufacture of ferro-alloys.
[3] Data not available.

TABLE 26.—*Coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, and 1939–42*

Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)	Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)
1913	2,172.6	66.9	3,247.5	1940	1,781.2	70.1	2,540.9
1918	2,120.7	66.4	3,193.8	1941	1,767.8	70.0	2,525.4
1939	1,778.0	69.8	2,547.3	1942	1,822.8	70.0	2,604.0

[1] From Report of American Iron and Steel Institute; consumption per ton of pig iron only, excluding furnaces making ferro-alloys, was 2,172.6 pounds in 1913, 2,120.7 in 1918, 1,760.0 in 1939, 1,756.9 in 1940, 1,745.2 in 1941, and 1,791.4 in 1942.

FURNACE, FOUNDRY, DOMESTIC, AND OTHER COKE

The terms "furnace coke" and "foundry coke," as used by the trade, refer to size and grade as well as to use. In the manufacture of byproduct coke the facilities for screening or sizing the product permit more precise definitions of grade. In terms of size, byproduct-furnace coke is run-of-oven coke, from which the breeze has been removed. Byproduct-foundry coke is blocky coke of which the maximum size is much greater than that of furnace, and from which all sizes below 2½ to 3 inches have been screened. Domestic coke generally includes a mixture of sizes approximately 3 inches and under, exclusive of breeze. It may result from the screening of foundry and furnace coke; or, where the principal demand is for domestic coke, it may be obtained by crushing the larger fragments. Other special sizes and grades are prepared for special purposes. The majority of the byproduct operators reported that their plants were equipped to screen and size coke for domestic use.

The total quantity of byproduct and beehive coke reported as "used by producers in blast furnaces" and "sold for use in blast furnaces," shown in tables 27 and 28, totaled 55,491,570 tons, whereas the quantity of coke charged into blast furnaces was 54,694,746 tons (table 25), a difference of 796,824 tons. There are two reasons for this discrepancy: (1) Tables 27 and 28 include exports to Canada and other countries, which of course are not included in the record of consumption by American furnaces; (2) tables 27 and 28 cover shipments of blast-furnace coke by producers and do not consider losses due to handling and changes in stocks at blast furnaces.

The total sales of byproduct- and beehive-foundry coke, including exports, were 2,591,576 tons compared with 2,846,459 tons in 1941. The contributing factors that led to decreased use of foundry coke were: (1) Shortages of pig iron and scrap, which diverted coke from cupolas to steel-producing plants; (2) limitation orders which limited the production of cast-iron ware to specified articles and which established quotas for each item of manufacture based upon the amount of iron so used during the year ended June 30, 1941.

The use of both byproduct and beehive coke as a domestic fuel dropped 621,265 tons (9 percent) in 1942 compared with 1941, principally because a number of merchant byproduct-coke plants which had not sold blast-furnace coke in recent years directed some of their output to the iron and steel industry.

TABLE 27.—*Byproduct coke produced and sold or used by producer in the United States in 1942, 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	5,579,511	$26,359,204	3,873,155	$16,125,286	912,312	$4,704,185	358,489	$2,994,074	101,943	$488,919	286,590	$1,839,180	1,659,334	$10,026,358
Colorado	676,209	(4)	654,366	(4)			4,408	(4)			16,298	(4)	20,706	(4)
Illinois	3,690,155	27,364,122	2,561,678	18,321,622	152,269	1,210,325	298,203	3,220,929	584,558	3,963,672	109,427	802,627	1,144,457	9,197,553
Indiana	7,337,512	52,848,043	6,440,682	45,640,324	(4)	(4)	(4)	(4)	183,753	1,157,290	94,747	738,596	868,424	7,011,839
Maryland	2,103,664	(4)	2,080,406	(4)					9,984	(4)	23,278	(4)	33,262	(4)
Massachusetts	1,176,359	(4)	250,173	(4)	20,224	(4)	74,746	(4)	788,236	(4)	46,216	(4)	929,422	(4)
Michigan	3,139,137	21,793,813	1,549,687	9,128,100	(4)	(4)	(4)	(4)	906,753	6,665,741	238,141	1,817,952	1,653,730	13,151,980
Minnesota	955,301	7,507,413	305,903	1,999,637	(4)	(4)	(4)	(4)	324,523	3,027,212	(4)	(4)	707,893	6,062,972
New Jersey	1,038,461	(4)	275,939	(4)	22,202	(4)	51,953	(4)	396,248	(4)	318,199	(4)	788,602	(4)
New York	5,180,384	37,660,727	1,901,537	14,292,989	1,962,138	12,786,188			1,020,259	8,193,846	245,617	1,938,042	3,228,014	22,918,076
Ohio	9,912,783	59,087,481	7,749,842	45,176,097	1,320,460	7,999,293	299,443	2,625,420	315,694	1,833,174	205,936	1,292,006	2,141,533	13,749,893
Pennsylvania	16,310,167	77,293,489	14,049,046	63,122,213	1,373,584	7,002,791	223,374	2,402,651	473,115	3,429,822	235,046	1,678,160	2,305,119	14,513,424
Tennessee	234,529	(4)	108,582	(4)			23,546	(4)			117,403	(4)	140,949	(4)
Utah	242,531	(4)	153,871	(4)	1,075	(4)			3,326	(4)	69,686	(4)	74,087	(4)
West Virginia	2,444,368	9,103,440	2,227,156	7,558,209	(4)	(4)	(4)	(4)	5,182	(4)	(4)	(4)	247,212	1,630,723
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,273,838	17,935,380	172,619	1,193,792	773,330	4,606,192	248,702	2,886,196	849,900	7,497,727	291,267	2,299,760	2,163,199	17,289,875
Undistributed		41,058,855		24,216,340	949,988	7,040,604	667,700	8,724,588		10,710,565	106,472	5,153,382		17,178,416
Grand total, 1942	62,294,909	378,011,967	44,354,642	246,774,609	7,487,582	45,349,578	2,250,564	22,853,858	5,963,474	46,967,968	2,404,323	17,559,705	18,105,943	132,731,109
At merchant plants	15,134,866	114,723,148	2,997,883	18,477,011	3,551,790	23,583,404	1,915,126	19,810,252	5,080,165	41,091,410	1,851,760	13,972,059	12,398,841	98,457,125
At furnace plants	47,160,043	263,288,819	41,356,759	228,297,598	3,935,792	21,766,174	335,438	3,043,606	883,309	5,876,558	552,563	3,587,646	5,707,102	34,273,984
Grand total, 1941	58,482,422	316,477,231	41,530,398	203,468,967	6,215,601	32,538,163	2,494,393	24,342,509	6,596,969	45,910,660	1,844,126	12,309,801	17,151,089	115,101,133

[1] Includes 810,492 net tons valued at $5,138,252 used to make producer gas; 1,527,191 tons, $8,440,530, used to make water gas; and 414,009 tons, $2,504,247, used for other purposes than in blast furnaces.

[2] Includes 3,515,351 net tons valued at $19,373,565 sold to financially affiliated corporations for blast-furnace use; 729,619 tons, $4,638,839, sold for other purposes; and 3,242,612 tons, $21,337,174, reported as merchant sales.

[3] Includes 657,761 net tons valued at $5,131,790 sold for manufacture of water gas.

[4] Included under "Undistributed."

TABLE 28.—*Beehive coke produced and sold or used by producers in the United States in 1942, by States*

State	Produced		Used by producers in blast furnaces [1]		Sold	
					Furnace [2]	
	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	95,428	$591,646	(3)	(3)	35,821	$287,552
Colorado and Utah	109,849	(3)	(3)	(3)	4,731	(3)
Kentucky and Tennessee	73,679	(3)	(3)	(3)	5,888	(3)
Pennsylvania	7,309,337	41,263,580	505,251	$2,635,989	6,055,834	34,018,152
Virginia	350,521	2,281,289			161,563	1,047,837
West Virginia	335,221	2,066,217	(3)	(3)	165,442	860,146
Undistributed		1,399,045	198,884	1,404,552		73,612
Total: 1942	8,274,035	47,601,777	704,135	4,040,541	6,429,279	36,287,299
1941	6,704,156	36,490,006	1,015,752	4,977,767	4,805,099	26,280,276

State	Sold—Continued							
	Foundry		Domestic use		Industrial and other use (including water gas) [4]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama					184	$1,133	36,005	$288,685
Colorado and Utah	663	(3)	306	$1,563	16,902	(3)	22,602	(3)
Kentucky and Tennessee	3,618	(3)			9,622	(3)	19,128	(3)
Pennsylvania	234,476	$1,629,050	89,385	500,560	433,098	2,531,364	6,812,793	38,679,126
Virginia	56,342	395,716	3,000	15,233	130,322	828,519	351,227	2,287,305
West Virginia	45,913	346,196	5,529	27,174	120,323	846,863	337,207	2,080,379
Undistributed		32,258				172,081		279,514
Total: 1942	341,012	2,403,220	98,220	544,530	710,451	4,379,960	7,578,962	43,615,009
1941	352,066	2,283,630	85,990	424,736	433,472	2,445,619	5,676,627	31,434,261

[1] Includes 2,305 net tons valued at $12,420 used for other purposes than in blast furnaces.
[2] Includes 1,542,503 net tons valued at $7,570,393 sold to financially affiliated corporations for blast furnace use; 452 tons, $2,179, sold for other purposes; and 4,886,324 tons, $28,714,727, reported as merchant sales.
[3] Included under "Undistributed."
[4] Includes 115,265 net tons valued at $691,508 sold for manufacture of water gas.

STOCKS OF COKE AND COKING COAL

Table 29 gives details of the quantity of coke and coke breeze on hand at all beehive and byproduct plants as of January 1, 1943. According to reports from byproduct-coke plants, stocks of furnace and foundry coke totaled 792,072 tons, domestic coke 661,401 tons, and coke breeze 655,175 tons. Stocks of metallurgical coke increased 10 percent during the year, but stocks of domestic coke decreased 33 percent. The decrease in stocks of domestic coke was general at merchant plants in 1942, as many producers were forced to draw from stocks because the current production was directed to the heavy industries.

In the operations of beehive ovens, the output is governed by the sales, and ordinarily stocks are negligible. Producers' stocks of beehive coke totaled 35,576 tons on January 1, 1943. Of this amount, 24,617 tons (69 percent) was blast-furnace coke, 2,203 tons foundry coke, and 8,756 tons domestic coke. Table 30 summarizes total stocks, by grades, at all byproduct and beehive plants as of January 1, 1929, and 1939–43. The stocks of coke on hand at producers' plants

by months for 1941 and 1942 are shown in table 31. These data show that stocks of coke carried by furnace plants remained relatively constant, but stocks of coke at merchant plants showed seasonal fluctuations.

Generally stocks of bituminous coal held by byproduct operators closely follow the trend of monthly production. In 1942, however, operators were advised by the Office of Solid Fuels Coordinator for War to build and maintain their stock piles of coking coal to full storage capacity, so that maximum production could be maintained if their normal supply was curtailed. On January 1, 1942, stocks of coking coal at byproduct plants totaled 8,901,462 tons, a 37.7-day supply at the December rate, and they steadily increased until, by December 31, 1942, stocks on hand amounted to 10,721,414 tons, enough for 43.8 days' requirements at the rate of consumption prevailing in December 1942.

TABLE 29.—*Stocks of furnace, foundry, and domestic coke and of breeze in the United States on January 1, 1943, by States, in net tons*

State	Coke				Breeze
	Furnace	Foundry	Domestic and other	Total	
Byproduct plants:					
Alabama	186,691	1,342	20,313	208,346	61,840
Colorado	5,866			5,866	711
Illinois	79,669	785	12,624	93,078	73,119
Indiana	24,795	2,233	8,207	35,235	26,815
Maryland	40,036			40,036	81,464
Massachusetts	380	138	143,759	144,277	5,521
Michigan	3,708	3,839	30,571	38,118	35,791
Minnesota	2,306		37,148	39,454	21,633
New Jersey		178	33,582	33,760	1,982
New York	37,268		175,132	212,400	79,829
Ohio	131,039	9,455	59,953	200,447	148,144
Pennsylvania	223,974		20,967	244,941	79,761
Tennessee	7,933			7,933	1,525
Utah	12,254		4,887	17,141	686
West Virginia	9,687	540	13,732	23,959	11,550
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	4,529	3,427	100,526	108,482	24,804
	770,135	21,937	661,401	1,453,473	655,175
At merchant plants	47,659	21,068	559,371	628,098	166,443
At furnace plants	722,476	869	102,030	825,375	488,732
Beehive plants:					
Alabama	5,715			5,715	
Colorado and Utah	655		226	881	102
Kentucky and Tennessee	2,178	1,010		3,188	
Pennsylvania	13,337	660	6,467	20,464	4,834
Virginia	1,573	138	277	1,988	20
West Virginia	1,159	395	1,786	3,340	
	24,617	2,203	8,756	35,576	4,956

TABLE 30.—*Summary of total stocks of coke on hand at all byproduct and beehive plants in the United States on January 1, 1929 and 1939–43, in net tons*

[Exclusive of screenings or breeze]

	1929	1939	1940	1941	1942	1943
Byproduct plants:						
Furnace	750,318	931,644	597,550	525,798	697,898	770,135
Foundry	24,426	88,334	49,771	14,123	20,448	21,937
Domestic and other	1,018,205	2,611,645	1,922,369	1,373,213	991,045	661,401
	1,792,949	3,631,623	2,569,690	1,913,134	1,709,391	1,453,473
Beehive plants:						
Furnace	38,446	7,228	16,402	16,022	20,311	24,617
Foundry	8,020	8,336	8,312	3,973	4,987	2,203
Domestic and other	8,511	29,367	7,695	23,313	23,397	8,756
	54,977	44,931	32,409	43,308	48,695	35,576
Total:						
Furnace	788,764	938,872	613,952	541,820	718,209	794,752
Foundry	32,446	96,670	58,083	18,096	25,435	24,140
Domestic and other	1,026,716	2,641,012	1,930,064	1,396,526	1,014,442	670,157
	1,847,926	3,676,554	2,602,099	1,956,442	1,758,086	1,489,049

TABLE 31.—*Total stocks of coke at all furnace and nonfurnace byproduct plants in the United States on first of each month, 1941–42, in net tons*

[Includes furnace, foundry, and domestic, but not breeze]

Month	Furnace plants		Other plants		Total	
	1941	1942	1941	1942	1941	1942
January	742,306	825,263	1,170,828	884,128	1,913,134	1,709,391
February	731,845	817,492	864,873	692,293	1,596,718	1,509,785
March	773,666	869,318	617,759	516,283	1,391,425	1,385,601
April	845,329	920,491	491,967	509,134	1,337,296	1,429,625
May	694,433	962,675	706,203	485,461	1,400,636	1,448,136
June	741,425	974,995	663,714	457,309	1,405,139	1,432,304
July	849,320	969,315	578,343	435,318	1,427,663	1,404,633
August	873,591	998,690	576,752	470,371	1,450,343	1,469,061
September	949,868	1,025,617	661,906	538,880	1,611,774	1,564,497
October	880,824	1,021,045	698,764	593,106	1,579,588	1,614,151
November	870,731	954,999	744,925	650,532	1,615,656	1,605,531
December	817,004	917,421	850,750	728,355	1,667,754	1,645,776

TABLE 32.—*Stocks of bituminous coal at byproduct-coke plants in the United States at end of each month, 1939–42, in net tons*

Month	1939	1940	1941	1942
January	7,373,871	6,613,253	9,886,936	8,178,962
February	7,372,654	5,978,167	9,889,674	7,888,481
March	7,221,632	5,373,567	9,853,544	7,881,459
April	4,434,124	5,217,870	4,969,862	8,408,907
May	2,598,470	5,995,170	4,725,310	9,179,025
June	3,548,326	6,506,396	5,912,874	9,866,281
July	4,534,922	7,448,266	6,215,277	9,922,306
August	5,631,984	7,831,640	7,205,844	10,238,114
September	6,220,015	8,860,832	7,291,698	10,565,801
October	7,250,436	9,711,983	8,371,329	10,997,933
November	8,114,807	10,091,259	8,327,472	11,150,840
December	7,992,848	10,184,443	8,901,462	10,721,414

VALUE AND PRICE

The term "value" as used in this report means the value of coke at the ovens. For that part of the output sold, the value is the amount received for the coke, f. o. b. ovens. A considerable amount (over

63 percent) of the coke produced in the United States is made in ovens operated by large corporations, which not only mine the coal they use for the manufacture of coke but also operate blast furnaces that consume almost all of the output of their ovens. Under such conditions, fixing a value for coal charged and for coke produced is purely arbitrary. With some corporations, the cost of coke to the furnace department equals the cost of production; with others a margin is added, or the cost is considered to be the market price.

The average receipts per ton of coke sold in 1942 increased over those of the previous year because of higher coal costs and increased manufacturing costs. Byproduct- and beehive-coke prices in 1942 were governed by maximum price regulations and are discussed in another section of this report. According to sales data furnished by the operators, average receipts per ton of byproduct coke sold in 1942 increased over the 1941 figures as follows: Furnace coke from $5.23 to $6.06; foundry from $9.76 to $10.15; domestic from $6.96 to $7.88; and other industrial from $6.68 to $7.30. Beehive coke showed the following price increases per ton: Furnace coke increased from $5.47 to $5.64; foundry from $6.49 to $7.05; domestic from $4.94 to $5.54; and other industrial from $5.64 to $6.17.

TABLE 33.—*Average receipts per net ton for coke sold in the United States in 1942, by States*

State	Byproduct				Beehive			
	Furnace [1]	Foundry	Domestic	Other industrial, including water gas	Furnace [1]	Foundry	Domestic	Other industrial, including water gas
Alabama	$5.16	$8.35	$4.80	$6.42	$8.03			$6.16
Colorado		[2]		[2]		[2]		[2]
Illinois	7.95	10.80	6.78	7.33				
Indiana	[2]	[2]	6.30	7.80				
Maryland			[2]	[2]				
Massachusetts	[2]	[2]	[2]	[2]				
Michigan	[2]	[2]	7.35	7.63				
Minnesota	[2]	[2]	9.33	[2]				
New Jersey	[2]	[2]	[2]	[2]				
New York	6.52		8.03	7.89				
Ohio	6.06	8.77	5.81	6.27				
Pennsylvania	5.10	10.76	7.25	7.14	5.62	$6.95	$5.60	5.84
Tennessee		[2]		[2]	[2]	[2]		[2]
Utah	[2]		[2]	[2]	[2]	[2]	5.11	[2]
Virginia					6.49	7.02	5.08	6.36
West Virginia	[2]	[2]	[2]	[2]	5.20	7.54	4.91	7.04
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5.96	11.61	8.82	7.90		5.40		6.41
Undistributed	7.09	10.61	8.90	7.39	6.93	7.81		6.49
United States average	6.06	10.15	7.88	7.30	5.64	7.05	5.54	6.17
At merchant plants	6.64	10.34	8.09	7.55				
At furnace plants	5.53	9.07	6.65	6.49				

[1] Includes coke sold to affiliated corporations for all other purposes and merchant sales.
[2] Included under "Undistributed."

TABLE 34.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1939–42* [1]

Month	Furnace coke					Foundry coke				
	1929	1939	1940	1941	1942	1929	1939	1940	1941	1942
January	$2.75	$3.75	$4.20	$5.50	$6.13	$3.75	$4.75	$5.50	$5.75	$6.88
February	2.90	3.75	4.00	5.50	6.00	3.75	4.75	5.31	5.75	6.88
March	2.98	3.75	4.00	5.52	6.00	3.75	4.75	5.25	5.85	6.88
April	2.78	3.75	4.00	5.63	6.00	3.75	4.75	5.25	5.62	6.88
May	2.75	3.75	4.00	6.00	6.00	3.75	4.75	5.25	6.72	6.88
June	2.75	3.75	4.00	6.13	6.00	3.75	4.75	5.25	6.88	6.88
July	2.75	3.75	4.20	6.13	6.00	3.75	4.75	5.25	6.88	6.88
August	2.73	3.75	4.63	6.13	6.00	3.75	4.75	5.25	6.88	6.88
September	2.65	4.25	4.75	6.13	6.00	3.75	5.12	5.25	6.88	6.88
October	2.65	4.90	4.75	6.13	6.00	3.75	5.65	5.25	6.88	6.88
November	2.65	5.00	5.10	6.13	6.00	3.75	5.75	5.63	6.88	6.88
December	2.64	5.00	5.38	6.13	6.00	3.75	5.75	5.75	6.88	6.88
Average	2.75	4.09	4.42	5.92	6.01	3.75	5.02	5.35	6.49	6.88

[1] Iron Age.

SHIPMENTS BY RAIL, WATER, AND TRUCK

TABLE 35.—*Beehive coke loaded for shipment on originating railroads, waterwary, and trucks in the United States in 1942, by routes, as reported by coke producers*

Route	State	Net tons		Percent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania	1,565,693	1,670,203	21.0
	West Virginia	104,510		
Chesapeake & Ohio	West Virginia	44,921	44,921	.6
Denver & Rio Grande Western	Colorado	92,987	116,090	1.5
	Utah	23,103		
Huntingdon & Broad Top Mountain	Pennsylvania	16,772	16,772	.2
Interstate	Virginia	309,339	309,339	3.9
Ligonier Valley	Pennsylvania	74,965	74,965	.9
Louisville & Nashville	Alabama	36,734	37,230	.5
	Kentucky	496		
Monongahela	Pennsylvania	1,906,497	1,906,497	24.0
Nashville, Chattanooga & St. Louis	Tennessee	18,579	18,579	.2
New York Central	West Virginia	183,335	183,335	2.3
Norfolk & Western	Virginia	41,734	41,734	.5
Pennsylvania	Pennsylvania	3,250,588	3,250,588	40.9
Pittsburgh & Lake Erie	do	86,731	86,731	1.1
Western Maryland	West Virginia	4,729	4,729	.1
Total railroad shipments		7,761,713	7,761,713	97.7
Waterways: Monongahela and Ohio Rivers	Pennsylvania	140,563	140,563	1.8
Trucks		[1] 37,596	37,596	.5
Grand total		7,939,872	7,939,872	100.0

[1] Coke delivered by trucks to consumers in all States that produced beehive coke.

DISTRIBUTION OF BYPRODUCT AND BEEHIVE COKE IN 1942

The unusually heavy demand for coke in 1942 by various war industries created widespread interest in coke production and distribution data. It is believed therefore that the statistics presented in the following tables showing geographic distribution of coke, by uses, will have interest and value to producers and consumers, and to war agencies responsible for the maintenance of adequate supplies of coke at war plants. The statistical data produced by the survey show (1) coke consumed in each State in 1942 by principal uses and (2) comparable tonnages of coke consumed in each State and region, by uses, from 1940 to 1942. The tonnages shipped to each destination represent

approximately the coke consumed therein, and for practical purposes the terms "distribution" and "consumption" are used here interchangeably.

The total consumption of coke in 1942, excluding imports, increased 8 percent from that in 1941 and reached 70,110,497 tons. This rise in consumption was due to the increased activities in the various industries producing essential war material. The tonnage of coke used in blast furnaces increased 5,058,458 tons, but the outstanding development in the distribution of coke in 1942 was the gain in the quantity used for the manufacture of water gas and for miscellaneous industrial purposes, which increased 23 and 27 percent. With the diversion of coke from the domestic trade to the iron and steel industry, the downward trend of domestic consumption that began in 1940 continued through 1942, when coke for domestic use dropped 734,831 tons. The quantity of coke used in foundries dropped 211,559 tons in 1942 compared with 1941, for reasons explained on page 978.

Furnace coke was used in 25 States in 1942. The great centers of consumption were naturally the iron- and steel-producing districts in Pennsylvania, Ohio, Indiana, Illinois, and Alabama, which took 81 percent of the total furnace coke used. Foundry coke was used in all States but 1; coke for the manufacture of water gas in 33 States; and unclassified industrial coke in all but 1 State. The largest tonnages of that classed as "other industrial" were consumed in Pennsylvania, New York, and Michigan. Coke used for domestic heating was distributed to all but 9 States. New York consumed almost one-fifth of the coke used for domestic purposes.

The distribution of coke by uses, by regions, increased in seven of the nine regions as classified (table 37). Outstanding was the increased consumption of 1,909,297 tons (26 percent) in the Southeast region because of an expanded iron and steel industry, chiefly in Alabama and West Virginia. The Middle Atlantic region increased its coke consumption by 7 percent, mainly because of the gain in tonnage of coke used for steelmaking in Pennsylvania. The only regions that showed decreased consumption in 1942 compared with 1941 were the Missouri Valley and the Lake Dock regions. Here decreases resulted from diminished consumption by foundries and for domestic heating.

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TABLE 36.—*Summary of byproduct and beehive coke and breeze consumed in each State in 1942, in net tons*

[Based upon reports from all United States producers showing destination of coke used by producer or sold in 1942. Does not include imported coke, which totaled 108,782 net tons in 1942]

Consuming State	Coke							Coke breeze
	Furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	Total	
Alabama	4,826,996	167,189		922	158,052	80,487	5,233,646	290,697
Arizona		5,925			455		6,380	16,188
Arkansas		759		(1)	(1)	(1)	1,659	1,944
California	24,326	62,677		(1)	(1)	(1)	125,646	255
Colorado	(1)	(1)			31,556		695,653	(1)
Connecticut		51,646	(1)	(1)	(1)	(1)	424,744	(1)
Delaware	38	(1)			(1)	(1)	(1)	2,470
District of Columbia				65,023	(1)	1,517	(1)	
Florida		2,410		36,201	5,113	3,923	47,647	(1)
Georgia	1,005	19,289		8,591	8,040	10,511	47,436	
Idaho		633			3,494		4,127	
Illinois	4,712,040	232,981	27,885	50,133	127,435	472,060	5,622,534	327,457
Indiana	5,562,396	113,748		34,069	134,376	206,659	6,051,248	432,895
Iowa		42,138		6,330	35,766	9,496	93,730	20,560
Kansas		10,127			(1)		(1)	1,640
Kentucky	400,108	21,153		51,901	18,616	43,359	535,137	8,975
Louisiana		3,811			25,528	5,496	34,835	
Maine		5,652		3,096		46,681	55,429	(1)
Maryland	2,220,653	25,746		13,871	49,741	13,067	2,323,078	127,220
Massachusetts	144,885	(1)	96,236	79,111	(1)	792,500	1,202,069	108,905
Michigan	1,397,755	278,501	26,993	5,367	317,981	795,712	2,822,309	186,038
Minnesota	(1)	27,981	(1)	(1)	44,655	304,232	682,717	54,152
Mississippi		(1)			2,346	(1)	4,042	
Missouri		51,410		888	65,954	147,821	266,073	749
Montana	(1)	3,120			(1)		42,943	8,576
Nebraska	(1)	(1)		13,932	6,287	894	23,933	206
Nevada		30			8,216		8,246	89
New Hampshire		5,169		1,330	138	50,006	56,643	
New Jersey	980	130,799	104,814	282,225	112,075	408,102	1,038,995	103,251
New Mexico		1,664			264		1,928	
New York	3,827,457	189,590	306,518	731,897	329,935	1,063,593	6,448,990	402,992
North Carolina		17,298		5,222	3,539	1,861	27,920	(1)
North Dakota		(1)		(1)	(1)	(1)	2,017	
Ohio	11,685,420	339,946	2,166	35,787	162,340	303,603	12,529,262	673,134
Oklahoma		4,064			345	771	5,180	29,886
Oregon		7,784			5,278	36	13,098	100
Pennsylvania	17,855,365	311,934	82,364	112,283	391,444	428,456	19,181,846	1,347,840
Rhode Island		19,112	(1)	(1)	(1)	(1)	191,618	(1)
South Carolina	25	5,265		(1)	(1)	(1)	31,765	5,225
South Dakota		212			431	1,657	2,300	
Tennessee	224,623	72,203		2,653	135,083	4,744	439,306	81,796
Texas	(1)	24,210		(1)	(1)	36	59,624	16,088
Utah	155,530	15,288			61,286	3,484	235,588	22,118
Vermont		8,729		1,873	3,045	16,688	30,335	
Virginia	(1)	48,043	40	358,880	82,354	(1)	573,512	(1)
Washington		8,260	169		4,186		12,615	
West Virginia	1,281,959	31,739		691,360	192,986	1,774	2,199,818	143,738
Wisconsin	(1)	120,400	(1)	35,868	(1)	345,540	575,867	108,465
Wyoming					2,174		2,174	25
Undistributed	1,068,572	87,333	175,298	88,022	148,548	361,250	94,835	121,042
United States, total	55,390,133	2,575,968	822,483	2,716,835	2,679,062	5,926,016	70,110,497	4,644,716
Exported	101,437	98,443	5,528	300	232,665	194,812	633,185	65,169
Grand total	55,491,570	2,674,411	828,011	2,717,135	2,911,727	6,120,828	70,743,682	4,709,885

[1] Included under "Undistributed."

TABLE 37.—*Comparative tonnages of byproduct and beehive coke consumed in each State and region, 1940–42, in net tons*

[Exclusive of imported coke and of screenings or breeze]

Consuming region and State	Furnace use			Foundry use			Other industrial and domestic use			Total coke		
	1940	1941	1942	1940	1941	1942	1940	1941	1942	1940	1941	1942
New England:												
Maine				(1)	(1)	5,652	[1] 54,610	[1] 61,588	49,777	54,610	61,588	55,429
New Hampshire				1,443	(1)	5,169	57,325	[1] 60,066	51,474	58,768	60,066	56,643
Vermont				5,433	8,141	8,729	35,878	26,719	21,606	41,311	34,860	30,335
Massachusetts	88,830	(2)	144,885	48,872	(2)	(1)	1,095,954	[2] 1,200,719	[1] 1,057,184	1,233,656	1,200,719	1,202,069
Connecticut				34,847	48,562	51,646	331,674	350,768	373,098	366,521	399,330	424,744
Rhode Island				(1)	15,613	19,112	[1] 189,393	178,403	172,506	189,393	194,016	191,618
	88,830	(2)	144,885	90,595	72,316	90,308	1,764,834	1,878,263	1,725,645	1,944,259	1,950,579	1,960,338
Middle Atlantic:												
New York	2,615,108	3,395,181	3,827,457	141,372	201,752	189,590	2,947,521	2,595,437	2,431,943	5,704,001	6,192,370	6,448,990
New Jersey	651	105	980	86,161	122,896	130,799	921,763	893,128	907,216	1,008,575	1,016,129	1,038,995
Pennsylvania	14,319,836	16,663,593	17,855,365	219,232	331,451	311,934	850,635	872,523	1,014,547	15,389,703	17,867,567	19,181,846
Delaware	764	284	38	2,758	4,227	(1)	3,524	8,987	(1) (3)	7,046	13,498	(3)
Maryland	1,849,917	1,920,995	2,220,653	23,891	36,550	25,746	85,487	85,284	76,679	1,959,295	2,042,829	2,323,078
District of Columbia				395	(1)		66,935	[1] 62,335	[3] 80,412	67,330	62,335	[3] 80,450
	18,786,276	21,980,158	23,904,493	473,809	696,876	658,069	4,875,865	4,517,694	4,510,797	24,135,950	27,194,728	29,073,359
Ohio	8,619,762	11,005,454	11,685,420	304,373	307,127	339,946	652,815	628,719	503,896	9,576,950	11,941,300	12,529,262
Michigan	1,076,370	1,058,522	1,397,755	333,791	415,126	278,501	1,389,182	1,034,768	1,146,053	2,799,343	2,508,416	2,822,309
Illinois-Indiana:												
Illinois	3,332,028	4,369,826	4,712,040	172,455	241,538	232,981	857,653	790,831	677,513	4,362,136	5,402,195	5,622,534
Indiana	4,305,518	5,231,850	5,562,396	106,063	145,936	113,748	518,413	434,610	375,104	4,929,994	5,812,396	6,051,248
	7,637,546	9,601,676	10,274,436	278,518	387,474	346,729	1,376,066	1,225,441	1,052,617	9,292,130	11,214,591	11,673,782
Missouri Valley:												
Missouri	19,144	121		34,426	51,836	51,410	313,661	209,270	214,663	367,231	261,227	266,073
Iowa				33,721	52,074	42,138	42,101	44,078	51,592	75,822	96,152	93,730
Nebraska	(4)	108	(3)	2,320	5,987	[5] 2,820	[4] 20,996	23,200	21,113	23,316	29,295	23,933
Kansas				7,510	10,690	10,127	2,837	3,467	(3)	10,347	14,157	(3)
	19,144	229	(3)	77,977	120,587	106,495	379,595	280,015	287,368	476,716	400,831	383,736
Lake Dock region:												
Wisconsin		30	(4)	99,327	139,350	120,400	553,703	491,548	[4] 455,467	653,030	630,928	575,867
Minnesota	225,569	282,693	(4)	15,684	24,764	27,981	373,685	333,202	[4] 654,736	614,938	640,659	682,717
North Dakota					(7)	(1)	1,758	1,596	[1] 2,017	1,758	(7)	2,017
South Dakota				(1)	(1) (7)	212	[1] 2,449	[1] 2,927	2,088	2,449	[7] 4,523	2,300
	225,569	282,723	(4)	115,011	164,114	148,593	931,595	829,273	1,114,308	1,272,175	1,276,110	1,262,901

See footnotes at the end of table.

TABLE 37.—*Comparative tonnages of byproduct and beehive coke consumed in each State and region, 1940–42, in net tons*—Continued

Consuming region and State	Furnace use			Foundry use			Other industrial and domestic use			Total coke		
	1940	1941	1942	1940	1941	1942	1940	1941	1942	1940	1941	1942
Southeast:												
Virginia	52,715	74,491	(4)	31,258	46,514	48,043	383,798	443,298	[4] 525,469	467,771	564,303	573,512
West Virginia	787,694	874,483	1,281,959	12,657	25,678	31,739	479,082	546,166	886,120	1,279,433	1,446,327	2,199,818
North Carolina		192		13,410	15,406	17,298	10,522	10,225	10,622	23,932	25,823	27,920
South Carolina		64	25	3,613	4,397	5,265	5,896	6,321	26,475	9,509	10,782	31,765
Georgia		1,220	1,005	13,765	19,147	19,289	26,435	26,644	27,142	40,200	47,011	47,436
Florida				1,017	1,641	2,410	35,251	35,166	45,237	36,268	36,807	47,647
Kentucky	[4] 276,223	281,364	400,108	20,341	21,897	21,153	(4)	59,549	113,876	296,564	362,810	535,137
Tennessee	54,312	140,162	224,623	59,724	76,177	72,203	63,113	76,124	142,480	177,149	292,463	439,306
Alabama	4,099,434	4,140,855	4,826,996	123,394	164,668	167,189	142,084	135,433	239,461	4,364,912	4,440,956	5,233,646
Mississippi				(1)	1,060	(1)	[1] 2,206	2,590	[1] 4,042	2,206	3,650	4,042
	5,270,378	5,512,831	6,734,716	279,179	376,585	384,589	1,148,387	1,341,516	2,020,924	6,697,944	7,230,932	9,140,229
Southwest, Mountain, and Pacific:												
Louisiana				2,883	3,785	3,811	29,030	29,702	31,024	31,913	33,487	34,835
Arkansas				1,444	(8)	759	605	(8)	900	2,049	(8)	1,659
Oklahoma				2,205	[8] 4,734	4,064	191	[8] 1,008	1,116	2,396	[8] 5,742	5,180
Texas	16,286	18,824	(4)	15,991	24,471	24,210	15,348	18,016	[4] 35,414	47,625	61,311	59,624
New Mexico				(1)	1,259	1,664	[1] 1,237	360	264	1,237	1,619	1,928
Arizona				4,053	6,500	5,925	295	387	455	4,348	6,887	6,380
Colorado	521,698	573,925	[5] 664,097	11,604	21,969	(8)	12,592	20,246	31,556	545,894	616,140	695,653
Utah	163,790	[4] 224,725	155,530	10,337	18,074	15,288	57,347	(4)	64,770	231,474	242,799	235,588
Nevada				28	56	30	29	6,857	8,216	57	6,913	8,246
Wyoming					(1)		2,472	[1] 7,949	2,174	2,472	7,949	2,174
Montana	19,494	23,988	[4] 39,823	2,060	2,515	3,120	3,239	5,200	(4)	24,793	31,703	42,943
Idaho				(1)	2,873	633	[1] 3,900	2,640	3,494	3,900	5,513	4,127
Washington				3,089	8,111	8,260	1,630	3,469	4,355	4,719	11,580	12,615
Oregon				2,821	4,871	7,784	1,788	5,056	5,314	4,609	9,927	13,098
California	(8)	20,375	24,326	[5] 47,720	72,657	62,677	19,960	24,368	38,643	67,680	117,400	125,646
	721,268	861,837	883,776	104,235	171,875	138,225	149,663	125,258	227,695	975,166	1,158,970	1,249,696

[1] Foundry and other industrial combined.
[2] Furnace, foundry, and other industrial combined.
[3] Delaware and District of Columbia combined.
[4] Furnace and other industrial combined.
[5] Furnace and foundry combined.
[6] Bureau of Mines not at liberty to publish.
[7] North and South Dakota combined.
[8] Arkansas and Oklahoma combined.

EXPORTS AND IMPORTS[6]

Exports of coke from the United States totaled 839,582 net tons valued at $6,349,801 in 1942—an increase of 130,611 tons over 1941. The principal export movement of coke in 1941 and 1942 was to Canada, which received 89 percent of all exported coke in 1941 and 96 percent in 1942. Aside from Canada, the export market for American coke is small, although South America received 54,585 tons in 1941 and 18,466 tons in 1942. The increase in exports of coke to South America in 1941 may be traced to World War II. Normally South America received most of its coke for metallurgical purposes from Germany and Great Britain. With those countries at war in 1941, South America turned to the United States for its supply. In 1942 the export movement of coke to South America decreased sharply, both because of increased requirements within the United States and because of shipping difficulties.

Imports of coke supply a very minor part of United States requirements and are a factor in the home market in restricted localities only. In 1941 267,886 tons of coke were imported. Of this amount, Great Britain supplied 178,209 tons (67 percent) and Canada, 89,677 tons (33 percent). In 1942, 108,782 tons were imported, and of this amount 97,386 tons came from Canada and 3,819 tons from Great Britain. In addition, Mexico sent the United States more coke than was exported to it, all of which came through the El Paso and Laredo customs districts. Imports from Canada have remained approximately the same during the past 3 years, although the 97,386 tons received in 1942 exceeded the 1941 figure by 7,709 tons.

TABLE 38.—*Coke exported from the United States, 1940–42, by customs districts*

Customs district	1940		1941		1942	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	304,390	$1,676,244	225,119	$1,461,672	280,085	$1,995,909
Chicago	11,128	41,752	24,714	194,536	6,395	18,558
Dakota	5,864	47,007	7,007	63,437	18,472	158,673
Duluth-Superior	11,427	71,225	3,414	34,588	9,296	86,835
Florida	5,851	53,166	3,504	40,201	4,487	56,119
Laredo	18,696	153,449	3,888	33,920	1,335	13,962
Maryland	9,006	76,866	16,085	167,751	2,926	27,134
Michigan	371,125	2,220,943	315,363	2,374,350	417,608	3,300,445
Mobile	9,825	186,565	5,329	82,021	7,135	66,957
New Orleans	8,112	78,341	4,805	52,390	3,937	59,880
New York	11,868	132,735	20,675	326,492	5,704	111,585
Ohio	17,982	116,369	42,951	160,182	70,819	331,769
Philadelphia	9,220	80,448	13,020	162,590		
St. Lawrence	488	4,279	4,368	45,252	3,506	30,977
San Diego	443	7,121	1,146	6,748	503	7,176
San Francisco	15	134	10	290	6	167
Virginia	7,411	68,376	10,070	122,714	6,767	75,164
Other districts	1,244	9,972	7,503	60,171	601	8,491
	804,095	5,024,992	708,971	5,389,305	839,582	6,349,801

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

TABLE 39.—*Coke exported from the United States, 1940–42, by countries*

Country	1940		1941		1942	
	Net tons	Value	Net tons	Value	Net tons	Value
North America:						
Canada	722,740	$4,182,630	630,271	$4,390,888	806,517	$5,925,858
Mexico	19,922	165,196	5,167	42,344	2,032	23,497
Panama	158	3,370	267	6,604	111	2,403
West Indies:						
Cuba	19,787	168,234	9,458	96,992	11,760	123,516
Trinidad and Tobago			102	1,183		
Other North America	453	5,944	882	16,833	475	9,298
South America:						
Argentina	1,557	13,575	23,164	325,888	5,048	79,087
Bolivia	264	4,542	399	7,401	200	3,349
Brazil	5,512	51,660	16,122	185,483	4,742	81,314
Chile	1,493	17,409	13,811	174,565	7,417	75,719
Peru	1,425	11,046	222	4,020	398	10,337
Other South America	632	12,210	867	16,470	661	10,474
Europe:						
Norway	2,567	28,087				
Sweden	10,291	77,458				
Switzerland	3,591	31,259				
United Kingdom	2,120	37,267				
Other Europe	28	503	166	2,744		
Asia:						
China	563	6,060				
Japan	8,019	172,860	3,471	60,262		
Philippine Islands	2,811	32,653	4,092	51,359		
Other Asia	123	2,242				
Oceania			10	290		
Africa	39	787	500	5,979	221	4,949
	804,095	5,024,992	708,971	5,389,305	839,582	6,349,801

TABLE 40.—*Coke imported for consumption in the United States, 1940–42, by countries and customs districts*

	1940		1941		1942	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
Canada	77,642	$1,114,683	89,677	$1,251,417	97,386	$1,221,448
Mexico					7,577	85,787
United Kingdom [1]	34,908	190,457	178,209	940,512	3,819	34,449
	112,550	1,305,140	267,886	2,191,929	108,782	1,341,684
CUSTOMS DISTRICT						
Buffalo	47,377	949,150	48,143	1,023,849	51,695	971,499
Connecticut			3,793	27,880		
El Paso					6,674	79,919
Laredo					617	4,660
Los Angeles	3,035	13,548	1,690	11 870		
Maine and New Hampshire	292	2,145	342	2,849	85	713
Maryland	3,390	27,241	107,169	579,442		
Massachusetts	14,091	74,196	60,062	289,517		
Michigan	10	74	9	76		
Montana and Idaho	26,885	141,598	37,339	201,793	38,877	218,241
New York	10,782	54,888	3,351	16,752	3,819	34,449
St. Lawrence	65	446				
San Francisco	3,611	20,619	2,143	15,051		
Vermont	291	2,247	360	2,977		
Washington State	2,721	18,988	3,485	19,873	7,015	32,203
	112,550	1,305,140	267,886	2,191,929	108,782	1,341,684

[1] United Kingdom of Great Britain and Northern Ireland.

WORLD PRODUCTION

The following table shows world production of coke by countries in 1929 and 1939–42 to the limit of available statistics. Because of Government restrictions on the publication of statistics for many of the leading coke-producing countries, few figures have been available since 1939. However, as the output of iron and steel has since increased in most countries, doubtless the production of coke has also increased correspondingly. Production in both Canada and the United States has increased steadily during the past 4 years, and the 1942 output in these countries exceeded all previous production records.

TABLE 41.—*Coke produced in principal countries of the world, 1929 and 1938–42, in metric tons* [1] [2]

[Compiled by B. B. Waldbauer]

Country [2]	1929	1938	1939	1940	1941	1942
Australia:						
New South Wales	471,813	1,153,670	1,370,814	(3)	(3)	(3)
Queensland	4,144	31,481	31,057	(3)	(3)	(3)
Belgium	6,192,960	4,894,980	5,176,650	(3)	(3)	(3)
Bulgaria		3,923	4,758	6,000	(3)	(3)
Canada	1,986,532	1,808,588	1,830,425	2,321,775	2,431,942	2,795,472
China (exports)	13,467	11,630	22,562	18,456	[4] 11,918	(3)
Czechoslovakia	3,170,629	[5] 2,367,000	(3)	(3)	(3)	(3)
France	9,080,127	7,785,000	(3)	(3)	(3)	(3)
Germany	39,421,033	43,511,082	(3)	(3)	(3)	(3)
Saar	2,423,000					
Great Britain [6]	13,637,421	13,031,396	(3)	(3)	(3)	(3)
Hungary	2,092	53,092	(3)	(3)	(3)	(3)
India, British [7]	843,504	1,738,178	1,947,455	(3)	(3)	(3)
Indochina	637	3,503	4,022	2,608	(3)	(3)
Italy	791,607	1,739,417	(3)	(3)	(3)	(3)
Mexico	493,777	(3)	(3)	(3)	(3)	(3)
Netherlands	2,402,566	3,158,065	[8] 2,207,501	(3)	(3)	(3)
New Caledonia		49,275	82,100	69,762	99,700	83,661
Peru	35,899		(3)	(3)	(3)	(3)
Poland	1,858,052	2,523,290	(3)	(3)	(3)	(3)
Rhodesia, Southern	100,001	47,986	32,785	(3)	(3)	(3)
Rumania		86,030	(3)	(3)	(3)	(3)
Spain	768,040	571,469	685,000	839,744	767,203	[9] 437,426
Sweden	103,778	112,107	115,150	(3)	(3)	(3)
Turkey		84,930	63,472	60,192	58,642	(3)
Union of South Africa	99,297	163,315	184,522	(3)	(3)	(3)
U. S. S. R.	4,700,000	20,700,000	16,670,000	16,500,000	(3)	(3)
United States	54,325,427	29,479,553	40,212,242	51,774,699	59,135,960	64,018,735
	142,926,000	135,110,000	(3)	(3)	(3)	(3)

[1] Gas-house coke is not included.
[2] In addition to countries listed, coke is produced in Chosen and Japan, but data of production are not available.
[3] Data not available.
[4] January to August, inclusive.
[5] Excluding Sudetenland since October.
[6] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was 13,049,139 tons in 1938.
[7] 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: 1938, 921,479 tons; 1939, data not available.
[8] Incomplete figure (from coke plants of only 2 mines).
[9] January to July, inclusive.
[10] Exclusive of Mexico.

GAS-HOUSE COKE

The production of gas-house coke in the United States in 1942 totaled 892,552 net tons. The Bureau of Mines obtained data on the manufacture of coke from coal-gas retorts by a survey of this industry conducted at the request of the Office of Solid Fuels Coordinator for War. The survey showed that most of the gas-house

coke was sold for domestic heating. Of the 533,882 tons sold, 449,220 tons was for domestic heating, 21,398 tons for water-gas manufacture, and 63,264 tons for miscellaneous industrial uses. The producers used 399,970 tons—206,864 tons for bench fuel, 123,851 tons for water-gas manufacture, 40,708 tons for boiler fuel, and 28,547 tons for the manufacture of producer gas. Table 42 gives salient statistics covering the operations of coal-gas retorts in the United States in 1942.

TABLE 42.—*Salient statistics of the coal-gas industry in 1942 (coke, breeze, and coal figures in net tons)*

	Horizontal retorts	Vertical retorts	Gas ovens	Total
Production:				
Coke	363,358	509,782	19,412	892,552
Breeze	38,191	90,782	3,002	131,975
Coal charged into retorts	602,623	886,659	32,330	1,521,612
Average yield of coal charged:[1]				
Coke—percent	60.30	57.49	60.04	58.66
Breeze—do	8.10	11.86	11.59	10.45
Number of active retorts	1,881	688	37	2,606
Annual coal capacity of retorts	714,037	1,105,202	68,529	1,887,768
Coke used by producer:				
For manufacture of water gas	35,226	87,627	998	123,851
For manufacture of producer gas		28,547		28,547
For bench fuel	97,944	102,970	5,950	206,864
For other purposes	28,863	7,117	4,728	40,708
Coke sold to other consumers:				
For manufacture of water gas	5,356	16,042		21,398
For domestic use	173,941	264,057	11,222	449,220
For other purposes	44,934	18,330		63,264
Stocks on hand January 1, 1943:				
Coke	45,550	81,829	3,916	131,295
Breeze	7,201	20,660	489	28,350
Byproducts:				
Production:				
Tar—gallons	7,366,756	13,440,106	284,967	21,091,829
Ammonia liquor (NH_3 content)—pounds	106,837	1,383,492		1,490,329
Crude light oil—gallons	23,793	68,207		92,000
Used by producer:				
Tar—gallons	41,665	72,292		113,957
Ammonia liquor (NH_3 content)—pounds				
Crude light oil—gallons	140			140
Sold to other consumers:				
Tar—gallons	6,556,546	13,113,393	317,777	19,987,716
Ammonia liquor (NH_3 content)—pounds	133,913	1,372,821		1,506,734
Crude light oil—gallons	19,109	62,531		81,640
Stocks on January 1, 1943:				
Tar—gallons	2,407,874	1,542,684	90,739	4,041,297
Ammonia liquor (NH_3 content)—pounds	7,669	119,758		127,427
Crude light oil—gallons	6,958	22,131		29,089
Yield of byproducts per ton of coal:[1]				
Tar—gallons	12.22	15.16	8.81	13.86
Ammonia liquor (NH_3 content)—pounds	1.72	3.45		3.22
Crude light oil—gallon	.27	.34		.32

[1] Calculated on coal charged at plants actually recovering

TABLE 43.—*Coke produced, number of retorts, coal charged, and average yield at coal-gas plants in 1942, by States*

State	Number of active plants	Number of active retorts	Coal capacity per 24-hour day (net tons)	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Coke sold (net tons)	Coke used (net tons)	Coke stocks on January 1, 1943 (net) tons)
Alabama and Kentucky	3	30	27	7,693	53.13	4,087	1,294	2,493	514
Colorado and North Dakota	4	46	70.6	22,790	59.78	13,625	8,332	5,363	3,460
Connecticut, Maine, Rhode Island, and Vermont	6	[1] 95	502.1	142,194	57.31	81,488	46,118	37,467	16,332
Georgia	3	48	45.96	12,733	50.16	6,387	4,278	3,077	330
Illinois, Indiana, and Iowa	5	69	143.4	33,560	58.69	19,697	18,068	6,358	749
Maryland, Virginia, and West Virginia	4	56	134.5	44,516	64.55	28,733	19,243	11,074	2,242
Massachusetts	10	382	1,214.72	427,336	55.26	236,151	119,301	108,075	56,323
Michigan	19	[2] 263	322.97	98,219	64.54	63,392	43,728	23,996	10,500
Minnesota	4	75	67.5	19,523	59.66	11,647	8,316	4,698	2,082
New Jersey, New York, and Ohio	6	268	634.45	129,334	65.25	84,387	52,161	24,941	18,750
North Carolina	10	306	358.1	98,790	58.89	58,175	32,133	31,163	5,646
Pennsylvania	5	144	278.65	91,404	64.91	59,335	1,492	57,397	583
South Carolina	3	126	144.4	39,047	58.22	22,735	11,407	12,470	1,855
Tennessee	3	270	240.12	73,416	60.50	44,419	26,996	19,346	1,358
Washington	3	156	101.88	32,970	59.42	19,592	11,580	12,411	461
Wisconsin	8	272	885.615	248,087	55.91	138,702	129,435	39,641	10,110
	96	2,606	5,171.965	1,521,612	58.66	892,552	533,882	399,970	131,295

[1] Includes 15 horizontal gas ovens. [2] Includes 22 horizontal gas ovens.

COKE-OVEN BYPRODUCTS

SUMMARY OF BYPRODUCTS

Rivaling the coke in importance and in volume of production but more versatile in the forms in which they are used are the byproducts. The volatile matter resulting from the carbonization process is processed to produce the four major byproducts—tar, ammonia, light oil, and gas—by preferential condensation and absorption operations. Initial cooling upon leaving the carbonizing chamber results in the condensation of the heavier higher-boiling-point constituents comprising the coal tar; further cooling with water or scrubbing with sulfuric acid effects recovery of the ammonia as an aqueous solution or in the form of ammonium sulfate; and still further cooling, followed by oil washing, strips out the light oils, consisting mainly of benzol, toluol, xylol, solvent naphtha, and naphthalene. After this point only the gas remains in the system as the final primary product. The further processing of some of the major byproducts involves many chemical industries. Here finished products consist of a host of chemical products, such as dyes, pharmaceuticals, plastics, explosives, and synthetic rubber goods, all of which are indispensable in peace and war.

The acceleration in the rate of coke-oven operation in 1942 increased substantially the production of the byproducts and thereby increased their total sales value. The total sales of all byproducts sold in 1942 (excluding the value of the tar used by the producers and the value of coke breeze produced) increased 11 percent from $158,809,184 in 1941 to $176,932,465 and amounted to 47 percent of the gross value of the coke produced. This was a slight decrease from the 1941 ratio and was caused by the price adjustments of coke and byproducts. The

yields of the primary coke byproducts per ton of coal carbonized declined in 1942 from that in 1941 because of more rapid coking rates (fig. 2).

Gas.—Coke-oven gas contributed approximately 50 percent of the total revenue derived from the sales of all byproducts. In addition to providing the fuel requirements of the byproduct ovens from which it is evolved, coke-oven gas supplied other fuel needs. In 1942, 585,455,085 M cubic feet (62 percent) of the 944,879,637 M cubic feet produced were used or sold for industrial purposes and for distribution through city mains. The total value of the gas so used rose from

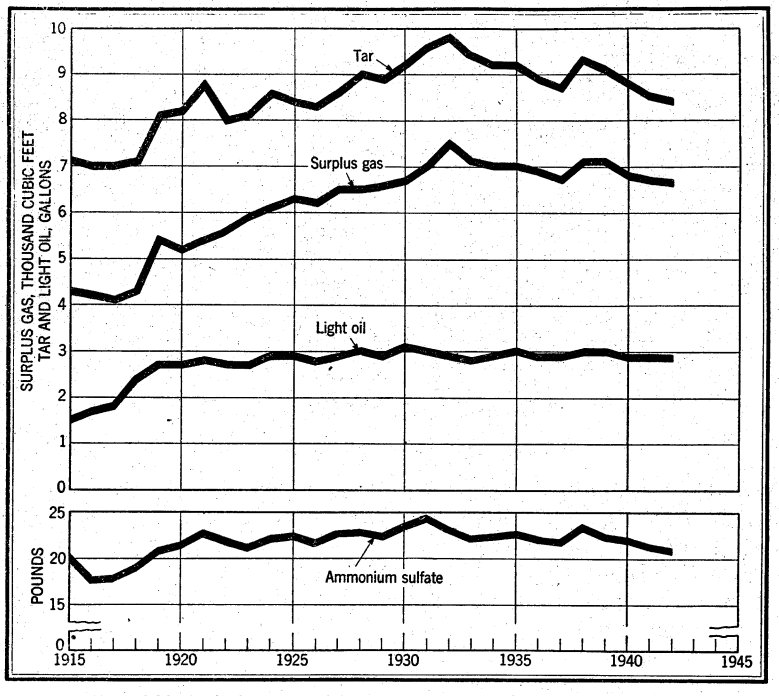

FIGURE 2.—Average yield of principal byproducts per net ton of coal carbonized in byproduct-coke ovens, 1915–42. Figures for light oil represent average at plants recovering light oil.

$85,040,609 to $88,823,807; however, the average sales value as reported by the operators dropped from $0.153 per M cubic feet in 1941 to $0.152 in 1942.

Tar.—The importance of tar as a commercial product has been emphasized during the past year more than ever before. During 1942 the market for tar and its derivatives increased sharply, since the tar derivatives are the basic raw materials from which many products essential to war industries and to public health are made. The diminishing consumption of tar as a fuel in metallurgical works is shown by the increased quantities available each year for refining. The quantity of tar refined by the producers and sold for refining increased 16 percent in 1942 and rose from 458,334,224 to 533,597,898 gallons. In addition, 104,101,925 gallons of crude tar were topped. "Topping" is designed primarily to strip the light oil and tar-acid oil

fractions from the crude tar, and in some plants even higher fractions by mild refining. Crude tar, used as fuel by producers and sold for use as fuel, decreased sharply and dropped from 154,065,404 in 1941 to 98,154,832 gallons in 1942. The sales of crude tar in 1942 amounted to 445,597,291 gallons, of which 443,007,596 gallons (99 percent) were sold for refining into tar products and 2,589,695 gallons for fuel. The average unit price of the crude coal tar sold in 1942 rose $0.007 and reached $0.054 per gallon.

Ammonia.—Byproduct-coke ovens are the most important source of fertilizer nitrogen in the United States. The relatively low conversion costs and the large demands for sulfate by the fertilizer industry account for the fact that most of the ammonia recovered from coke ovens is converted to ammonium sulfate. In 1942, 1,533,608,185 pounds of ammonium sulfate and 67,854,384 pounds of ammonia in the form of liquor were produced compared with the 1941 figure of 1,490,395,760 and 62,777,031 pounds. The average unit value of ammonium sulfate remained the same as for the previous year at $0.013 per pound and was governed by Maximum Price Regulation 205.

Light oil and its derivatives.—The primary product, light oil, and its components are extensively used in the chemical industries. The production of crude light oil in 1942 increased 6 percent over 1941 and totaled 246,024,882 gallons. The majority of the byproduct-coke plants have refining equipment adjacent to the ovens, and the light oil is processed on the premises. Of the total production, 241,854,110 gallons (98 percent) were refined by the producers, and only 14,915,409 gallons were sold as crude light oil.

The issuance of War Production Board General Preference Order M–137, effective July 1, 1942, prohibited the use of benzol in motor fuel and placed it under complete allocation. In previous years most of the benzol produced was motor benzol; however, the acute need for industrial pure or 2° benzol by the war industries that manufacture aviation gasoline, synthetic phenol, aniline, and other finished products resulted in issuance of this order. In 1942 the production of motor benzol decreased 40,267,397 gallons, but the production of crude and refined benzol, principally 1° and 2°, increased 46,066,495 gallons. The production of toluol, another major derivative of light oil, advanced from 29,337,178 to 32,314,560 gallons (10 percent), and practically all of it was used for explosives. Toluol had been under allocation since August 1941, following the issuance of the War Production Board General Preference Order M–34 on August 8, 1941.

Naphthalene.—Naphthalene is an important byproduct of coal carbonization. It is solid crystalline hydrocarbon and is obtained principally by cooling coal-tar oils, which boil between 170° and 230° C. Naphthalene is used in the manufacture of phthalic anhydride for smokeless powder, alkyd resins, dyestuffs, perfumes, medicinal insecticides, and moth preventatives. Naphthalene grades are defined in terms of melting points, 79° C. being the dividing line between pure and crude grades. In view of increasing requirements, the byproduct-coke-plant operators increased the output of this valuable byproduct, and production in 1942 rose to 95,612,788 pounds compared with the 1941 figure of 84,046,676 pounds—an increase of 14 percent. The sales of naphthalene increased in proper-

tion to the production, and the value totaled $1,941,626—an increase of $419,108 (28 percent). Naphthalene was placed under allocation on May 6, 1942, following issuance of the War Production Board General Preference Order M–105.

TABLE 44.—*Byproducts obtained from coke-oven operations in the United States in 1942* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales			On hand December 31
		Quantity	Value		
			Total	Average	
Tar—gallons	740,175,619	445,597,291	$24,155,601	$0.054	31,738,564
Ammonia:					
Sulfate—pounds	1,533,608,185	1,503,828,945	19,460,205	.013	87,352,849
Liquor (NH_3 content)—do	67,854,384	63,875,140	2,238,367	.035	2,031,142
			21,698,572		
Sulfate equivalent of all forms—do	1,805,025,721	1,759,329,505			95,477,417
NH_3 equivalent of all forms—do	451,256,430	439,832,376			23,869,354
Gas:					
Used under boilers, etc—M cubic feet	[2] 944,879,637	49,414,260	3,990,716	.081	
Used in steel or affiliated plants—do		335,290,705	34,935,356	.104	
Distributed through city mains—do		169,530,544	45,782,434	.270	
Sold for industrial use—do		31,219,576	4,115,301	.132	
	[2] 944,879,637	585,455,085	88,823,807	.152	
Light oil and derivatives:					
Crude light oil—gallons	[3] 246,024,882	14,915,409	1,247,073	.084	3,204,821
Benzol, crude and refined—do	85,256,998	80,778,763	10,487,450	.130	4,978,004
Motor benzol—do	64,797,595	62,854,535	5,389,540	.086	1,759,602
Toluol, crude and refined—do	32,314,560	32,182,327	8,536,446	.265	1,005,966
Xylol—do	9,332,273	8,868,817	2,219,991	.250	550,530
Solvent naphtha—do	5,215,617	5,067,935	726,247	.143	341,383
Other light oil products—do	9,238,117	7,509,421	686,533	.091	182,668
	[4] 206,155,160	212,177,207	29,293,280	.138	
Naphthalene, crude and refined—pounds	95,612,788	95,039,639	1,941,626	.020	2,648,546
Tar derivatives:					
Creosote oil, distillate as such—gallons	39,047,106	39,305,409	4,651,761	.118	2,440,749
Creosote oil in coal-tar solution—do	3,172,731	1,299,576	185,055	.142	34,826
Tar acid oil—do	17,921,998	11,340,244	1,555,882	.137	661,794
Phenol, crude and refined—do	1,019,808	1,017,762	768,926	.756	4,366
Pitch of tar—net tons	638,158	8,584	114,504	13.339	39,737
Other tar derivatives			2,211,509		
Light carbolic oil—gallons	1,858,928	1,816,207	229,225	.126	159,210
Pyridine, crude and refined—do	529,564	485,552	634,358	1.306	64,418
Sodium phenolate—do	11,115,407	4,258,481	249,465	.059	126,912
Other byproducts [5]			418,894		
Value of all byproducts sold			[6] 176,932,465		

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name.
[2] Includes gas wasted and gas used for heating ovens.
[3] Refined on premises to make the derived products shown: 241,854,110 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, cyanogen, dicycloentadiene, phenol from sources other than tar distillation, picoline, sal ammoniac, sodium prussiate, spent soda ash solution, sulfur, vented vapors, and residue.
[6] Exclusive of value of breeze production, which was $10,897,121 in 1942.

TABLE 45.—*Coal equivalent of byproducts of byproduct coking in the United States, 1913, 1914, 1918, and 1941–42*

Year	Quantity of byproducts				Rough equivalent in heating value (billion B. t. u.)					Coal equivalent	
	(1) Coke breeze (thousand net tons)	(2) Surplus gas (billion cubic feet)	(3) Tar produced (thousand gallons)	(4) Light oil produced (thousand gallons)	(5) Coke breeze (1 x 20)	(6) Surplus gas (2 x 550)	(7) Tar (3 x 0.150)	(8) Light oil (4 x 0.130)	(9) Total (5+6+7+8)	(10) Net tons (9÷0.0262)	(11) 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
1941	4,433	554	704,149	231,359	88,660	304,700	105,622	30,077	529,059	20,193,000	21.7
1942	4,600	585	740,176	246,025	92,000	321,800	111,026	31,983	556,809	21,252,000	21.1

COKE-OVEN GAS

TABLE 46.—*Coke-oven gas produced and sold in the United States in 1942, 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	8	84,788,995	38,316,744	43,813,596	$3,707,353	$0.085	2,658,655
Colorado	1	12,325,052	6,202,494	5,964,084	(1)	(1)	158,474
Illinois	9	50,672,125	15,506,573	34,380,676	4,508,067	.131	784,876
Indiana	5	108,155,676	44,475,612	62,746,234	11,598,599	.185	933,830
Maryland	1	26,315,747	9,783,301	16,064,326	(1)	(1)	468,120
Massachusetts	2	18,390,302	3,993,939	14,339,572	(1)	(1)	56,791
Michigan	7	48,190,216	6,812,537	41,212,476	5,071,299	.123	165,203
Minnesota	3	13,784,317	5,811,707	7,821,718	1,745,263	.223	150,892
New Jersey	2	16,354,789	3,353,573	13,001,216	(1)	(1)	----------
New York	8	78,491,881	21,184,788	56,891,882	16,699,455	.294	415,211
Ohio	15	143,321,823	60,881,437	77,508,715	8,654,467	.112	4,931,671
Pennsylvania	14	262,615,454	106,219,892	154,305,494	17,165,770	.111	2,090,068
Tennessee	1	3,098,650	1,366,071	1,538,879	(1)	(1)	193,700
Utah	1	5,265,925	2,328,957	2,636,753	(1)	(1)	300,215
West Virginia	5	39,186,622	10,843,875	28,101,587	2,355,758	.084	241,160
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	33,922,063	7,331,307	25,127,877	6,295,474	.251	1,462,879
Undistributed	-------	----------	----------	----------	11,022,302	.206	----------
Grand total, 1942	88	944,879,637	344,412,807	585,455,085	88,823,807	.152	15,011,745
At merchant plants	42	224,425,460	54,402,790	163,322,088	40,664,004	.249	6,700,582
At furnace plants	46	720,454,177	290,010,017	422,132,997	48,159,803	.114	8,311,163
Grand total, 1941	87	892,819,811	328,137,246	554,126,449	85,040,609	.153	10,556,116

[1] Included under "Undistributed."

TABLE 47.—*Disposal of surplus coke-oven gas in the United States in 1942, 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	8,504,879	$402,082	$0.047	26,248,173	$2,375,732	$0.091	6,602,717	$701,092	$0.106	2,457,827	$228,447	$0.093
Colorado				5,964,084	(1)	(1)						
Illinois	2,631,427	209,466	.080	5,855,471	903,274	.154	23,015,131	3,108,250	.135	2,878,647	287,077	.100
Indiana	3,175,229	257,373	.081	49,890,021	6,758,456	.135	7,643,947	3,869,807	.506	2,037,037	712,963	.350
Maryland				8,987,904	(1)	(1)	7,076,422	(1)	(1)			
Massachusetts	3,035	(1)	(1)	668	(1)	(1)	14,200,092	(1)	(1)	135,777	(1)	(1)
Michigan	6,947,587	831,649	.120	27,889,308	3,290,314	.118	1,958,108	319,532	.163	4,417,473	629,804	.143
Minnesota	1,583,910	133,128	.084	1,852,165	229,115	.124	4,385,643	1,383,020	.315			
New Jersey				284	(1)	(1)	13,000,932	(1)	(1)			
New York	2,300,016	190,664	.083	11,292,120	1,094,357	.097	40,627,275	14,973,578	.369	2,672,471	440,856	.165
Ohio	4,436,292	411,814	.093	60,296,114	6,101,842	.101	8,165,926	1,620,360	.198	4,610,383	520,451	.113
Pennsylvania	6,146,797	571,696	.093	120,714,286	11,071,951	.092	19,874,343	4,796,304	.241	7,570,068	725,819	.096
Tennessee	449,650	(1)	(1)				1,089,229	(1)	(1)			
Utah	1,696,354	(1)	(1)	77,377	(1)	(1)	664,665	(1)	(1)	198,357	(1)	(1)
West Virginia	9,791,784	672,418	.069	16,222,730	1,412,455	.087				2,087,073	270,885	.130
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,747,300	150,432	.086				21,226,114	5,905,148	.278	2,154,463	239,894	.111
Undistributed		159,994	.074		1,697,860	.113		9,105,343	.253		59,105	.177
Grand total, 1942	49,414,260	3,990,716	.081	335,290,705	34,935,356	.104	169,530,544	45,782,434	.270	31,219,576	4,115,301	.132
At merchant plants	21,892,848	1,610,895	.074	2,110,736	294,162	.139	120,185,225	35,854,767	.298	19,133,279	2,904,180	.152
At furnace plants	27,521,412	2,379,821	.086	333,179,969	34,641,194	.104	49,345,319	9,927,667	.201	12,086,297	1,211,121	.100
Grand total, 1941	31,404,684	2,365,659	.075	330,452,000	34,448,880	.104	159,746,453	44,108,797	.276	32,523,312	4,117,273	.127

[1] Included under "Undistributed."

TABLE 48.—*Coke-oven tar produced and sold in the United States in 1942, by States*

State	Produced [1] (gallons)		Sold					Used by producer [2] (gallons)			On hand December 31 (gallons)
	Total	Per ton of coal coked	For use as fuel [3] (gallons)	For refining into tar products (gallons)	Total			As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
					Gallons	Value					
						Total	Average				
Alabama	65,869,866	8.47		44,596,096	44,596,096	$2,627,238	$0.059	265,797	21,507,495	305,805	2,465,530
Colorado	10,716,805	10.50		214,054	214,054	[4]	[4]				296,159
Illinois	38,819,743	7.43		29,713,290	29,713,290	1,601,264	.054		91,423	110	1,790,771
Indiana	61,509,465	6.06	140,535	43,785,114	43,925,649	1,978,541	.045		2,157,984	1,023,620	2,977,666
Maryland	22,675,636	7.81		20,056,159	20,056,159	[4]	[4]		600		2,810,338
Massachusetts	12,884,547	7.72		13,154,237	13,154,237	[4]	[4]				196,096
Michigan	34,640,046	7.95		34,583,816	34,583,816	1,778,968	.051	446	1,000		1,282,653
Minnesota	8,461,949	6.66		8,511,731	8,511,731	505,762	.059			47,718	419,359
New Jersey	11,712,216	8.14		12,092,576	12,092,576	[4]	[4]				262,100
New York	64,441,849	8.88	357,861	51,513,097	51,870,958	2,910,293	.056		911,482	2,436	3,483,743
Ohio	105,975,336	7.72	50	90,134,094	90,134,144	5,053,420	.056	617,853	11,109,424	66,571	4,311,939
Pennsylvania	234,531,227	9.82	2,091,147	27,461,900	29,553,047	1,572,815	.053	293,849	58,235,280	220,753	9,239,924
Tennessee	2,369,894	7.18		2,343,964	2,343,964	[4]	[4]				49,792
Utah	4,512,437	11.14	102	4,527,076	4,527,178	[4]	[4]			3,205	160,008
West Virginia	36,780,326	10.50		36,319,703	36,319,703	2,049,387	.056		322,502		1,040,446
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	24,274,277	7.98		24,000,689	24,000,689	1,274,036	.053			655	952,040
Undistributed						2,803,877	.054				
Grand total, 1942	740,175,619	8.41	2,589,695	443,007,596	445,597,291	24,155,601	.054	1,177,945	94,387,192	1,670,873	31,738,564
At merchant plants	179,956,343	8.59	309,807	169,741,341	170,051,148	9,066,585	.053			102,195	5,919,443
At furnace plants	560,219,276	8.36	2,279,888	273,266,255	275,546,143	15,089,016	.055	1,177,945	94,387,192	1,568,678	25,819,121
Grand total, 1941	704,149,468	8.52	14,749,274	377,790,519	392,539,793	18,386,170	.047	3,225,550	136,090,580	1,401,067	[5] 26,854,903

[1] Includes 90,590,302 gallons of tar "refined at plant" and 104,101,925 gallons of tar "topped."
[2] Excludes 90,590,302 gallons of tar "refined at plant" and 104,101,925 gallons of tar "topped" that the Bureau of Mines is not at liberty to publish by States.
[3] Comprises 395,450 gallons of tar sold to affiliated corporations and 2,194,245 gallons sold to other purchasers.
[4] Included under "Undistributed."
[5] Revised figure.

AMMONIA

TABLE 49.—*Coke-oven ammonia produced and sold in the United States in 1942, by States*

State	Active plants	Sulfate equivalent of all forms (pounds)		Produced as—		Sold as—				On hand December 31 (pounds)	
		Total	Per ton of coal coked	Sulfate (pounds)	Liquor (NH_3 content) (pounds)	Sulfate		Liquor (NH_3 content)		Sulfate	Liquor (NH_3 content)
						Pounds	Value	Pounds	Value		
Alabama	8	186,939,287	24.03	159,143,535	6,948,938	154,513,244	$2,104,800	7,056,766	$275,914	5,572,258	66,559
Colorado	1	23,665,332	23.18	23,665,332		22,127,312	(1)			3,640,000	
Illinois	7	95,466,198	19.10	74,304,414	5,290,446	74,440,267	909,601	5,313,732	(1)	3,373,380	81,011
Indiana	5	173,475,476	17.10	151,570,132	5,476,336	161,438,918	2,011,857	5,506,296	(1)	1,936,466	163,003
Maryland	1	50,430,800	17.36	50,430,800		50,658,600	(1)			1,472,200	
Massachusetts	2	30,859,968	18.49	27,056,000	950,992	26,652,000	(1)	949,192	(1)	690,000	18,042
Michigan	7	92,549,331	21.23	32,999,499	14,887,458	35,347,980	(1)	12,500,139	308,921	23,575	553,715
Minnesota	3	22,620,012	17.80	22,620,012		22,610,595	267,607			2,049,032	
New Jersey	2	29,342,234	20.39	29,342,234		28,787,070	(1)			949,828	
New York	8	148,989,829	20.53	118,106,005	7,720,956	115,797,020	1,604,010	7,706,391	299,490	7,352,881	132,997
Ohio	15	280,434,134	20.42	223,582,802	14,212,833	221,520,645	2,740,824	12,832,768	496,502	5,918,285	376,887
Pennsylvania	13	533,724,262	22.43	526,823,974	1,725,072	496,390,399	6,323,851	1,641,405	65,216	51,714,615	46,799
Tennessee	1	6,412,272	19.44	6,412,272		6,500,680	(1)			86,239	
Utah	1	11,069,740	27.32	11,069,740		10,735,675	(1)			1,435,764	
West Virginia	3	55,081,872	22.54	55,081,872		54,799,530	697,969			500,556	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	63,964,974	21.04	21,399,562	10,641,353	21,509,010	295,109	10,368,451	371,928	637,770	592,129
Undistributed							2,504,577		420,396		
Grand total, 1942	82	1,805,025,721	20.85	1,533,608,185	67,854,384	1,503,828,945	19,460,205	63,875,140	2,238,367	87,352,849	2,031,142
At merchant plants	36	416,541,607	21.33	232,473,491	46,017,029	231,671,335	3,202,382	41,996,167	1,557,778	8,886,183	1,757,298
At furnace plants	46	1,388,484,114	20.71	1,301,134,694	21,837,355	1,272,157,610	16,257,823	21,878,973	680,589	78,466,666	273,844
Grand total, 1941	81	1,741,503,884	21.34	1,490,395,760	62,777,031	1,513,137,970	19,708,646	60,341,804	2,000,973	62,182,393	1,513,180

[1] Included under "Undistributed."

LIGHT OIL AND ITS DERIVATIVES

TABLE 50.—*Coke-oven crude light oil produced in the United States and derived products obtained and sold in 1942, by States*

State	Active plants	Produced (gallons)		Refined on premises (gallons)	Derived products obtained and sold			On hand December 31 (gallons)
		Total	Per ton of coal coked		Produced (gallons)	Sold [1]		
						Gallons	Value	
Alabama	8	22,378,246	2.88	20,111,009	17,442,896	17,210,861	$2,297,722	541,511
Colorado	1	3,063,002	3.00	3,058,450	2,844,646	2,779,893	(2)	129,455
Illinois	5	11,573,875	2.45	11,027,210	8,714,473	9,049,234	1,417,256	187,726
Indiana	4	23,064,655	2.44	24,782,790	21,748,646	21,157,966	2,979,188	613,420
Maryland	1	10,431,365	3.59	10,409,584	8,682,447	8,371,240	(2)	586,511
Michigan	4	12,237,878	2.94	6,854,856	6,195,667	4,854,559	705,136	146,338
New York	8	19,977,208	2.75	32,867,937	28,774,959	27,758,825	4,131,794	1,496,288
Ohio	15	40,018,828	2.91	34,852,189	28,152,365	27,445,479	3,763,315	1,257,271
Pennsylvania	13	75,258,010	3.16	74,253,947	63,674,869	60,821,821	8,472,368	2,819,419
Tennessee	1	694,228	2.10	697,044	525,721	488,904	(2)	62,604
Utah	1	1,690,520	4.17	1,691,657	1,189,670	1,162,632	(2)	73,842
West Virginia	4	9,908,249	3.21	10,229,128	8,661,015	6,878,734	1,144,537	320,502
Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin	9	15,728,818	2.34	11,018,309	9,547,786	9,281,650	1,482,688	583,266
Undistributed							1,652,203	
Grand total, 1942	74	246,024,882	2.88	241,854,110	206,155,160	197,261,798	28,046,207	8,818,153
At merchant plants	29	48,625,969	2.61	49,414,608	42,599,376	39,810,457	6,090,734	2,247,516
At furnace plants	45	197,398,913	2.96	192,439,502	163,555,784	157,451,341	21,955,473	6,570,637
Grand total, 1941	70	231,358,897	2.90	225,294,298	194,713,669	193,011,869	22,824,574	5,135,095

[1] Excludes 14,915,409 gallons, valued at $1,247,073, of crude light oil sold as such.
[2] Included under "Undistributed."

NAPHTHALENE

TABLE 51.—*Crude and refined naphthalene sold by byproduct-coke operators in the United States, 1938–42*

Year	Pounds	Value		Receipts per ton of coke (cents)
		Total	Average receipts per pound (cents)	
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
1941	83,879,396	1,522,518	1.8	2.6
1942	95,039,639	1,941,626	2.0	3.1

BYPRODUCT-COKE OVENS OWNED BY CITY GAS COMPANIES (PUBLIC UTILITY PLANTS)

The adaptability of byproduct 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 coal- or water-gas sets. Although more emphasis is placed upon the production of gas of proper analysis than upon the grade of coke obtained, viewed from supply and demand for coke and byproducts, these installations belong to the byproduct-coke industry and are therefore included in the current statistics compiled by the Bureau of Mines and released to the public

in weekly and monthly reports. The difference in classification is maintained in the interest of those who may want to obtain information on the operations of city gas works proper. Table 52 shows separate figures for the group of byproduct-coke plants operated by city gas companies (Public Utilities) and for all other byproduct-coke plants. In 1942, there were 16 active plants in the group owned by city gas companies and they produced 3,693,407 tons of coke, 59,480,526 M cubic feet of gas, 48,548,754 gallons of tar, and 7,973,417 gallons of light oil. This was an increase of 9 percent for coke, 6 percent for gas, 6 percent for tar, and 28 percent for light oil. This table also shows the operations of the plants not owned by city gas companies, which in 1942 produced 58,601,502 tons of coke, 885,399,111 M cubic feet of gas, 691,626,865 gallons of tar, and 238,051,465 gallons of crude light oil.

TABLE 52.—*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, 1941–42*

Product	1941			1942		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)[1]	Total[1]	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)[1]	Total
Number of active plants	71	16	87	72	16	88
Coke:						
Production—net tons	55,079,048	3,403,374	58,482,422	58,601,502	3,693,407	62,294,909
Value	$291,628,638	$24,848,593	$316,477,231	$348,619,972	$29,391,995	$378,011,967
Average	$5.29	$7.30	$5.41	$5.95	$7.96	$6.07
Screenings or breeze:						
Production—net tons	4,146,242	286,622	4,432,864	4,329,511	270,519	4,600,030
Sales—do	804,324	31,835	836,159	912,652	19,470	932,122
Value	$1,930,149	$84,411	$2,014,560	$2,495,558	$60,427	$2,555,985
Average	$2.40	$2.65	$2.41	$2.73	$3.10	$2.74
Coal charged into ovens:						
Quantity—net tons	77,763,252	4,845,585	82,608,837	82,749,694	5,224,127	87,973,821
Coke:						
Used by producer:						
Quantity—net tons	40,416,930	1,113,468	41,530,398	43,135,628	1,219,014	44,354,642
Value	$196,417,684	$7,051,283	$203,468,967	$238,573,063	$8,201,546	$246,774,609
Sales:						
Quantity—net tons	14,747,208	2,403,881	17,151,089	15,522,951	2,582,992	18,105,943
Value	$96,481,516	$18,619,617	$115,101,133	$110,614,001	$22,117,108	$132,731,109
Byproducts:						
Gas:						
Production—M cu. ft	836,747,586	56,072,225	892,819,811	885,399,111	59,480,526	944,879,637
Sales of surplus:						
Used under boilers:						
Quantity—M cu. ft	31,368,112	36,572	31,404,684	49,403,214	11,046	49,414,260
Value	$2,357,378	$8,281	$2,365,659	$3,987,367	$3,349	$3,990,716
Used in steel or affiliated plants:						
Quantity—M cu. ft	330,443,993	8,007	330,452,000	335,290,705	----------	335,290,705
Value	$34,446,478	$2,402	$34,448,880	$34,935,356	----------	$34,935,356
Distributed through city mains:						
Quantity—M cu. ft	110,054,651	49,691,802	159,746,453	117,181,422	52,349,122	169,530,544
Value	$26,565,768	$17,543,029	$44,108,797	$27,301,899	$18,480,535	$45,782,434
Sold for industrial use:						
Quantity—M cu. ft	29,820,721	2,702,591	32,523,312	27,660,835	3,558,741	31,219,576
Value	$3,293,920	$823,353	$4,117,273	$2,994,472	$1,120,829	$4,115,301
Tar:						
Production—gallons	658,263,692	45,885,776	704,149,468	691,626,865	48,548,754	740,175,619
Sales:						
Quantity—do	345,358,272	47,181,521	392,539,793	397,409,041	48,188,250	445,597,291
Value	$16,185,453	$2,200,717	$18,386,170	$21,595,088	$2,560,513	$24,155,601
Average	$0.047	$0.047	$0.047	$0.054	$0.053	$0.054

[1] Includes all byproduct ovens built by city gas companies, some of which are operated in conjunction with coal, oil, and water-gas plants. Does not include independent byproduct plants, which may sell gas to public utility companies for distribution.

TABLE 52.—*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, 1941–42*—Continued

Product	1941			1942		
	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)	Total
Ammonia:						
Production (NH_3 equivalent of all forms) pounds	410,834,145	24,541,826	435,375,971	426,031,332	25,225,098	451,256,430
Liquor (NH_3 content):						
Production pounds	59,596,924	3,180,107	62,777,031	64,198,324	3,656,060	67,854,384
Sales do	57,167,866	3,173,938	60,341,804	60,280,429	3,594,711	63,875,140
Value	$1,930,241	$70,732	$2,000,973	$2,134,065	$104,302	$2,238,367
Sulfate:						
Production pounds	1,404,948,883	85,446,877	1,490,395,760	1,447,332,033	86,276,152	1,533,608,185
Sales do	1,425,243,940	87,894,030	1,513,137,970	1,415,334,330	88,494,615	1,503,828,945
Value	$18,499,497	$1,209,149	$19,708,646	$18,247,787	$1,212,418	$19,460,205
Crude light oil:						
Production gallons	225,150,258	6,208,639	231,358,897	238,051,465	7,973,417	246,024,882
Sales do	8,750,082	2,402,264	11,152,346	12,085,223	2,830,186	14,915,409
Value	$650,603	$193,624	$844,227	$1,016,992	$230,081	$1,247,073
Light oil derivatives:						
Production gallons	189,652,682	5,060,987	194,713,669	199,097,945	7,057,215	206,155,160
Sales do	187,898,957	5,112,912	193,011,869	190,028,510	7,233,288	197,261,798
Value	$22,063,964	$760,610	$22,824,574	$26,929,688	$1,116,519	$28,046,207
Naphthalene, crude and refined:						
Production pounds	83,291,568	755,108	84,046,676	94,452,435	1,160,353	95,612,788
Sales do	83,140,313	739,083	83,879,396	93,704,188	1,335,451	95,039,639
Value	$1,511,176	$11,342	$1,522,518	$1,913,215	$28,411	$1,941,626
All other byproducts, value	$8,413,250	$68,217	$8,481,467	$10,944,458	$75,121	$11,019,579

FUEL BRIQUETS AND PACKAGED FUEL [1]

By G. S. Goodman and G. E. Carlson

SUMMARY OUTLINE

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SUMMARY

Notwithstanding difficulties resulting from the war in securing raw fuel, labor, and miscellaneous supplies and the increase in manufacturing cost, production in the briquet industry reached an all-time high of 1,748,300 net tons in 1942—a 35-percent increase over 1941, the former record year; the output of packaged fuel (considered separately in this report) amounted to 253,048 net tons—a decrease of 6 percent compared with 1941. The combined output totaled 2,001,348 tons, valued at $13,806,128.

Statistics on fuel briquets have been collected since 1907, when 11 plants produced a total of 66,524 net tons. Data on packaged fuel have been collected since 1935, and for the 5 years following the industry made a remarkable record of growth, attaining the peak production of 284,513 tons in 1940—more than 11 times that produced in 1935. In 1941 and 1942 production declined.

As during World War I, the scarcity of competing fuels created a very large demand in 1942 for briquets for domestic use; the trend toward utilization of fireplaces as an added source of heat has brought briquets and packaged fuel into greater service.[2] Despite the heavy demand for these fuels, the industries, especially the packaged-fuel industry, have suffered from inability to obtain the raw materials of manufacture, labor, and necessary repair parts, as well as from the increased cost of these items, which forced many plants to discontinue operation for the war, some permanently. No sales of bri-

[1] Directories of fuel-briquetting and packaged-fuel plants operating in 1942 will be furnished, on request, by the Coal Economics Division, Bureau of Mines, Washington, D. C. Names of manufacturers of equipment will not be issued for 1942, as companies formerly listed therein did not manufacture fuel-briquetting machinery in 1942 owing to pressure of war work.

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

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; 1939 is the latest year for which such data have been collected.

Briquets made from charcoal, wood wastes, and fruit pits are not included in the Bureau of Mines review.

[2] Black Diamond, Chicago and Central Western Market: Vol. 109, No. 11, 1942, p. 46.
Saward's Journal, Boston Market: Vol. 25, No. 36, 1942, p. 430.

quetting or packaged-fuel equipment were reported for 1942 by the manufacturers of such machinery because of priorities, but a number indicated the diversion of their business to war work.

In an effort to meet urgent fuel needs, various briquetting projects have been advanced in foreign countries. Inquiries from Argentina concerning the possibilities of briquetting surpluses of corn and corn husks have resulted in the construction of a plant for the manufacture of corn briquets for domestic and industrial fuel uses, and American machinery has recently been installed at the Brazeau Collieries, Ltd., in Canada, for producing binderless briquets from coal fines.[3]

Technologic developments.—The briquetting and packaged-fuel industries continued their research in 1942, although a number of projects were laid aside in favor of work of a military nature.

A technologic and economic study of the packaged-fuel industry, which began in the fall of 1941 by V. F. Parry of the Fuels and Explosives Service, Bureau of Mines, Golden, Colo., has been completed and it is expected that the results will be published during 1943.[4] A study has been completed by V. F. Parry and J. B. Goodman [5] of the Bureau of Mines laboratory in Golden, Colo., dealing with the technical phases of the briquetting industry.

Construction of the commercial-scale briquetting press designed by R. J. Piersol [6] at the Illinois State Geological Survey was completed in 1941, but owing to delays in obtaining the necessary equipment because of war priorities the date for final demonstrations on briquetting various Illinois coals scheduled for 1942 has been postponed further.

Komarek-Greaves & Co.[7] of Chicago, Ill., is reported to have developed a roll press for manufacturing fairly strong briquets from low-volatile coals without a binder, using pressures of 30,000 to 40,000 pounds per square inch. Three of these presses are operating in Canada.

FUEL BRIQUETS

Salient statistics of the fuel-briquetting industry from 1938 to 1942 are summarized in the following table. Detailed data for earlier years, beginning with 1907, are to be found in annual issues of Mineral Resources (part II) and Minerals Yearbook, which include chapters on briquetting. Production and value from 1915 to 1942, inclusive, are presented graphically in figure 1.

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[3] Mining Congress Journal, Experiences in Briquetting Coking Coal: Vol. 28, No. 4, 1942, pp. 45–47.

[4] Parry, V. F., Technical and Economic Study of Packaged Fuel: Bureau of Mines Rept. of Investigations (in preparation).

[5] Parry, V. F., and Goodman, J. B., Briquetting of Subbituminous Coal: Bureau of Mines Rept. of Investigations 3707.

[6] 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; Study Illinois Coals: Coal Heat, vol. 40, No. 3, 1941, p. 16.

[7] Mining and Metallurgy, vol. 24, No. 434, 1943, p. 80.

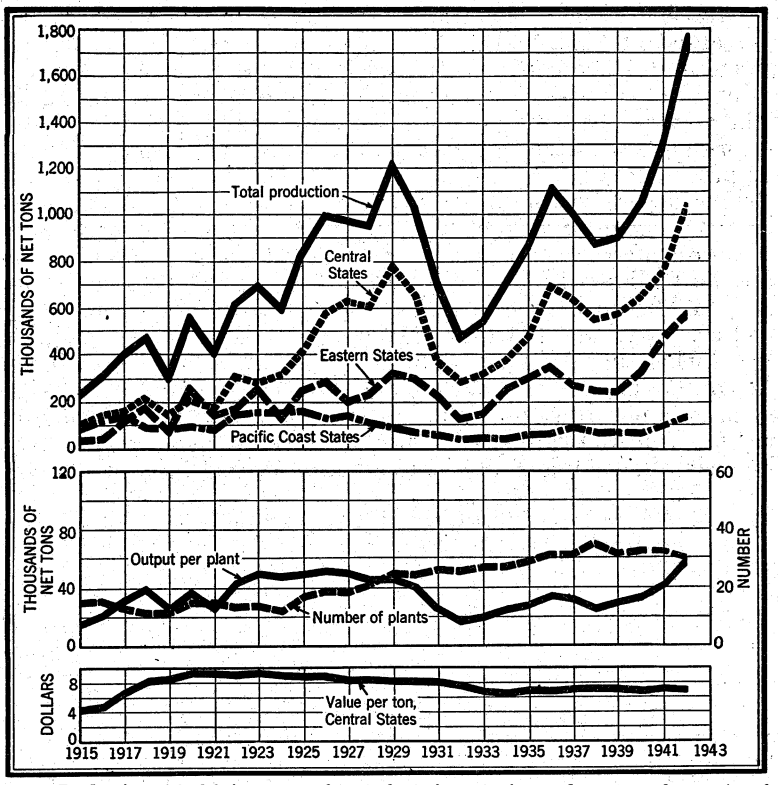

FIGURE 1.—Production of fuel briquets, number of plants in operation, and average value per ton, f. o. b plant (Central States), 1915–42.

Salient statistics of the fuel-briquetting industry in the United States, 1938–42

[Data regarding packaged fuel are given separately at end of this chapter]

Year	Production				Imports	Exports[1]	Consumption[2]	Value of production (thousands of dollars)	Plants in operation	Average output per plant (thousands of net tons)	Average value per net ton, f. o. b. plant		
	Eastern States	Central States	Pacific Coast States	Total							Eastern States	Central States	Pacific Coast States
	Thousands of net tons												
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
1941	458	752	89	1,299	(3)	40	1,259	8,002	32	41	4.21	7.09	8.36
1942	565	1,048	135	1,748	(3)	104	1,644	11,266	30	58	4.56	7.04	9.69

[1] Exports reported separately by Department of Commerce beginning with 1937.
[2] Production plus imports minus exports.
[3] Less than 1,000 tons.

Production.—The output of fuel briquets in 1942—1,748,300 net tons valued at $11,266,041—represents an increase of 35 percent in tonnage and 41 percent in value over 1941, the previous record production year. This increase in production in 1942 is readily explained by the general increase in demand for fuels of all kinds in time of war.[8] The present full rated capacity of the industry is nearly double the 1942 production.

Briquets were produced in 14 States, and all but 3 showed increases over 1941. Almost half of the output came from Wisconsin, where production increased 40 percent over 1941; West Virginia, Pennsylvania, and Missouri followed in order, with large increases in production. In Missouri three plants, two of which were new in 1942, produced a total of 104,415 tons valued at $589,466. Output for the 12 States (other than Wisconsin and Missouri) that produced briquets in 1942 cannot be shown separately without revealing individual data. The large quantities of bituminous slack available at Lake ports, resulting from rehandling of coal at the docks, have helped to make Wisconsin the leading State in production of fuel briquets.

Production of fuel briquets in the United States, 1941–42

	1941			1942				
	Plants	Net tons	Value	Plants	Net tons	Value	Percent of increase over 1941 in—	
							Tonnage	Value
Eastern States	4	457,511	$1,926,048	3	565,675	$2,580,934	23.6	34.0
Central States	23	751,801	5,329,408	23	1,047,747	7,378,165	39.4	38.4
Pacific Coast States	5	89,294	746,373	4	134,878	1,306,942	51.0	75.1
	[1] 32	1,298,606	8,001,829	[1] 30	1,748,300	11,266,041	34.6	40.8

[1] 1941: 10 plants in Wisconsin; 2 each in California, Illinois, Michigan, Nebraska, Washington, and West Virginia; and 1 each in Arkansas, Massachusetts, Minnesota, Missouri, North Dakota, Ohio, Oregon, Pennsylvania, Texas, and Wyoming; 1942: 10 plants in Wisconsin; 3 in Missouri; 2 each in California, Illinois, Michigan, Nebraska, and West Virginia; and 1 each in Arkansas, Minnesota, North Dakota, Oregon, Pennsylvania, Washington, and Wyoming.

Production of fuel briquets in Wisconsin, 1937–42

Year	Plants	Net tons	Value	Year	Plants	Net tons	Value
1937	10	507,462	$3,639,183	1940	11	487,574	$3,440,676
1938	10	422,281	3,085,873	1941	10	535,457	3,870,077
1939	10	430,554	3,158,859	1942	10	750,417	5,498,748

Other large plants are located at coal mines, chiefly in West Virginia and Pennsylvania, and smaller operations at gas plants and petroleum refineries, principally in the Pacific Coast States.

Nearly 51,000 net tons of bulk briquets were packaged at producing plants by 13 operators. No data are available on the quantity of briquets packaged by retailers.

As briquets are used mostly for domestic space heating, production normally is highly seasonal. However, in 1942 wartime demands resulted in more uniform production than in previous years. Twenty-

[8] Black Diamond, Twin Cities and Northwest: Vol. 109, No. 9, 1942, p. 48; Kansas City News Notes: Vol. 109, No. 12, 1942, p. 57.

three of the 30 active plants were operated every month of the year, and only 2 less than 6 months—1 of these was a new company that began operations in October.

In 1942, production was lowest in March, but in May it stepped up markedly. According to the Weather Bureau,[9] below-normal temperatures prevailed during May in the North Central States, where the bulk of briquet consumption is concentrated. The unusual jump in production for October, when above-normal warmth prevailed, can be explained no doubt by the anticipated heavy seasonal demands because of a threatened scarcity of competing fuels.

Monthly production of fuel briquets in the United States, 1940–42, in net tons

Month	1940	1941	1942	Month	1940	1941	1942
January	157,091	135,532	170,991	August	58,706	109,487	112,434
February	76,550	118,596	122,083	September	84,466	107,257	139,699
March	68,981	85,728	93,668	October	92,295	120,197	204,665
April	43,936	27,252	102,514	November	128,301	143,339	177,938
May	66,449	82,723	145,792	December	140,133	137,166	197,982
June	57,814	105,307	146,389				
July	76,148	126,022	134,145		1,050,870	1,298,606	1,748,300

Value.—Sales realizations on briquets vary considerably in the widely separated producing centers in a given year, therefore an average value per ton for the entire industry has little significance because conditions under which briquets are manufactured and sold differ throughout the country. The most important factors that influence the value per ton realized at any plant are the cost of raw materials, labor, and price of competing fuels; hence, the trend of fuel-briquet prices in the past 5 years is indicated best in this review by considering the average values in the Eastern, Central, and Pacific Coast States separately, as shown in the last three columns of the salient statistics table. These figures are the values received by producers for the total product (exclusive of delivery charges) and not the prices paid by consumers. Some plants are far 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 1942 was $11,266,041 f. o. b. plant, an increase of $3,264,212 (41 percent) over 1941. This large increase is due to a great extent to the 35-percent increase in production.

In the eastern part of the United States the average value ($4.56 per ton) was relatively low because all the output came from plants in the low-volatile bituminous fields of West Virginia and in the anthracite region of Pennsylvania, where freight charges are a small proportion of the cost of raw fuel. In the Central States, where the average value was $7.04 per ton, the major part of the production comes from the docks at Lakes Michigan and Superior, and the cost of raw fuel at these plants involves a considerable freight charge. In the Pacific Coast States, where residual carbon from the manufacture of oil gas constitutes the greater part of the raw fuel used, the average value increased from $8.36 in 1941 to $9.69 in 1942.

[9] Baldwin, J. L., The Weather of 1942 in the United States: U. S. Dept. of Commerce Monthly Weather Rev., vol. 70, No. 12, December 1942, pp. 271–273.

Prices.—The following monthly fuel-briquet prices, by cities, for 1941–42 are based upon cash delivery in 1-ton (2,000-pound) lots for retail sales to household consumers at the curb or into the customer's bin (without extra handling or additional charge).

Retail fuel-briquet prices per net ton, 1941–42, by cities and months[1]

City	January		February		March		April		May		June	
	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942
Baltimore, Md	$9.75	$11.00	$9.75	$11.00	$9.75	$11.00	$9.75	$11.00	$9.75	$11.00	$9.82	$11.02
Boston, Mass	12.50	13.75	12.50	13.75	12.50	13.75	12.50	13.75	12.50	13.75	12.22	13.77
Charleston, S. C	13.33	14.08	13.33	14.08	13.33	14.08	13.33	14.08	13.33	14.08	13.33	14.08
Chicago, Ill.[2]	11.65	12.21	11.65	12.21	11.65	12.21	11.65	12.04	11.71	12.26	11.71	12.26
Cincinnati, Ohio[3]	8.56	9.40	8.56	9.27	8.56	9.21	8.63	8.99	8.50	9.22	8.50	9.28
Columbus, Ohio[3]	8.39	9.63	8.39	9.63	8.39	9.63	8.39	9.39	8.39	9.39	8.39	9.42
Fall River, Mass	12.50	13.75	12.50	13.75	12.50	13.75	12.50	13.75	12.50	13.75	12.50	13.80
Kansas City, Mo.[2]	9.69	10.05	9.69	10.05	9.69	10.05	9.69	10.05	9.69	10.05	9.56	10.05
Los Angeles, Calif.[3]	17.00	20.15	17.00	20.15	17.20	19.76	17.10	19.76	16.89	19.76	16.89	20.73
Louisville, Ky	8.00	8.70	8.00	8.70	8.00	8.70	8.00	8.75	8.00	8.75	8.15	8.77
Manchester, N. H	12.75	14.00	12.75	14.00	12.75	14.00	12.75	14.00	12.75	14.00	13.00	14.00
Milwaukee, Wis	10.90	11.77	10.90	11.77	10.90	11.77	10.90	11.74	10.89	11.74	10.80	11.75
Minneapolis, Minn	12.80	13.05	12.80	13.05	12.80	13.05	12.80	12.74	12.44	12.94	12.40	13.01
Norfolk, Va	10.50	11.50	10.50	11.50	10.50	11.50	10.50	11.50	10.50	11.50	10.50	11.50
Providence, R. I	11.97	12.13	11.88	12.13	11.88	12.13	11.88	12.13	11.88	12.13	12.13	12.13
Richmond, Va	10.50	11.42	10.50	11.42	10.50	11.42	10.50	11.42	10.00	11.42	10.00	11.42
St. Louis, Mo.[2]	9.95	10.80	9.95	10.80	9.95	10.80	9.95	10.59	9.95	10.62	10.03	10.76
St. Paul, Minn	12.80	13.05	12.80	13.05	12.80	13.05	12.80	12.74	12.47	12.96	12.42	13.02
San Francisco, Calif.[3]	20.60	21.63	20.60	21.63	20.60	21.63	20.60	21.63	20.60	21.63	20.60	21.63
Seattle, Wash.[3]	13.90	14.36	13.90	14.42	13.90	14.42	13.39	14.42	13.52	(4)	13.65	(4)
Washington, D. C.[5]	11.05	11.62	11.05	11.50	11.05	11.50	11.05	11.53	11.05	11.56	11.05	11.56

City	July		August		September		October		November		December	
	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942	1941	1942
Baltimore, Md	$10.50	$11.02	$11.00	$11.02	$11.00	$11.02	$11.00	$11.02	$11.00	$11.02	$11.00	$11.02
Boston, Mass	13.25	13.77	13.25	13.77	13.75	13.77	13.75	13.77	13.75	13.77	13.75	13.77
Charleston, S. C	13.33	14.08	14.08	14.08	14.08	14.08	14.08	14.08	14.08	14.08	14.08	14.08
Chicago, Ill.[2]	11.89	12.26	11.96	12.26	11.96	12.26	12.21	12.26	12.21	12.26	12.21	12.26
Cincinnati, Ohio[3]	8.88	9.28	9.27	9.35	9.27	9.35	9.27	9.35	9.27	9.35	9.27	9.35
Columbus, Ohio[3]	8.76	9.53	8.93	9.53	9.34	9.54	9.63	9.54	9.63	9.54	9.63	9.54
Fall River, Mass	13.00	13.80	13.15	13.80	13.75	13.80	13.75	13.80	13.75	13.80	13.75	13.80
Kansas City, Mo.[2]	10.05	10.05	10.05	10.07	10.05	10.09	10.05	(4)	10.05	(4)	10.05	[6]10.69
Los Angeles, Calif.[3]	18.00	20.73	18.09	20.73	18.67	20.73	19.12	20.73	19.57	20.73	19.43	20.73
Louisville, Ky	8.25	8.77	8.45	8.77	8.70	8.76	8.70	8.76	8.70	8.76	8.70	8.76
Manchester, N. H	13.00	14.00	13.50	14.00	13.50	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Milwaukee, Wis	10.86	11.75	11.27	11.75	11.27	11.75	11.77	11.77	11.77	11.77	11.77	11.77
Minneapolis, Minn	12.70	13.10	12.92	13.10	13.05	13.10	13.05	13.10	13.05	13.10	13.05	13.10
Norfolk, Va	10.50	11.50	11.00	11.50	11.00	11.50	11.50	11.50	11.50	11.50	11.50	11.50
Providence, R. I	12.13	12.13	12.13	12.13	12.13	(4)	12.13	(4)	12.13	(4)	12.13	(4)
Richmond, Va	10.50	11.42	10.50	11.42	11.17	11.33	11.17	11.33	11.17	11.33	11.42	11.33
St. Louis, Mo.[2]	10.12	10.76	10.39	(4)	10.47	10.91	10.62	10.91	10.80	10.87	10.80	10.87
St. Paul, Minn	12.70	13.10	12.95	13.10	13.05	13.10	13.05	13.10	13.05	13.10	13.05	13.10
San Francisco, Calif.[3]	20.60	21.63	20.60	21.63	20.60	(4)	20.60	(4)	21.63	(4)	21.63	(4)
Seattle, Wash.[3]	13.78	(4)	13.90	(4)	13.90	(4)	14.29	(4)	14.29	(4)	14.29	(4)
Washington, D. C.[5]	11.25	11.56	11.38	11.56	11.38	11.56	11.50	11.56	11.50	11.56	11.50	11.56

[1] Compiled from reports of Retail Price Division, Bureau of Labor Statistics; 1942 figures preliminary.
[2] Includes 2-percent sales tax.
[3] Includes 3-percent sales tax.
[4] Data not available.
[5] Price per ton of 2,240 pounds.
[6] Not comparable with preceding months.

Number of plants.—Records show 30 plants in commercial operation in 1942; all but 2 of these (the new briquetting plant of the Smokeless Coal Blox Co.[10] and that of the St. Louis Briquette Co., Inc., both at St. Louis) were also active in 1941. One plant active in 1941 failed to report operations for 1942. Nine plants were idle in 1942; of these, 6 were also idle in 1941, and 3 went out of business. Of the 2 reported as under construction in 1941 to begin operations in 1942, 1—

[10] Black Diamond, St. Louis News Notes: Vol. 107, No. 11, 1941, p. 43.

the Smokeless Coal Blox Co., at St. Louis—went into commercial production in 1942. In 1942 the Binkley Coal Co. purchased the Standard Briquet Fuel Co. plant at Kansas City, which it had been operating as lessee since 1935.

Size of plants.—The following table classifies the plants operating in 1941 and 1942 according to actual production as well as rated capacity. Rated capacity, of course, is the better indicator of the relative size of plants.

The total annual rated capacity of the 30 plants active in 1942, as shown on operators' reports, was over 3 million net tons. It should be noted that, notwithstanding the great increase in production over 1941, these 30 plants could nearly double their 1942 output should demand warrant.

The average output of individual plants increased from 41,000 tons in 1941 to 58,000 in 1942 (41 percent). Twenty-three plants operated every month and produced 1,709,997 tons or about 98 percent of the total.

Classification of briquetting plants in the United States, 1941–42, by size of output and annual capacity

Output (net tons)	Plants		Annual capacity (net tons)	Plants	
	1941	1942		1941	1942
Less than 2,000	6	2	Less than 5,000	2	1
2,000 and less than 5,000	2	3	5,000 and less than 10,000	4	2
5,000 and less than 10,000	3	5	10,000 and less than 25,000	6	7
10,000 and less than 25,000	9	5	25,000 and less than 100,000	11	9
25,000 and less than 100,000	6	9	100,000 and less than 200,000	5	7
100,000 and over	6	6	200,000 and less than 400,000	2	2
			400,000 and over	2	2
	32	30		32	30

Raw fuels.—The number of plants, classified according to type of fuel used in 1942, was as follows:

Classification of fuel-briquetting plants in the United States in 1942, by kinds of raw fuel used

Kind of raw fuel used:	*Plants*
Anthracite and semianthracite fines exclusively	6
Mixture of Pennsylvania anthracite and bituminous	4
Bituminous:	
Low-volatile	14
High-volatile	2
Semicoke (lignite char)	1
Residual carbon from pyrolysis of natural gas	1
Residual carbon from manufacture of oil gas	2
Petroleum coke	6
	[1] 36

[1] 4 plants made 2 kinds and 2 plants 3 kinds of briquets; hence, the sum of the items exceeds the total number of plants.

It is noteworthy that in 1942 the production of fuel briquets from petroleum coke, which in recent years had been used in increased amounts, dropped far below the 1941 figure. Large quantities of petroleum coke are now used for manufacturing ashless carbon electrodes essential in producing aluminum and other metals by electrometallurgical processes.

A small tonnage of raw Texas lignite was made into briquets in 1940

and 1941, but no briquets were produced from such raw material in 1942, owing to the labor shortage and the general effect of the war on small industries. In 1942 six operations reported making more than one kind of briquet—four plants made two kinds and two plants made three kinds. Six operators reported washing a total of 349,100 tons of raw fuel before using it in the manufacture of briquets.

Raw fuels used in making fuel briquets in the United States, 1941–42

Raw fuel	Net tons		Percent of tota	
	1941	1942	1941	1942
Anthracite and semianthracite culm and fine sizes	265,637	386,947	21.6	23.4
Bituminous and subbituminous slack	[1] 787,722	1,077,474	64.1	65.3
Residual carbons from oil-gas manufacture and natural-gas pyrolysis; petroleum coke; and semicoke (lignite char)	175,043	187,207	14.3	11.3
	1,228,402	1,651,628	100.0	100.0

[1] Includes small tonnage of Texas lignite used without charring.

Production of fuel briquets, 1941–42, grouped according to location of plants with reference to supply of raw fuel

Location of plant	Net tons		Percent of change in 1942
	1941	1942	
At or near Lake Superior or Lake Michigan coal docks	560,506	782,436	+39.6
At coal mines	579,844	789,535	+36.2
At or near petroleum refineries and oil- and natural-gas plants	142,378	163,294	+14.7
At other locations [1]	15,878	13,035	−17.9
	1,298,606	1,748,300	+34.6

[1] Jackson, Mich., and Omaha, Nebr.

Binders.—The following table classifies the fuel-briquet plants by type and percentage of binder used. As indicated in the table, asphaltic pitch continues to be the preferred binder in briquetting coal and coke. Approximately 102,000 tons of asphaltic pitch and smaller amounts of other binders were used in 1942 in the manufacture of fuel briquets.

In 1942, as in 1941, three plants used no binder; two of these briquetted the carbon residue from the manufacture of oil gas, and one used low-volatile bituminous coal.

Classification of briquetting plants in the United States in 1942, by type and percentage of binder used

Type of binder	Plants	Production		Ratio of binder to raw fuel (by weight)	Plants	Production	
		Net tons	Percent of total			Net tons	Percent of total
Asphaltic pitch	22	1,390,481	79.5	Less than 5 percent	4	197,236	11.3
Mixed pitches	1	239,092	13.7	5 and less than 7 percent	12	548,834	31.4
Asphalt and starch	2			7 and less than 9 percent	9	883,503	50.5
Starch	2			9 percent and over	2		
No binder	[1] 3	118,727	6.8	No binder	[1] 3	118,727	6.8
	30	1,748,300	100.0		30	1,748,300	100.0

[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 continue to be the most popular in the United States. Of the 30 active plants in 1942, 24 produced 1,250,360 tons (72 percent) of this type briquet, 4 plants 19,034 tons (about 1 percent) of cube-shaped briquets, and 3 plants 478,906 tons (27 percent) of the cylindrical type. One of these made both pillow- and cube-shaped briquets; hence, the sum of the plants described above exceeds by 1 the total number of active plants. Records show two plants making briquets in 1942 in more than one shape and three plants making two sizes.

Prevailing weight of briquets produced in the United States in 1942

Weight (ounces)	Plants	Production		Weight (ounces)	Plants	Production	
		Net tons	Percent of total			Net tons	Percent of total
Less than 2	3	45,757	2.6	6 and under 10			
2 and under 3	11	926,975	53.0	10 and under 16	1	76,431	4.4
3 and under 4	7	536,565	30.7	16 and under 25	4		
4 and under 5	5	162,572	9.3				
5 and under 6					[1] 31	1,748,300	100.0

[1] 1 plant made a 2-ounce pillow briquet and a 24-ounce cube; hence, the sum of these items exceeds the total number of plants.

Distribution.—According to reports received, shipments of briquets during 1942 increased 27 percent over 1941; they were shipped into 37 States and the District of Columbia and exported to other countries.[11]

It is not possible to show shipments from each producing State because there are only one or two producers in each of the States except Missouri and Wisconsin, and confidential reports of individual companies would thus be revealed. However, for a graphic presentation of the centers of production for 1928 and 1936, with corresponding States of destination, see Minerals Yearbook, 1937 (p. 965, fig. 65).

Generally, rail shipments represent consumption at distant points, and shipments by truck show local and nearby consumption.

Shipments of fuel briquets of domestic manufacture, 1941–42, by States of destination, as reported by producers, in net tons

State	1941	1942	State	1941	1942
Alaska	2,213		New Hampshire	3,210	2,551
Arkansas	256	376	New Jersey	871	1,139
California	14,075	17,798	New York	25,141	26,097
Connecticut	844	1,544	North Carolina	13,203	12,894
Delaware	208	516	North Dakota	80,136	96,912
District of Columbia	248	520	Ohio	67,822	54,699
Florida	591	503	Oklahoma	43	61
Georgia	238	178	Oregon	32,414	77,204
Illinois	50,398	65,709	Pennsylvania	14,166	21,999
Indiana	45,934	48,868	Rhode Island	3,843	4,070
Iowa	31,608	47,392	South Carolina	4,798	4,890
Kansas	4,957	10,731	South Dakota	64,026	73,744
Kentucky	5,734	4,954	Texas	178	
Louisiana	48		Vermont	238	195
Maine	4,828	6,254	Virginia	18,187	17,370
Maryland	2,969	3,765	Washington	42,977	21,505
Massachusetts	38,756	38,978	West Virginia	339	322
Michigan	107,217	107,576	Wisconsin	220,939	317,627
Minnesota	244,767	303,497	Wyoming	1,576	409
Missouri	82,954	172,269			
Montana	22	73		1,256,964	1,600,300
Nebraska	23,992	35,111			

[11] See also followin table of exports.

Direct shipments of fuel briquets by rail and truck, 1941–42, as reported by producers, in net tons [1]

Produced in—	1941			1942		
	Rail	Truck [2]	Total	Rail	Truck [2]	Total
Eastern States	447,458	8,428	455,886	550,220	16,244	566,464
Central States	569,295	181,849	751,144	829,858	212,584	1,042,442
Pacific Coast States	38,377	54,184	92,561	27,746	88,434	116,180
Total United States	1,055,130	244,461	1,299,591	1,407,824	317,262	1,725,086

[1] Includes shipments outside the United States.
[2] Includes local deliveries.

Imports and exports.—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, and mainly for consumption in the anthracite-consuming States), which in 1926 reached a peak of 123,593 net tons. Imports continued at a comparatively high level through 1932, when they totaled 80,288 tons. Thereafter they dropped sharply and since September 1939—the beginning of the war—have virtually ceased. In 1941, 162 tons were imported from Canada; and in 1942, 325 tons came from Canada and 9 tons from the United Kingdom.

Figures for imports of briquets since 1919 (the first year of record) are included in annual volumes of Mineral Resources and Minerals Yearbook.[12]

Briquets (coal and coke) and other composition coals for fuels imported for consumption in the United States, 1938–42

Year	Net tons	Value	Year	Net tons	Value
1938	13,814	$67,366	1941	162	$791
1939	1,344	5,752	1942	334	1,739
1940					

Wartime fuel demands are reflected in briquet-export data. Canadian shipments in 1942 amounted to 103,329 net tons, more than three times the 1941 tonnage. Canada received 77 percent of the total exports in 1941 and 99.5 percent in 1942.

Briquets (coal and coke) exported from the United States, 1941–42, by countries and customs districts

	1941		1942	
	Net tons	Value	Net tons	Value
Country				
Brazil	57	$552	249	$2,616
Canada	31,153	225,148	103,329	764,573
Chile	39	475	279	3,068
Colombia	29	441		
Dominican Republic	2	29		
Mexico	9,144	61,084	12	169
Nicaragua	1	12		
Venezuela	13	117	10	130
West Indies (French)	39	735		
	40,477	288,593	103,879	770,556
Customs district				
Alaska	82	767		
Arizona	35	522		
Buffalo	15,186	95,877	22,417	132,205
Dakota	155	$1,525	4,975	$43,094
Duluth and Superior	165	1,172	1,709	13,484
El Paso	87	525	7	52
Laredo	9,019	60,012		
Maine and New Hampshire	37	308	44	228
Michigan	1,148	8,612	36,432	300,597
New Orleans	15	129		
New York	166	2,232	289	3,198
Ohio			1,428	9,648
Philadelphia			249	2,616
St. Lawrence	14,097	114,556	36,262	264,877
San Diego	2	25	6	117
Vermont			22	90
Washington	283	2,331	39	350
	40,477	288,593	103,879	770,556

[12] 1919–29, Mineral Resources, 1929, part II, p. 32; 1930–35, Minerals Yearbook, 1936, p. 657.

World production.—Official data on production of fuel briquets in other countries since 1939 have been meager, owing to the war.

World production of fuel briquets, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Algeria	68,682	(2)	(2)	(2)	(2)	(2)
Australia: Victoria [3]	396,760	420,704	421,254	(2)	(2)	(2)
Belgium	1,849,280	1,712,280	1,561,210	(2)	(2)	(2)
Bulgaria	47,106	85,770	88,496	100,000	(2)	(2)
Czechoslovakia:						
Coal	459,680	(2)	(2)	(2)	(2)	(2)
Lignite	264,482	(2)	(2)	(2)	(2)	(2)
Eire (Irish Free State)	10,725	20,501	(2)	5,337	15,446	(2)
France	8,321,000	7,475,000	(2)	(2)	(2)	(2)
Germany:						
Coal	6,785,537	6,897,245	(2)	(2)	(2)	(2)
Lignite	41,951,141	44,007,268	(2)	(2)	(2)	(2)
Hungary	373,519	441,081	(2)	(2)	(2)	(2)
Indochina	132,225	131,558	185,400	114,000	(2)	(2)
Italy	58,860	51,047	(2)	(2)	(2)	(2)
Netherlands:						
Coal	1,277,305	1,262,716	1,268,926	(2)	(2)	(2)
Lignite	49,539	60,543	68,607	(2)	(2)	(2)
Netherlands Indies	55,349	82,123	85,079	99,315	(2)	(2)
New Zealand	31,582	29,947	29,889	28,529	20,220	(2)
Poland	209,347	222,531	(2)	(2)	(2)	(2)
Portugal	7,772	19,865	(2)	(2)	(2)	(2)
Rumania	262,330	232,662	(2)	(2)	(2)	(2)
Spain	342,000	568,000	765,000	785,000	[4] 178,000	(2)
Tunisia	82,805	86,478	(2)	(2)	(2)	(2)
Turkey	14,761	37,285	14,792	24,497	28,392	(2)
United Kingdom	826,600	507,415	(2)	(2)	(2)	(2)
United States [5]	1,035,970	936,402	1,004,902	1,211,433	1,422,866	1,815,583
Yugoslavia	61,323	100,945	132,466	(2)	(2)	(2)
Total [6]	64,975,680	65,389,366	(2)	(2)	(2)	(2)

[1] In addition to countries listed, briquets are produced in Canada and New Caledonia, but data on output are not available.
[2] Data not available.
[3] Data for year ended March 31 of year stated.
[4] January to June, inclusive.
[5] Includes packaged fuel as follows—1937: 132,482 tons; 1938: 146,012 tons; 1939: 195,504 tons; 1940: 258,105 tons; 1941: 244,797 tons; 1942: 229,560 tons.
[6] Totals incomplete; they represent sum of figures given in table only.

PACKAGED FUEL

Packaged fuel differs from fuel briquets in that the former is made up of more or less friable rectangular blocks wrapped together to form neat, tightly fitted packages, which withstand weathering fairly well, eliminate much of the breakage, and provide a relatively clean fuel to handle. They are designed primarily for local or nearby consumption. The packages, wrapped in heavy paper and sealed with gummed tape, usually consist of 3- to 4-inch cubes (six or eight to a package, the package weighing 10 to 15 pounds). Packaged fuel is made from various types of coal or coke screenings, usually mixed with a neutral binder. Its growth in popularity has been due largely to its convenience and cleanliness in handling and to the fact that it may be purchased in less-than-ton lots.

Production of packaged fuel declined in 1942. The phenomenal growth of this industry from 1935 through 1940 is illustrated strikingly in figure 2. In 1941, however, production dropped 5 percent from 1940; and in 1942, it dropped 6 percent from 1941. World War II and competition within the industry are the major factors for the decline since 1940.

The effect of the war on this industry has been felt mostly through increased cost of raw fuels, manufacturing materials, and labor as

well as the inability to obtain the same. According to operators' reports, the cost of production in 1942 increased to such an extent that it has made the price of packaged fuel prohibitive and has forced a large number of plants to discontinue operations for the war, some permanently.

Machinery manufacturers reported no sales for fuel-briquetting or packaged-fuel installations in 1942, principally because of priorities on the necessary materials; a number of them have followed the war trend and diverted their businesses to war work—one manufactured special machinery for briquetting iron ore and flue dust [13] and another a press to be used in research work on the briquetting of sponge iron.

Processes.—United States operators in 1942 reported no new processes or types of machinery for use in the packaged-fuel industry. The Eberling process [14] was used by 75 manufacturers in 1942. Other processes used were the Glenn-Smith [15] and Leemon [16]; and one manufacturer—the Johnson Coal Cubing Co.,[17] of Detroit, Mich., largest operator since 1932—uses a process and equipment of its own design. The process and machine developed in 1939 by the Viking Manufacturing Co., of Jackson, Mich., are not yet in use in the United States, but plans are under way for a number of such installations after the war. These processes are discussed in earlier reports of this series and in the trade journals.

Salient statistics of the packaged-fuel industry from 1937 to 1942 are summarized in the following table; 1935 was the first year for which such data were collected by the Bureau of Mines.

Salient statistics of the packaged-fuel industry in the United States, 1937–42

[Data regarding fuel briquets are given separately at 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
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
1941	10	260	270	2,472	103	3	10.95	9.09
1942	8	245	253	2,540	89	3	10.74	10.02

Production and value.—The 89 active plants in 1942 produced 253,048 net tons with a value of $2,540,087 (see fig. 2); all but 7 of these plants are in the Central States. Production decreased 6 percent from 1941, but the total value increased 3 percent.

Output declined in 8 of the 13 States producing packaged fuel; of the three largest producing States—Michigan, Ohio, and Wisconsin, in order named—only one (Wisconsin) showed an increase in production over 1941.

[13] Steel, Briquetting Machine—Supplies Charge and Feed Ore in Cubes: Vol. 112, No. 2, January 11, 1943, pp. 82–84.
[14] Eberling, C. M., Packaged Fuel by the Eberling Process: 1938 Catalog, 6002 Ellen Ave., Cleveland, Ohio.
[15] Black Diamond, Briquetting Plant Solves Slack Problem: Vol. 98, No. 6, March 13, 1937, p. 60.
[16] Black Diamond, vol. 102, No. 12, June 17, 1939, p. 15.
[17] Black Diamond, A Mammoth Package Fuel Plant: Vol. 102, No. 7, April 8, 1939, p. 23.

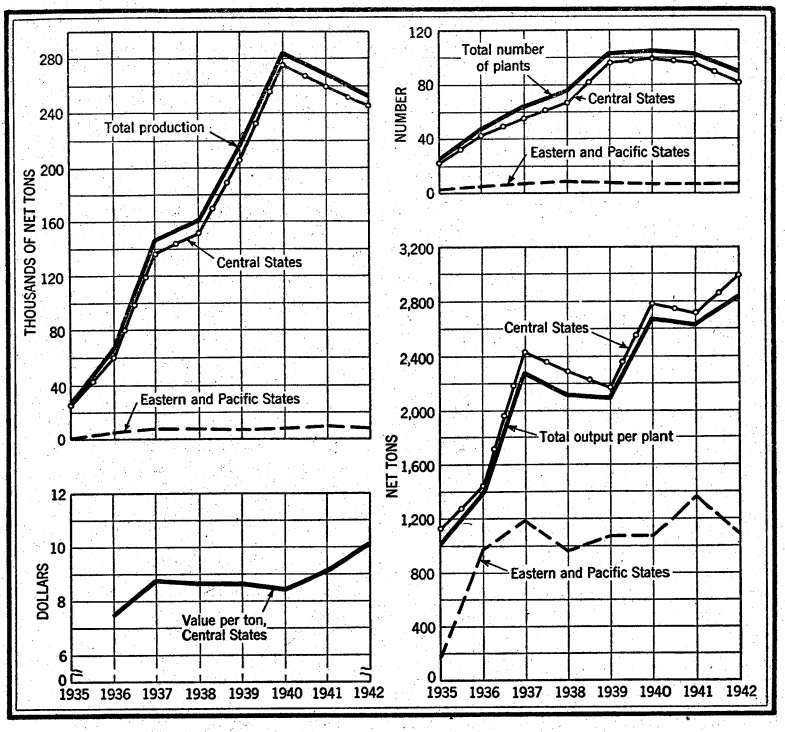

FIGURE 2.—Production of packaged fuel, number of plants in operation, output per plant, and average value per ton, f. o. b. plant (Central States), 1935–42.

Production of packaged fuel in the United States, 1941–42, by States

[Plants and production not included in preceding fuel-briquet tables]

	1941			1942		
	Plants	Net tons	Value	Plants	Net tons	Value
Central States:						
Illinois	6	8,924	$95,431	6	4,980	$60,001
Indiana	6	13,976	126,560	5	16,698	168,882
Iowa	2	[1]	[1]	2	[1]	[1]
Michigan	38	93,213	796,226	30	89,080	867,671
Minnesota	6	28,377	307,134	4	26,887	307,887
Missouri	4	24,356	199,379	3	14,088	119,578
Nebraska	1	[1]	[1]	1	[1]	[1]
Ohio	20	46,566	429,744	22	45,228	456,896
Wisconsin	13	37,747	345,239	9	41,203	398,263
Undistributed [2]		7,136	67,250		7,301	79,500
Total Central States	96	260,295	2,366,963	82	245,465	2,458,678
Eastern and Pacific Coast States	[3] 7	9,549	104,604	[3] 7	7,583	81,409
Total United States	103	269,844	2,471,567	89	253,048	2,540,087

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[2] Includes States entered as "1" above.
[3] Maine 2, Pennsylvania 1, Virginia 3, and Washington 1.

The values, by States, in the following table represent the average per ton received by operators in 1941 and 1942 and indicate increases in average realization in each of the eight States shown; similar advances were prevalent in all but one of the other producing States, but these cannot be shown because there were less than three operators

in each State. The values do not represent the price per ton to the consumer, as many plants sell both to retailers and consumers, but rather the average per ton received by producers on the total product (exclusive of delivery charges). The value at the plant comprises cost of coal at the mine, freight rate, direct and indirect manufacturing costs, and profit.

Average value received per net ton of packaged fuel, 1941–42

State	1941	1942	State	1941	1942
Illinois	$10.69	$12.05	Missouri	$8.19	$8.49
Indiana	9.06	10.11	Ohio	9.23	10.10
Michigan	8.54	9.74	Virginia	9.70	10.06
Minnesota	10.82	11.45	Wisconsin	9.15	9.67

Only about one-fifth of the plants in preceding years were active throughout the year, but 42 of the 89 plants active in 1942 operated each month of the year, and only 9 plants operated less than 6 months.

Monthly production of packaged fuel in the United States, 1941–42, in net tons

Month	1941	1942	Month	1941	1942
January	39,594	33,924	August	10,184	9,346
February	37,727	29,360	September	17,422	18,519
March	40,893	26,779	October	27,183	30,378
April	17,592	19,353	November	30,506	26,361
May	6,318	14,068	December	30,296	27,739
June	5,028	9,533			
July	7,101	7,688		269,844	253,048

Number of plants.—Eighty-nine plants reported commercial production of packaged fuel in 1942; 85 of these were also active in 1941. There were four new plants in 1942; three of these reported production. One plant in Indiana, new in 1941, started operating in 1942. Eight plants went out of business in 1942; five of these had been in operation part of the year, and three were plants that had been in operation each year for 8 years or more. From 1935 to 1940—the peak year—many plants established themselves firmly and built up a stable business; but during this development period a relatively large number of plants went out of business soon after they began to operate.

Activity in number of packaged-fuel plants, 1937–42

Year	Active	New	Idle	Out of business	Year	Active	New	Idle	Out of business
1937	64	17	6	3	1940	106	16	15	14
1938	76	16	8	1	1941	103	7	8	14
1939	103	29	11	9	1942	89	[1] 4	[2] 16	[3] 8

[1] 2 in Michigan and 2 in Ohio; all but 1 active in 1942.
[2] 8 in Michigan, 3 in Ohio, 2 in Wisconsin, and 1 each in Idaho, Minnesota, and Missouri; 5 of these also idle in 1941.
[3] 4 in Michigan, 2 in Ohio, and 1 each in Missouri and Idaho; 7 of these active in 1941.

Size of plants.—The average annual production per plant increased from 2,600 tons in 1941 to 2,800 in 1942. According to operators' reports the industry, if operated at full capacity, could produce 2½ times its 1942 output.

Classification of packaged-fuel plants in the United States, 1941–42, by size of output and annual capacity

Output (net tons)	Plants		Annual capacity (net tons)	Plants	
	1941	1942		1941	1942
Less than 500	[1] 25	[2] 20	Less than 5,000	68	52
500 and less than 1,000	19	14	5,000 and less than 10,000	17	21
1,000 and less than 3,000	39	38	10,000 and less than 15,000	6	5
3,000 and less than 5,000	5	6	15,000 and less than 25,000	6	6
5,000 and less than 10,000	9	7	25,000 and less than 40,000	5	4
10,000 and less than 25,000	5	3	40,000 and less than 60,000		
25,000 and over	1	1	60,000 and over	1	1
	103	89		103	89

[1] 2 of these began operations in the fall of 1941. [2] 1 of these began operations in the fall of 1942.

Raw fuels.—The kinds and quantities of raw fuels used are shown in the following table. The decrease in petroleum coke (which rose significantly from 1939 to 1941) is due to the War Production Board freeze order on this fuel, which became effective in October 1942.[18]

Low-volatile bituminous cubes were made at 77 plants in 1942, petroleum-coke cubes at 10, high-volatile bituminous cubes at 3, and semianthracite cubes at 2; cubes of mixtures of the various raw fuels were made at 2 plants. Five operators made more than one kind, and three made cubes in two sizes. About 188,000 tons (75 percent) of the total raw fuels were shipped-in slack from the mines and Lake docks; the remainder represents yard screenings. Proportionately fewer operators used shipped-in slack exclusively in 1942 than in 1941—owing to difficulties in obtaining the raw fuels.

Raw fuels used in making packaged fuel in the United States, 1941–42

Raw fuel	Net tons		Percent of total	
	1941	1942	1941	1942
Bituminous (high-volatile) and semianthracite	4,784	8,053	1.8	3.2
Bituminous (low-volatile)	213,474	210,761	80.0	84.2
Petroleum coke	[1] 48,560	31,571	18.2	12.6
	266,818	250,385	100.0	100.0

[1] Includes small tonnage of coke breeze.

Binders.—Cornstarches of various types, averaging about 15 pounds per ton of packaged fuel produced, continue to be the principal binders used in the manufacture of packaged fuel. Cement and asphalt—either alone or in combination with starch—were also employed. About 1,600 tons each of starch and asphalt and 83 tons of cement were used by packaged-fuel operators in 1942. The following table classifies the packaged-fuel plants in 1941 and 1942 according to type and percentage of binder used.

Classification of packaged-fuel plants in the United States, 1941–42, by type and percentage of binder used

Type of binder	Plants		Ratio of binder to raw fuel (by weight)	Plants	
	1941	1942		1941	1942
Starch	91	82	Less than 0.5 percent		
Starch and cement	3	2	0.5 and less than 1 percent	71	65
Starch and asphalt	1	1	1 and less than 2 percent	26	19
Cement	5	2	2 and less than 3 percent	4	1
Asphalt	2	2	3 and less than 5 percent		2
Sulfite cellulose	1		5 percent and over	2	2
	103	89		103	89

[18] Coal Dealer, War Production Board Freezes Stocks of Petroleum Coke: Vol. 39, No. 7, November 1942, p. 23.

PEAT

By Joseph A. Corgan

SUMMARY OUTLINE

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SUMMARY

Reports received by the Bureau of Mines from producers indicate that the output of peat in the United States in 1942 totaled 71,500 short tons valued at $516,887—substantially less than in 1941, when the production was 86,503 tons valued at $657,556. The decline can be attributed largely to cessation or curtailment of operations at many peat bogs because of a shortage of labor. In 1942 imports amounted to 49,236 short tons valued at $1,219,473, an increase over 1941 of 62 percent in quantity and 73 percent in value. Although the quantity imported in 1942 was considerably below the pre-war figure of 78,611 tons in 1939, the reported value of $1,219,473 in 1942 was slightly higher than that in 1939 No exports were reported for 1942; thus, the total quantity available for domestic consumption (domestic production plus imports) was 120,736 tons, a gain of 3,891 tons over 1941 but a decline of 13,358 tons from 1939. In the United States, peat is used primarily for soil improvement and in mixed fertilizers. As in many years past, producers reporting for 1942 showed no use of peat as fuel.

Every effort has been made to cover in the canvass all commercial operations. A directory, listing names and addresses of operators who reported production in 1942 to the Bureau of Mines, has been prepared; it will be sent, upon request, to those who may be interested.

Reserves.—The peat reserves of the United States are extensive and constitute an important item in the natural resources of the country. About half of the States contain some peat reserves. The total, calculated as air-dried peat, has been estimated to be 13,827,000,000 tons. [1] Three of the Great Lakes States—Minnesota, Wisconsin, and Michigan—together contain 75 percent of the reserves, and 14 percent of the country's total is in Florida; in the Pacific Coast region, California contains most of the known deposits.

PRODUCTION

Commercial production of peat in the United States was reported to the Bureau of Mines by 41 producers operating in 17 States in 1942, compared with 49 producers in 17 States in 1941. The decline in output from 86,503 short tons in 1941 to 71,500 tons in 1942 and the decrease of 8 in number of producers were caused primarily by the

[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.

closing of some plants for the duration of the war and a shortage of labor at others. Some of the operators indicated that former employees are in the armed forces and that the plants will not reopen until the war is over.

The average value of peat per ton was $7.23 in 1942, compared with $7.60 in 1941. Production and value for the years 1937 to 1942 are shown in the following table.

Peat produced in the United States, 1937–42

Year	Short tons	Value	Year	Short tons	Value
1937	51,223	$305,156	1940	70,097	$516,865
1938	45,933	286,127	1941	86,503	657,556
1939	55,483	362,066	1942	71,500	516,887

Figure 1 illustrates graphically the trend in production and value of peat from 1908 to 1926 and 1934 to 1942. The Federal Government made no canvass of the industry from 1927 to 1933, inclusive, and no data for these years are available.

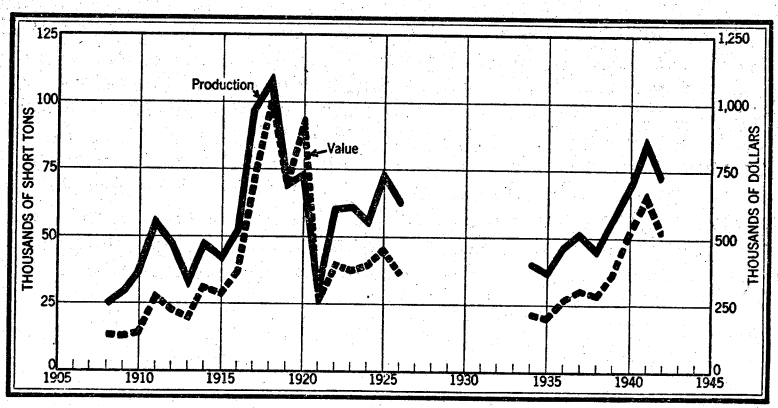

FIGURE 1.—Quantity and value of peat production, 1908–42; no data available for 1927–33.

In 1942 the producing States, in order of output, were: Illinois, New York, Michigan, New Jersey, Iowa, Maine, Pennsylvania, California, Minnesota, Florida, Wisconsin, Connecticut, Ohio, Georgia, Massachusetts, Washington, and New Hampshire. In 1941 New York led in output and was followed by Illinois, New Jersey, and Michigan; the order of the other States also varied from that in 1942.

Peat humus comprised 53 percent of the total production in 1942; reed or sedge peat, 31 percent; and moss peat and other, 16 percent. Peat humus was produced in 9 States, reed or sedge peat in 8, and moss peat in 7.

One plant reported production of kiln-dried peat; 12, raw peat; 14, shredded peat; and 8, cultivated peat.

USES

Peat is used for soil improvement on lawns, golf courses, and gardens, and at greenhouses and nurseries; as packing material for plants, shrubs, eggs, fruits, vegetables, and fragile articles; for insulating material; and as litter for livestock and poultry. The principal use of peat in the United States is in agriculture and horticulture as a soil conditioner and an ingredient of fertilizer. In 1942, of the total peat sales 61 percent was used for soil improvement, 30 percent in mixed fertilizers, and 9 percent for other purposes. No sales of peat for fuel in 1942 were reported, although in some European countries it is used extensively for this purpose; reports indicate that efforts are being made to extend its use in countries where supplies of fuels customarily used are deficient.

IMPORTS

In 1939, before the war became world-wide, peat moss imported for consumption in the United States totaled 78,611 short tons valued at $1,204,883. In 1942 the quantity imported was 49,236 tons, but the reported value of $1,219,473 was slightly greater than the value of 1939 imports. Imports were received from 15 countries in 1939, and in that year, as in many earlier years, Germany was the chief source of supply. Netherlands and Sweden also exported large quantities of peat moss to the United States. In 1942 all imports came from Canada and the United Kingdom, the former supplying 49,100 tons and the latter only 136 tons. In 1939 imports from Canada were only 6,922 tons and those from the United Kingdom 785 tons. It is evident from these figures that Canada, now supplying much of the peat moss imported, has replaced Germany, Sweden, Netherlands, and other European countries as the source of imported peat.

Peat moss imported for consumption in the United States, 1937–42

Year	Short tons	Value	Year	Short tons	Value
1937	86,871	$1,219,127	1940	21,689	$454,632
1938	69,509	1,092,942	1941	30,342	704,264
1939	78,611	1,204,883	1942	49,236	1,219,473

With the drastic reduction of imports subsequent to 1939, peat producers in the United States were presented with an excellent opportunity to expand their markets and increase production; however, the closing of some plants because of labor shortages and curtailment of activities at others for the same reason prevented operators from taking full advantage of the situation in 1942.

The pre-war values of the imported product are considerably lower than those of 1942. The average value per ton was $15.33 in 1939, compared with $24.77 a ton for 1942. This increase is attributable almost entirely to the high value of the Canadian product.

Peat moss imported for consumption in the United States, 1941–42, by countries

Country	Poultry and stable grade				Fertilizer grade			
	1941		1942		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Canada	12,145	$308,416	36,164	$943,385	17,053	$374,143	12,936	$273,576
Germany	16	388						
United Kingdom [1]	34	578			1,094	20,739	136	2,512
	12,195	309,382	36,164	943,385	18,147	394,882	13,072	276,088

[1] United Kingdom of Great Britain and Northern Ireland.

WORLD PRODUCTION

Reports from some foreign countries indicate that peat is being used extensively as fuel; however, complete production data cannot be obtained until after the war. The following table shows available statistics on world output of peat, 1938–42.

World production of peat, 1938–42, by countries [1]

[Compiled by B. B. Waldbauer]

Country [1]	1938	1939	1940	1941	1942
Canada:					
Fuel, metric tons	454	404	27	322	191
Peat moss, do	(2)	(2)	15,591	25,222	40,747
Denmark, do	(2)	(2)	[3] 2,500,000	[3] 2,500,000	[3] 4,600,000
Eire, do	(2)	(2)	(2)	5,398,274	(2)
Estonia, do	185,600	(2)	(2)	(2)	(2)
Finland, do	(2)	(2)	[3] 30,000	[3] 100,000	[3] 200,000
Latvia:					
Litter, cubic meters	90,369	80,000	(2)	(2)	(2)
Waste, do	14,901	20,000	(2)	(2)	(2)
Insulation, do	2,440	3,000	(2)	(2)	(2)
Lithuania, metric tons	180,000	230,000	(2)	(2)	(2)
Netherlands, do	800,000	822,400	842,000	(2)	(2)
Norway, do	(2)	(2)	(2)	[4] 60,000	[4] 120,000
Sweden:					
Fuel, do	25,711	22,953	[3] 25,000	[3] 400,000	[3] 1,000,000
Litter, baled, do	99,998	(2)	(2)	(2)	(2)
Litter and "mull," unbaled, cubic meters	36,578	(2)	(2)	(2)	(2)
"Mull," baled, metric tons	31,959	(2)	(2)	(2)	(2)
Switzerland, do	10,000	15,000	12,000	(2)	(2)
U. S. S. R., do	26,460,700	(2)	(2)	(2)	(2)
United States, do	41,669	50,333	63,591	78,474	64,863

[1] In addition to countries listed Argentina, Austria, France, Germany, Hungary, Italy, and Poland produce peat, but data of production are not available.
[2] Data not available.
[3] Estimated.
[4] Estimated production of a factory at Vigra, near Aalesund.

CRUDE PETROLEUM AND PETROLEUM PRODUCTS[1]

By A. G. White, G. R. Hopkins, H. A. Breakey, and A. T. Coumbe

SUMMARY OUTLINE

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GENERAL REVIEW

Outstanding effects of the war on the supply and demand for all oils in 1942 were the sharp decline in civilian gasoline demand owing to the necessity of conserving both tires and motor vehicles; the readjustments in refinery operations and yields resulting from the drop in gasoline demand and the rise in fuel-oil requirements; a major recession in imports, accompanied by a substantial gain in exports; the drastic curtailment of oil consumption in the Atlantic Coast States resulting from the diversion of tankers to war uses and the substitution of new overland transport routes; and the large increase in the total demand for oil in the Pacific Coast district.

The total demand for all oils reached a peak of 1,595 million barrels in 1941 and decreased about 32 million barrels (2 percent) in 1942. The principal changes compared with 1941 were a drop of 72 million barrels in the total demand for motor fuel, a gain of almost 20 million barrels in the total demand for residual fuel oil, and an increase of 17 million barrels in the demand for distillate fuel oil. The decline in total demand would have been greater except for liquidation of almost 37 million barrels of stocks of refined oils in areas where normal transportation facilities were sharply curtailed. In the East Coast district such stocks were reduced almost to bare working levels. In view of the large increases in the direct war demands for oil products, a substantial increase in total demand might have been expected in 1942 rather than a decrease. To visualize the effect of various restrictions on civilian consumption properly it would be necessary to set up an estimated normal demand for 1942 rather than to make direct comparisons between actual 1941 and 1942 data.

[1] Data for 1942 are preliminary; detailed statistics with final revisions will be released later.

The progressive readjustment in refinery operations in 1942 resulted from a 5-percent decline in the amount of crude refined as well as from the substantial gain in fuel-oil demand and the sharp reduction in gasoline demand. This situation was complicated further by a 62-million barrel drop in imports, consisting primarily of heavy crude and fuel oils. As the result of these various factors, the average yield of gasoline was reduced 4.5 percent, whereas the yield of residual fuel oil was increased 2.6 percent and that of distillate fuel 1.3 percent.

The production of crude petroleum totaled 1,385 million barrels in 1942, and the demand for domestic crude petroleum amounted to 1,395 million barrels. Compared with 1941, there was a decline of 17 million barrels in crude production and a decrease of 26 million barrels in crude demand. The recession in total demand for all oils and the large withdrawals from refined stocks tended to reduce the demand for domestic crude petroleum, but the effect was largely offset by the sharp drop in total imports.

Total demand for all oils in the United States, 1933–42

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
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	1,326.6	130.5	1,457.1
1936	1,092.7	132.0	1,224.7	1941	1,485.8	108.8	1,594.6
1937	1,169.7	172.8	1,342.5	1942 [1]	1,442.0	121.1	1,563.1

[1] Subject to revision.

The combined demand for motor fuel, residual fuel oil, and distillate fuel oil represents about 80 percent of the total demand for all oils. A brief review of the demand and supply trends for these three products will reflect the most significant changes in the oil situation in 1942 compared with 1941.

The total demand for motor fuel declined from 695 million barrels in 1941 to 622 million in 1942—a 10-percent decrease. The average yield of gasoline from crude petroleum fell from 44.2 percent in 1941 to 39.7 percent in 1942. The refinery output was supplemented by a reduction of over 15 million barrels in finished gasoline stocks compared with an increase of over 8 million barrels in 1941. Exports of motor fuel rose from 27 million barrels in 1941 to 36 million in 1942, and domestic demand decreased from 667 million barrels in 1941 to 586 million in 1942. As the rapidly expanding military requirements for gasoline are included in domestic demand, the decline in civilian consumption was materially greater than the total decline in domestic demand. According to the best estimates available, the decline in the civilian automotive use of motor fuel in 1942 was about 105 million barrels or approximately 18 percent. In evaluating the actual effect of the curtailment in civilian consumption, this decline might reasonably be compared with an expectation of at least a 5 percent normal increase in 1942 based upon the increase in the number of motor vehicles in use on January 1, 1942, compared with January 1, 1941. As the total indicated decline in gasoline demand in the Eastern States (Petroleum Administration for War District 1) was about 46 million barrels in 1942, it would appear that about half of the total national decline in civilian automotive use occurred in that area.

The total demand for residual fuel oil rose to 417 million barrels in 1942—a gain of almost 20 million barrels or 5 percent compared with 1941. This increase was all in domestic demand, as exports showed a small decline. Three major changes of about equal importance featured domestic demand. Railroad consumption increased by about 20 million barrels, the rise in naval requirements was probably of similar magnitude, and a decline of about the same amount is indicated as the result of conversions to coal and rationing. On the supply side, imports were 20 million barrels less; withdrawals from storage rose from 5 million barrels in 1941 to 21 million in 1942; transfers from crude to residual were 6 million barrels greater; and refinery production increased from 342 million barrels in 1941 to 359 million in 1942, with an increase in yield from 24.3 percent to 26.9 percent.

Salient statistics of crude petroleum, refined products, and natural gasoline in the United States, 1938–42

	1938	1939	1940	1941	1942[1]
Crude petroleum:					
Domestic production—thousands of barrels[2]	1,214,355	1,264,962	1,353,214	1,402,228	1,385,479
World production—do	1,988,041	2,085,444	2,141,721	2,212,332	2,054,318
United States proportion of world production—percent	61	61	63	63	67
Imports[3]—thousands of barrels[2]	26,412	33,095	42,662	50,606	12,297
Exports—do	[4] 77,254	[4] 72,076	[4] 51,496	[3] 33,238	[3] 33,834
Stocks, end of period:					
Gasoline-bearing crude—do	274,165	239,978	264,079	{247,499 [5]246,884}	234,354
California heavy crude—do	16,467	13,330	11,906	10,179	10,865
Runs to stills—do	1,165,015	1,237,840	1,294,162	1,409,142	1,333,769
Total value of domestic production at wells—thousands of dollars	1,373,060	1,294,470	1,385,440	1,602,000	[6]1,620,000
Average price per barrel at wells	$1.13	$1.02	$1.02	$1.14	[6]$1.17
Total producing oil wells in the United States, Dec. 31	369,640	380,390	389,010	399,960	(7)
Total oil wells completed in the United States during year	18,433	17,485	19,125	19,195	10,302
Refined products:					
Imports[4]—thousands of barrels[2]	27,896	25,965	41,089	46,536	22,777
Exports[4]—do	116,474	116,883	78,970	75,592	87,295
Stocks, end of period—do	272,241	268,109	{282,265 [5]280,958}	{290,375 [5]294,310}	247,554
Output of motor fuel—do	569,162	611,043	616,695	701,294	607,011
Yield of gasoline—percent	44.3	45.0	43.1	44.2	39.7
Completed refineries, end of year	538	547	556	522	471
Daily crude-oil capacity of refineries—thousands of barrels[2]	4,509	4,629	4,719	4,957	4,899
Average dealer's net price (excluding tax) of gasoline in 50 United States cities—cents per gallon[8]	10.04	9.58	9.08	9.49	10.44
Natural gasoline:					
Production—thousands of barrels[2]	51,347	51,650	55,700	80,855	83,567
Stocks, end of period—do	4,830	4,421	5,704	{4,275 [5]4,437}	4,632

[1] Subject to revision.
[2] 42 gallons.
[3] As reported to the Bureau of Mines.
[4] Department of Commerce; exports include shipments to noncontiguous Territories.
[5] For comparison with succeeding year.
[6] Estimated.
[7] Figures not available.
[8] American Petroleum Institute.

The total demand for distillate fuel oil increased from 190 million barrels in 1941 to 207 million in 1942—a 9-percent gain. Exports rose from 17 million barrels to 23 million and domestic demand from 173 million barrels to 184 million. About 70 percent of the total domestic demand is used for heating purposes. In view of the larger number of oil-heating installations in use in 1942, a substantial

increase in demand was anticipated, but this expected gain was reduced by the rationing program effective in the last quarter of 1942. The principal changes in supply in 1942 were a decrease of about 2 million barrels in imports, a reduction of over 4 million barrels in stocks compared with a stock increase of 7 million in 1941, and a gain of about 8 million barrels in refinery production with an increase in yield from 13.4 percent in 1941 to 14.7 percent in 1942.

From a regional viewpoint, the outstanding changes in oil demand in 1942 were the rapid rise in demand in the Pacific Coast district and the sharp curtailment in normal consumption in the Atlantic Coast States. California was the main source of oil supply for war operations in the Pacific and an important supplier of fuel for expanding war industries and increasing railroad traffic. The Atlantic Coast area consumed about 38 percent of the total demand for all oils in 1941 and felt the full effect of the major disturbances in transportation in 1942.

The increase in the total demand for all oils in the Pacific Coast area has been one of the major results of the changes due to the war. The demand for all oils approximated 246 million barrels in both 1939 and 1940. It rose to 256 million barrels in 1941 and to 279 million in 1942. Exports and noncontiguous shipments have dropped steadily from 61 million barrels in 1939 to 23 million in 1942. Shipments by boat and rail to States outside the Pacific Coast market area have likewise slumped from about 11 million barrels in 1939 to 3 million in 1942. This sharp reduction in outside shipments has been much more than offset by the rapid increase in railroad, war industry, and military and naval requirements in the five States constituting the dometic market area. This domestic demand has increased from about 174 million barrels in 1939 to 213 million in 1941 and 253 million in 1942. The major factor in the 40-million-barrel gain in domestic demand in 1942 was the 28-million-barrel increase in the demand for heavy fuel oils. The production of crude petroleum in 1942 was 24 million barrels above the 1939–40 level and was supplemented by a withdrawal from stocks of all oils of about 12 million barrels.

In contrast with the sharp rise in oil demand in the Pacific Coast district, the war has brought a severe curtailment of consumption in the Atlantic Coast States. The indicated demand for all oils in this area (Petroleum Administration for War District 1) fell from 607 million barrels in 1941 to 509 million in 1942—a decline of 98 million barrels (16 percent). In normal times, the major part of the supply was delivered by boat from the Gulf coast and from foreign sources. The diversion of tankers to war uses shifted the burden of transportation to new overland routes that required organization of a huge tank-car movement, construction of new pipe lines, and increased use of inland waterways. The total indicated demand for motor fuel rose from 214 million barrels in 1940 to 236 million in 1941 and was reduced to about 190 million in 1942—a decline of 19 percent for the year. Compared with 1941, gasoline consumption during the first quarter of 1942 showed a slight gain but was reduced by 23 percent in the second quarter, by 28 percent in the third quarter, and by 23 percent in the fourth quarter. A sharp reduction in deliveries to distributors was followed by inauguration of a gasoline-rationing system in May that reduced civilian consumption more drastically

than in other districts, where rubber conservation was the main objective.

The supply of residual fuel oil presented a problem second only to that of motor fuel. The long-distance movements of residual oil depended on tanker transport, owing to lower cost and the inherent difficulty of moving this heavy product by either tank car or pipe line. A program was begun early in the year to urge industrial consumers to convert from fuel oil to coal, and these conversions had reached an annual rate of over 30 million barrels in District 1 by the end of the year. The alarming depletion of the total stocks of all oils led to establishment, on October 1, of a system for rationing heating oils in both the Atlantic Coast area and in the Middle West. Although the cumulative effect of these measures made it possible to meet the most essential requirements during the winter months, an adequate civilian supply for this district remains one of the acute problems in 1943.

A brief review of the major factors in the trend of oil supply and demand, by quarters, beginning with the last quarter of 1941 and extending through the first quarter of 1943, will give a better perspective of the results of increasing war requirements and of progressive restrictions on less essential civilian uses.

The demand for all oils reached an all-time peak of 422 million barrels in the last quarter of 1941, with daily average crude production at a peak of 4,107,000 barrels and crude runs at a peak of 4,058,000 barrels daily for the quarter.

The total demand for all oils dropped to 408 million barrels in the first quarter of 1942, but this amount was still almost 11 percent greater than for the same period in 1941. War requirements were increasing, and the need for curtailing civilian demands was just becoming apparent. The decline in imports was relatively small, and demand was sustained further by a reduction of over 27 million barrels in the stocks of refined oils, compared to a liquidation of only 7 million barrels for the same period of 1941. Compared with the first quarter of 1941, average runs to stills gained 146,000 barrels daily and crude production 366,000 barrels daily, although about one-half of this increase was reflected in a rise in crude stocks. The total demand for motor fuel increased by almost 5 percent, for residual fuel oil by over 12 percent, and for distillate fuel oil by almost 12 percent.

In the second quarter of 1942 the effects of the disturbance in normal transportation and the necessity of conserving rubber became more apparent. The demand for all oils was almost 3 percent less than in the same period of 1941. Imports declined 16 million barrels, refined stocks were reduced almost 21 million barrels, and crude stocks dropped over 11 million barrels. Compared with the second quarter of 1941, average runs to stills decreased 323,000 barrels daily and crude production 203,000 barrels daily. The reduction of almost 11 percent in the total demand for motor fuel was the major factor, accompanied by smaller relative gains of 6 percent in the total demand for residual fuel oil and about 9 percent for distillate fuel oil. With rapidly dwindling stocks and reduced tanker movements, the supply situation in the East coast became a serious problem, and steps were taken to restrict civilian consumption of motor fuel and to urge industrial plants using fuel oil to convert to coal.

Supply and demand of all oils in the United States in 1942, by months

[Including wax, coke, asphalt, and still gas, in thousands of barrels]

	1942 [1]													1941 (total)
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
New supply:														
Domestic production:														
Crude petroleum	128,262	113,961	114,473	105,053	110,192	108,595	111,782	120,429	115,801	120,311	116,101	120,519	1,385,479	1,402,228
Natural gasoline	7,488	6,768	7,020	6,257	6,718	6,558	6,804	7,028	6,998	7,256	7,156	7,516	83,567	80,855
Benzol	208	189	200										597	3,435
Total production	135,958	120,918	121,693	111,310	116,910	115,153	118,586	127,457	122,799	127,567	123,257	128,035	1,469,643	1,486,518
Imports:														
Crude petroleum	3,554	3,068	2,058	1,109	849	540	135	315	236	111	74	248	12,297	50,606
Refined products	3,933	4,009	3,496	1,894	739	437	637	829	601	2,450	1,964	1,788	22,777	46,536
Total new supply, all oils	143,445	127,995	127,247	114,313	118,498	116,130	119,358	128,601	123,636	130,128	125,295	130,071	1,504,717	1,583,660
Change in stocks, all oils	−2,519	+2,691	−9,874	−13,552	−8,200	−9,224	−7,353	+5,862	−1,591	−470	−9,047	−5,128	−58,405	−10,949
Demand:														
Total demand	145,964	125,304	137,121	127,865	126,698	125,354	126,711	122,739	125,227	130,598	134,342	135,199	1,563,122	1,594,609
Exports:														
Crude petroleum	1,522	1,336	1,887	2,973	3,709	3,591	3,370	4,073	3,240	3,264	2,826	2,043	33,834	33,238
Refined products	6,761	5,238	7,139	7,139	6,097	7,775	10,780	6,680	5,702	9,026	6,818	8,140	87,295	75,592
Domestic demand:														
Motor fuel	49,223	42,415	50,440	49,396	52,512	49,945	54,228	48,606	49,828	49,793	50,413	39,289	586,088	667,505
Kerosine	9,750	7,690	7,230	5,516	4,580	3,653	3,266	4,039	5,012	5,367	5,684	7,827	69,614	69,469
Distillate fuel oil	24,981	21,671	18,517	13,769	11,191	11,187	6,987	10,649	13,800	13,050	15,900	22,610	184,312	172,824
Residual fuel oil	37,701	34,275	36,803	34,109	31,414	31,040	30,104	30,600	30,442	33,830	35,376	37,779	403,473	383,422
Lubricating oil	2,680	2,453	2,615	2,781	2,525	2,665	1,962	2,128	2,267	2,112	2,598	2,232	29,018	30,255
Miscellaneous	13,346	10,226	12,490	12,182	14,670	15,498	16,014	15,964	14,936	14,156	14,727	15,279	169,488	162,304
Total domestic demand	137,681	118,730	128,095	117,753	116,892	113,988	112,561	111,986	116,285	118,308	124,698	125,016	1,441,993	1,485,779
Stocks:														
Gasoline-bearing crude in U. S	253,531	260,844	261,832	257,761	254,577	251,421	245,026	244,125	240,043	237,361	234,100	234,354	234,354	247,499 [2] 246,884
Heavy crude petroleum in California	10,543	11,229	11,737	11,434	11,168	10,892	10,950	10,706	10,167	10,868	10,724	10,865	10,865	10,179
Natural gasoline	4,802	5,209	5,620	6,043	6,568	6,517	6,588	6,405	6,056	5,424	4,996	4,632	4,632	4,275 [2] 4,437
Refined products	284,415	278,700	266,919	257,318	252,043	246,302	245,215	252,405	255,784	257,927	252,713	247,554	247,554	290,375 [2] 294,310
Total, all oils	553,291	555,982	546,108	532,556	524,356	515,132	507,779	513,641	512,050	511,580	502,533	497,405	497,405	552,328 [2] 555,810

[1] Subject to revision.

[2] Preliminary figures for Jan. 1, 1942.

In the third quarter of 1942, the demand for all oils was 9 percent less than in the same period of 1941. Imports were almost 23 million barrels less. Efforts to rebuild depleted stocks of refined oils resulted in a gain of about 10 million barrels, but crude stocks were reduced further by 12 million barrels. Although crude runs and crude production were substantially above the low levels of the second quarter, the daily average was still 305,000 and 112,000 barrels, respectively, below the third quarter of 1941. The total demand for motor fuel showed a relative decline of 17 percent from the previous year, while the gain in residual demand was less than 5 percent and for distillate fuel oil only 6 percent. A gasoline-rationing system was inaugurated in May in the Eastern States, restrictions were placed on the distribution of distillate fuel oil, and further conversions of industrial plants from oil to coal became effective.

The total demand for all oils was only about 5 percent less in the last quarter of 1942 than in the same period of 1941. Imports were 22 million barrels less than in 1941. Crude production and runs to stills continued to rise, but the daily averages were, respectively, 228,000 and 340,000 barrels daily below the all-time peaks of the last quarter of 1941. The total demand for gasoline showed a relative decline of over 15 percent, whereas the demand for residual fuel oil increased only 2 percent and for distillate fuel oil about 8 percent above the previous year. Gasoline rationing was established on a Nation-wide basis in December, but its effect on total demand was obscured by heavy advance stocking by consumers. Inauguration of the rationing of heating oils in the main consuming areas on October 1 reduced potential demand materially, but the effect was modified by the substantial gain in the number of installations compared with the previous year. The small gain in residual demand indicated that the large increases in naval and railroad consumption were largely offset by the cumulative effect of conversions to coal, of increased prices, or of actual inability to procure adequate supplies in some districts.

The total demand for all oils in the first quarter of 1943 was about 9 percent less than in the same period of 1942 but was almost 1 percent greater than the comparatively low level of the first quarter of 1941. For the succeeding quarters of 1943, total demand may exceed the 1942 levels, as war requirements and exports progressively increase and as civilian consumption reaches essential minimum levels.

RESERVES

Reserves of crude oil on January 1, 1943, were estimated by the American Petroleum Institute Committee on Petroleum Reserves at 20,082,793,000 barrels. These reserves include only crude oil and distillate in known and proved fields and recoverable by present production methods. Additions to reserves during 1942 totaled 1,878,976,000 barrels; but only 260,051,000 barrels represented new pools discovered during the year, and 1,618,925,000 barrels represented upward revisions of reserve estimates for fields discovered before 1942. Although estimated reserves are more than 14 times the amount of petroleum produced in the peak year 1941, warnings of a shortage are increasing. It was pointed out that if the demands for this nation and its allies increased materially, new discoveries would be necessary to supply these requirements and yet keep within an efficient rate of production.

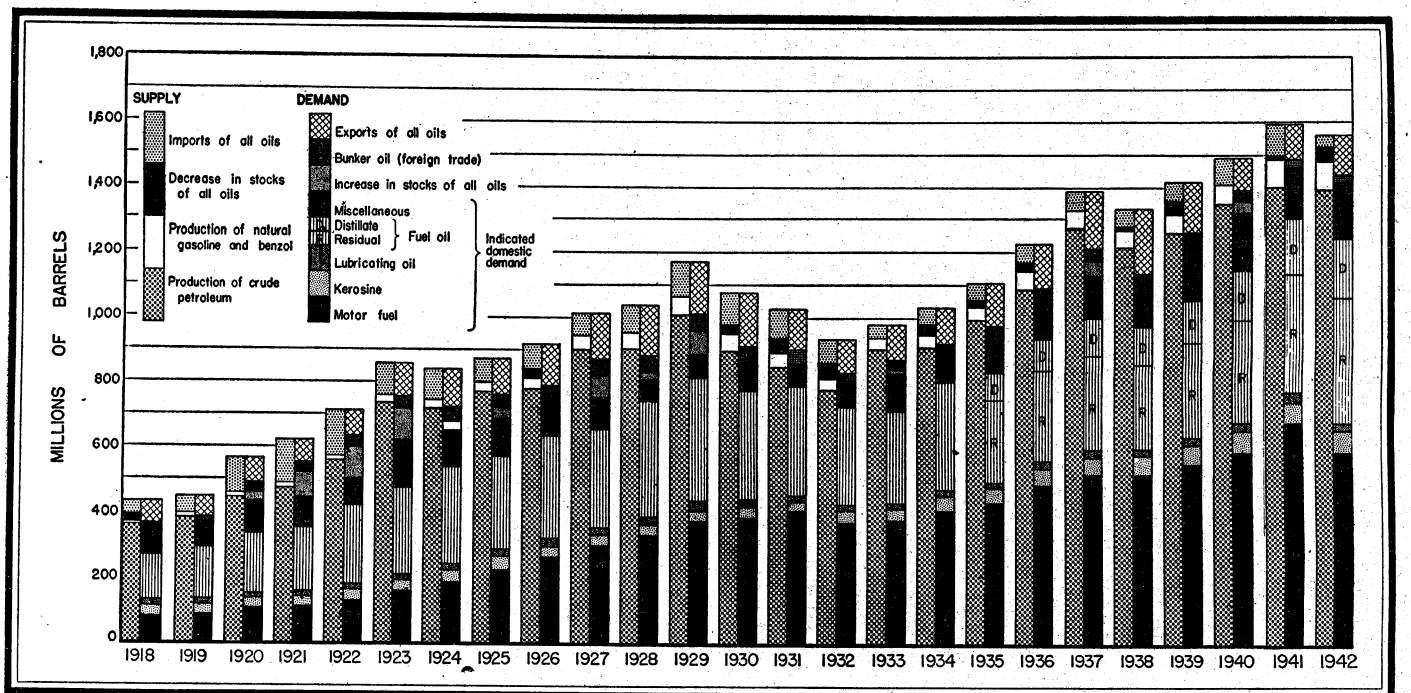

FIGURE 1.—Supply and demand of all oils in the United States, 1918–42.

Estimates of proved oil reserves in the United States on Jan. 1, 1937–43, by States [1]

[Millions of barrels]

State	1937	1938	1939	1940	1941	1942	1943
Eastern States:							
Illinois	28	41	243	382	315	334	307
Indiana	3	3	6	14	14	23	32
Kentucky	39	38	38	44	41	36	35
Michigan	44	49	43	51	35	56	64
New York	66	61	41	35	65	60	54
Ohio	32	28	26	32	30	37	35
Pennsylvania	307	288	200	183	188	171	153
West Virginia	32	28	24	46	53	50	47
	551	536	621	787	741	767	727
Central and Southern States:							
Arkansas	84	192	188	320	306	295	300
Kansas	568	601	613	726	692	690	687
Louisiana	524	714	1,040	1,173	1,216	1,330	1,442
Mississippi				7	40	80	41
New Mexico	471	547	703	687	692	675	677
Oklahoma	1,141	1,212	1,162	1,063	1,002	1,036	969
Texas	6,422	8,248	9,448	9,768	10,624	10,976	11,546
	9,210	11,514	13,154	13,744	14,572	15,082	15,662
Mountain States:							
Colorado	15	19	18	20	23	23	39
Montana	92	109	105	94	89	86	86
Wyoming	239	266	261	306	305	304	370
	346	394	384	420	417	413	495
Pacific Coast States: California	2,956	3,063	3,189	3,532	3,291	3,323	3,197
Other States					4	4	2
Total United States	13,063	15,507	17,348	18,483	19,025	19,589	20,083

[1] From reports of Committee on Petroleum Reserves, American Petroleum Institute, of the amount of crude oil that may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations. The change in reserves during any year represents total new discoveries, extensions, and revisions minus production.

LEGISLATION AND ADMINISTRATION

Among the legislation affecting the petroleum industry was the O'Mahoney Act, signed December 24. This act, although passed too late to influence operations in 1942, is designed to promote exploration on public lands. It provides a flat 12½-percent royalty for 10 years on all oil and gas produced from new wells in newly discovered fields on public lands in place of the "Step-scale rates" provided for in the act of 1935. Another law suspends antitrust action on acts done to further the war program, and yet another gives the Army and Navy pewor to force reductions in patent royalties.

Administrative orders by agencies appointed by the President put the petroleum industry under wartime regulation. The principal agencies involved were the Office of Defense Transportation, the Office of Price Administration, and the Office of Petroleum Coordinator (changed toward the end of the year to Petroleum Administration for War).

The Petroleum Administration for War, in addition to being made a claimant agency (an agency that has the right to claim a priority on scarce material), was given the power to issue instructions and orders relating to all phases of the industry and the means for enforcing such instructions and orders.

Office of Petroleum Coordinator Conservation Order M–68 and War Production Board Preference Rating Order P–98 were two im-

portant regulatory measures in effect during 1942. The former limited drilling, with exceptions, to one well to each 40 acres and provided for easy acquisition of drilling and operating material and supplies by operators who conform to the regulation. This order eliminated the drilling of an estimated 13,000 wells, with the result that the use of steel for drilling in defined fields was reduced to 60 percent of that in 1941. Even greater curtailment is promised in future, with a much wider spacing pattern.

Preference Rating Order P–98 enabled oil operators to get priority ratings on scarce material under the Priorities Rating Plan (PRP). The Controlled Materials Plan (CMP), a new plan for distributing scarce materials, came into use January 1, 1943, 6 months being allowed for the transition period from the old PRP to the CMP. Under the CMP certain agencies, designated as claimant agencies, submit requirements for scarce material to the Controlled Materials Division of the War Production Board. The Controlled Materials Division then analyzes the requirement claims and makes allotments to the claimant agencies through its Requirements Committee, which is made up of representatives from each of the claimant agencies, in addition to one from the Department of State. Claimant agencies then distribute the allotments to the qualified consumers. The Petroleum Administration for War was made a claimant agency under this plan.

Office of Petroleum Coordinator Directive 59 called for the joint use of facilities among persons engaged in the petroleum industry and the joint use of their products in Districts 1, 2, and 3. It was designed to eliminate crosshauling and to assure, as far as possible, an equitable proportion of stocks and of sales among the supplies in each area. These acts, illegal under the Sherman antitrust law, were approved by legislation passed in 1942 suspending antitrust action on acts done to further the war program.

Other administrative acts affecting the petroleum industry included prohibition of the use of tank cars in the Midwest; prohibition of use of tin, terneplate, and blackplate for motor-oil cans; prohibition of gasoline shipments from the East coast; prohibition of use of benzene in motor fuel; prohibitions on the use of asphalt and road oil; placing of butadiene under allocation control; setting Nation-wide automobile speed limit, first at 40 miles per hour then at 35; making United States refining processes available to Russia; directing the shipments of specific quantities of products from Districts 2 and 3 to District 1; modifying refinery yields; prohibition of manufacture of domestic oil burners; prohibition of movement of gasoline to East coast by tank car in favor of fuel oil; and prohibition of use of credit cards for gasoline.

PRORATION

Early in 1942 the Office of Petroleum Coordinator assumed the function of prescribing the rates of crude-oil production for the States in place of the estimates of market demand that had been issued by the Bureau of Mines theretofore. The Bureau of Mines continued to issue the monthly forecast of motor fuel and crude-oil requirements and to supply the Office of Petroleum Coordinator with estimates of the market demand for crude oil for the individual States.

Production recommendations by the Office of Petroleum Coordinator included consideration of reserves and of efficient production rates as well as market demand. Beginning in April, recommendations for production comprised all petroleum liquids, including condensate and natural-gas derivatives as well as crude oil.

Proration in the past generally has been based upon dividing the production determined necessary, so that each well received its share based upon the proration formula in effect. Thus a purchaser might be required to fill part of his needs with an oil that he did not desire because the proration theory required that the demand be divided proportionately among all the oils. War conditions, however, changed this aspect of proration in 1942, and wells producing crudes suitable for aviation gasoline, high-grade lubricants, and other military requirements were given preference.

The Interstate Oil Compact Commission voted at the December meeting to extend the life of the compact to September 1, 1947.

The table usually appearing in this section showing market-demand estimates, State allowables, and production has been suspended because Petroleum Administration for War certified production rates, which have supplanted the Bureau of Mines estimates of market demand, include natural gasoline and distillates and are not comparable with crude-oil production.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The total demand for crude petroleum was approximately 1,410 million barrels in 1942, compared with 1,472 million in 1941—a reduction of about 62 million barrels or 4 percent. This decline was due to a drop in the total demand for all oils and an abnormal liquidation of stocks of refined oils. A 75-million-barrel decrease in crude runs to stills was partly offset by a 13-million-barrel rise in crude used for fuel and losses and a slight gain in crude exports. Compared with 1941, domestic crude production declined by about 17 million barrels, crude imports were reduced by 38 million barrels, and total withdrawals from crude stocks were only 12 million barrels or 7 million less than in 1941.

Supply of and demand for crude petroleum in the United States, 1938–42

[Thousands of barrels]

	1938	1939	1940	1941	1942 [1]
Production	1,214,355	1,264,962	1,353,214	1,402,228	1,385,479
Imports [2]	26,412	33,095	42,662	50,606	12,297
Changes in stocks [2]	−28,913	−37,314	+23,307	−18,942	−11,844
Total supply	1,269,680	1,335,371	1,372,569	1,471,776	1,409,620
Runs to stills:					
Domestic	1,138,828	1,204,350	1,252,364	1,358,246	1,319,173
Foreign	26,187	33,496	41,798	50,946	14,596
Exports	77,254	72,076	51,496	[3] 33,238	[3] 33,834
Transfers to fuel oil:					
Pipe-line operations east of California	1,930	2,125	2,297	2,383	2,484
Other transfers	12,112	10,284	7,978	13,099	19,255
Other fuel and losses	13,369	13,046	16,636	13,864	20,278
Total demand	1,269,680	1,335,371	1,372,569	1,471,776	1,409,620

[1] Subject to revision.
[2] As reported to Bureau of Mines.
[3] Inclusive of heavy crude in California.

PRODUCTION

General.—Crude-oil output of 1,385,479,000 barrels was 16,749,000 barrels less than the 1,402,228,000 produced in 1941. Greatest declines were in Illinois—25,937,000 barrels; Texas—22,201,000; and Oklahoma—14,012,000. Production increased 18,063,000 barrels in California and 14,394,000 in Kansas.

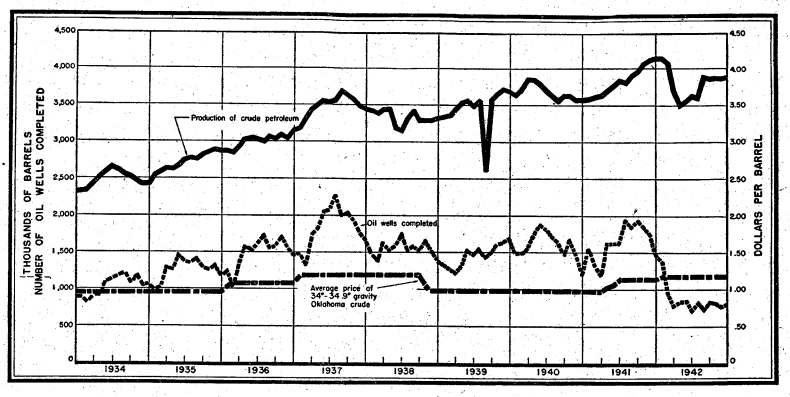

FIGURE 2.—Daily average production of crude petroleum, total number of oil wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum in the United States, 1934–42, by months.

Petroleum produced in the United States, 1938–42, and total, 1859–1942, by States[1]

[Thousands of barrels]

	1938	1939	1940	1941	1942 [2]	1859–1942 (total)
Production:						
Arkansas	18,180	21,238	25,775	26,327	26,628	559,372
California	249,749	224,354	223,881	230,263	248,326	6,048,667
Colorado	1,412	1,404	1,626	2,150	2,220	44,266
Illinois	24,075	94,912	147,647	132,393	106,456	938,521
Indiana	995	1,711	4,978	7,411	6,743	145,264
Kansas	60,064	60,703	66,139	83,242	97,636	[3] 1,301,811
Kentucky	5,821	5,621	5,188	4,762	4,472	[4] 176,395
Louisiana	95,208	93,646	103,584	115,908	115,726	1,291,623
Michigan	18,745	23,462	19,753	16,359	21,754	[5] 183,219
Mississippi	----------	107	4,400	15,327	28,833	48,667
Montana	4,946	5,960	6,728	7,526	8,074	99,092
Nebraska	----------	2	276	1,898	1,237	3,413
New Mexico	35,759	37,637	39,129	39,569	31,544	[6] 345,872
New York	5,045	5,098	4,999	5,185	5,421	[7] 129,383
Ohio	3,298	3,156	3,159	3,510	3,543	595,430
Oklahoma	174,994	159,913	156,164	154,702	140,690	[3] 5,101,515
Pennsylvania	17,426	17,382	17,353	16,750	17,779	[7] 1,031,597
Texas	475,850	483,528	493,209	505,572	483,371	7,568,750
West Virginia	3,684	3,580	3,444	3,433	3,574	417,777
Wyoming	19,022	21,454	25,711	29,878	31,392	562,248
Other States [8]	82	94	71	63	60	1,243
Total, United States	1,214,355	1,264,962	1,353,214	1,402,228	1,385,479	26,594,125
Value at wells:						
Total (thousands of dollars)	1,373,060	1,294,470	1,385,440	1,602,000	1,620,000	31,365,379
Average per barrel	$1.13	$1.02	$1.02	$1.14	$1.17	$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 1925–42 production only; earlier years included under "Other States."
[6] Figures represent 1924–42 production only; earlier years included under "Other States."
[7] Early production in New York included with Pennsylvania.
[8] Includes Alaska, 1912–33; Arkansas, 1920; Michigan, 1900–19; Missouri, 1889–1911, 1913–16, 1919–23, 1932–42; New Mexico, 1913, 1919–23; Tennessee, 1916–42; Utah, 1907–11, 1920, 1924–42

Production of crude petroleum in the United States in 1942, by districts, States, and months

[Thousands of barrels]

District and State	1942 [1]												1941 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
DISTRICT														
Pennsylvania Grade	2,377	2,124	2,416	2,492	2,403	2,481	2,450	2,404	2,387	2,429	2,185	2,244	28,392	26,808
Other Appalachian	466	455	517	504	491	502	507	478	495	486	587	624	6,112	6,294
Lima-Northeastern Indiana-Michigan	1,647	1,408	1,551	1,908	1,996	2,016	1,944	1,960	1,932	1,981	1,846	1,886	22,075	16,933
Illinois-Southwestern Indiana	12,121	10,294	10,588	9,640	9,667	9,106	9,060	9,017	8,485	8,666	8,284	8,247	113,175	139,780
Mid-Continent:														
North Louisiana, Arkansas, and Mississippi	6,939	6,656	7,260	7,292	7,259	7,231	7,293	7,252	7,068	7,054	6,680	6,673	84,657	66,645
West Texas and Southeastern New Mexico	13,198	11,393	9,620	7,957	7,811	7,846	8,290	9,583	8,949	9,580	9,192	9,399	112,818	132,077
East Texas	12,424	10,905	9,425	6,419	9,822	9,368	8,947	11,335	10,826	11,328	10,825	11,247	122,871	132,486
Oklahoma, Kansas, North Texas, etc.	34,193	30,139	32,063	30,193	31,426	31,138	31,934	32,596	31,597	33,081	32,167	32,785	383,312	385,336
Gulf Coast	21,957	19,349	18,600	16,090	16,281	15,797	16,499	19,794	18,659	19,683	18,992	19,849	221,550	225,649
Rocky Mountain	3,453	3,093	3,606	3,433	3,634	3,585	3,555	3,530	3,611	3,600	3,515	3,576	42,191	39,957
California	19,487	18,145	18,827	19,125	19,402	19,525	21,303	22,480	21,792	22,423	21,828	23,989	248,326	230,263
Total United States	128,262	113,961	114,473	105,053	110,192	108,595	111,782	120,429	115,801	120,311	116,101	120,519	1,385,479	1,402,228
STATE														
Arkansas	2,251	2,072	2,302	2,148	2,237	2,223	2,208	2,230	2,209	2,228	2,222	2,298	26,628	26,327
California [2]	19,487	18,145	18,827	19,125	19,402	19,525	21,303	22,480	21,792	22,423	21,828	23,989	248,326	230,263
Colorado	196	145	166	170	200	180	204	195	193	196	182	193	2,220	2,150
Illinois	11,503	9,772	9,986	9,048	9,042	8,520	8,483	8,448	7,958	8,136	7,801	7,759	106,456	132,393
Indiana	620	524	604	594	627	588	579	571	529	532	485	490	6,743	7,411
Kansas	7,650	6,687	7,548	7,493	7,580	8,142	8,625	8,502	8,599	9,077	8,833	8,900	97,636	83,242
Kentucky	344	335	376	356	348	355	361	337	357	346	460	497	4,472	4,762
Louisiana	10,863	9,550	10,127	9,205	8,974	9,141	9,731	10,300	9,348	9,670	9,425	9,392	115,726	115,908
Michigan	1,618	1,383	1,527	1,875	1,968	1,986	1,912	1,936	1,904	1,955	1,824	1,866	21,754	16,359
Mississippi	2,489	2,601	2,708	2,885	2,648	2,531	2,469	2,366	2,194	2,126	1,953	1,863	28,833	15,327
Montana	679	617	671	660	657	696	693	683	678	693	669	678	8,074	7,526
Nebraska	115	117	122	118	116	113	104	99	90	87	78	78	1,237	1,898
New Mexico	3,601	3,077	2,554	2,018	1,921	2,057	2,310	2,712	2,714	2,904	2,830	2,846	31,544	39,569
New York	453	405	454	458	455	467	474	456	459	461	425	454	5,421	5,185
Ohio	277	262	296	317	297	322	319	297	300	308	280	268	3,543	3,510
Oklahoma	12,653	10,982	12,424	11,689	12,039	11,828	12,058	11,760	11,404	11,616	11,110	11,127	140,690	154,702
Pennsylvania	1,501	1,332	1,518	1,582	1,522	1,560	1,526	1,508	1,481	1,502	1,359	1,388	17,779	16,750
Texas	49,139	43,402	39,223	32,430	37,121	35,379	35,492	42,626	40,576	43,057	41,442	43,484	483,371	505,572
West Virginia	294	267	310	313	297	306	306	305	310	321	267	278	3,574	3,433
Wyoming	2,523	2,281	2,725	2,563	2,736	2,671	2,619	2,613	2,702	2,668	2,624	2,667	31,392	29,878
Other States	6	5	5	6	5	5	6	5	4	5	4	4	[3] 60	63
Total United States: 1942	128,262	113,961	114,473	105,053	110,192	108,595	111,782	120,429	115,801	120,311	116,101	120,519	1,385,479	
1941	110,446	100,659	112,648	110,550	116,941	114,854	117,843	121,159	119,320	125,891	123,483	128,434		1,402,228
Daily average, 1942	4,138	4,070	3,693	3,502	3,555	3,620	3,606	3,885	3,860	3,881	3,870	3,888	3,796	3,842

[1] Subject to revision.

[2] American Petroleum Institute.

[3] Missouri (44), Tennessee (12), Utah (4).

The relative importance of the three outstanding producing States—Texas, California, and Oklahoma—declined further, so that in 1942 they supplied only 63.0 percent of the country total compared with 63.5 percent in 1941 and 64.5 percent in 1940 (see fig. 3).

East Texas remained the greatest producing field, despite a decline in 1942. The Wilmington (Calif.) field rose to second place and the Tinsley (Miss.) field to third.

Percentage of total crude petroleum produced in the United States, 1933–42, by principal States

State	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942[1]
Texas	44.5	42.0	39.4	38.9	39.9	39.2	38.2	36.4	36.1	34.9
California	19.0	19.2	20.9	19.5	18.6	20.6	17.7	16.6	16.4	17.9
Oklahoma	20.1	19.9	18.6	18.8	17.9	14.4	12.7	11.5	11.0	10.2
Total, 3 States	83.6	81.1	78.9	77.2	76.4	74.2	68.6	64.5	63.5	63.0
Louisiana	2.8	3.6	5.0	7.3	7.1	7.8	7.4	7.7	8.3	8.3
Illinois	.5	.5	.4	.4	.6	2.0	7.5	10.9	9.4	7.7
Kansas	4.6	5.1	5.5	5.3	5.5	5.0	4.8	4.9	5.9	7.0
New Mexico	1.6	1.9	2.1	2.5	3.1	2.9	3.0	2.9	2.8	2.3
Mississippi								.3	1.1	2.1
Arkansas	1.3	1.1	1.1	.9	.9	1.5	1.7	1.9	1.9	1.9
Michigan	.9	1.2	1.5	1.1	1.3	1.5	1.8	1.5	1.2	1.6
Pennsylvania	1.4	1.6	1.6	1.6	1.5	1.4	1.4	1.3	1.2	1.3
All other	3.3	3.9	3.9	3.7	3.6	3.7	3.8	4.1	4.7	4.8
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, 1941–42, and total production since discovery [1]

[Thousands of barrels]

Field	State	1941	1942	Total since discovery
East Texas	Texas	130,637	120,943	1,850,135
Midway-Sunset	California	17,468	20,440	932,872
Seminole	Oklahoma	23,687	20,408	915,917
Long Beach	California	14,712	13,124	660,302
Oklahoma City	Oklahoma	32,184	26,484	573,398
Santa Fe Springs	California	8,559	7,763	484,938
Bradford-Allegany	Pennsylvania-New York	17,200	[2] 20,547	476,547
Coalinga	California	14,222	19,285	405,338
Smackover	Arkansas	5,354	4,884	380,432
Cushing-Shamrock	Oklahoma	3,223	3,069	362,418
Huntington Beach	California	10,755	12,108	313,119
Salt Creek	Wyoming	5,076	4,719	302,930
Yates district	Texas	6,719	7,481	277,372
Kettleman Hills	California	13,987	13,015	265,214
Augusta-Eldorado district	Kansas	5,230	4,700	238,037
Gray County	Texas	12,506	13,654	199,612
Wilmington	California	30,682	33,696	173,717
Salem	Illinois	29,539	14,705	166,998
Caddo	Louisiana	3,096	2,667	155,523
Conroe	Texas	11,747	13,589	142,742
Rodessa	Arkansas-Louisiana-Texas	10,451	7,684	133,717
Hobbs	New Mexico	3,686	2,928	100,801
Fitts	Oklahoma	4,223	3,050	97,406
Louden	Illinois	22,918	17,961	87,680
Eunice	New Mexico	6,658	5,242	58,703
Monument	do	6,960	6,698	53,009
Lance Creek	Wyoming	8,919	8,023	48,837
Tinsley	Mississippi	15,564	27,106	46,708
Wasson	Texas	13,170	9,401	42,549

[1] Oil and Gas Journal.

[2] Bureau of Mines.

Arkansas.—Output in Arkansas in 1942 of 26,628,000 barrels was but slightly more than the 26,327,000 barrels produced in 1941. Declines in most of the fields were offset by production of 1,218,000 barrels from the new Midway field in Lafayette County, discovered in January. Twenty-nine producing wells were completed in this field, with an average initial daily production of 101 barrels per well. Eleven completions, with an average initial daily production of 155 barrels, raised the production in the Stephens field 150 percent, but the 1942 production totaled only 614,000 barrels.

There were 103 completions in 1942, with an initial daily average production of 121 barrels, compared with 95 completions in 1941, with an average initial daily production of 190 barrels.

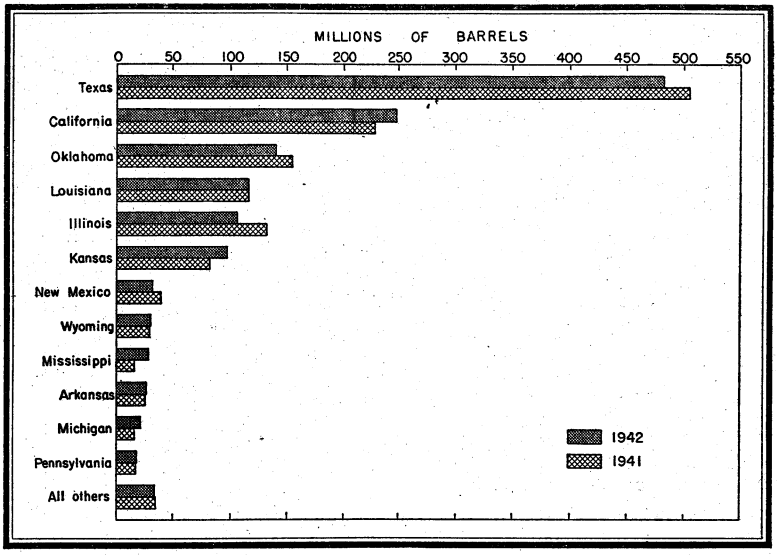

FIGURE 3.—Production of crude petroleum in the United States, 1941–42, by States.

Production of crude petroleum in Arkansas, 1938–42, by fields

[Thousands of barrels]

Year	Atlanta	Buckner	Champagnolle	El Dorado	Magnolia	McKamie	Rodessa	Schuler	Smackover	Stephens	Urbana	Other fields	Total
1938	------	340	452	709	68	-------	2,317	6,359	6,406	198	422	909	18,180
1939	108	662	566	630	3,639	-------	1,358	6,430	5,945	196	381	1,323	21,238
1940	721	815	581	591	7,383	74	711	6,547	5,500	196	468	[1] 2,188	25,775
1941	1,013	816	332	534	7,121	891	497	6,055	5,351	251	837	[1] 2,629	26,327
1942 [2]	1,034	765	273	497	6,364	723	366	5,913	4,907	614	985	[1] 4,187	26,628

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Subject to revision.

California.—The urgent need for heavy crude oils to produce naval and industrial fuels prompted a comprehensive survey and planned efforts to increase the production of such oils. Success was indicated by about 45 percent more production of heavy crude at the end of the year than at the beginning. Total crude-oil production in California amounted to 248,326,000 barrels in 1942, or 18,063,000 more than in

1941; 13,459,000 barrels of this increase was in heavy crude, which raised the total output of that type to 40,716,000 barrels.

Biggest gain was in the San Joaquin Valley district, where production totaled 105,075,000 barrels compared with 93,811,000 in 1941. The heavy-oil fields of Coalinga, Mount Poso, and Midway-Sunset were principally responsible for this gain. Coalinga's 5,099,000-barrel increase was accompanied by the completion of 43 oil wells with an average initial daily production of 645 barrels. Twenty-six wells were completed in the Mount Poso field, with an average daily initial production of 101 barrels, and the output increased from 4,117,000 barrels in 1941 to 7,566,000 in 1942. Activity in Midway-Sunset interrupted a downward trend in production from that field, with an increase from 17,461,000 barrels to 20,470,000. Sixty-two wells were drilled, with an average initial production of 74 barrels.

Production of crude petroleum in California, 1938–42, by districts and fields [1]

[Thousands of barrels]

District and field	1938	1939	1940	1941	1942
San Joaquin Valley:					
Belridge	5,312	4,781	4,614	4,185	2,917
Canal	849	1,855	2,034	1,816	1,069
Coalinga	3,898	5,731	9,916	14,224	19,323
Coles Levee [2]	12	526	2,589	5,717	5,436
Edison	1,102	838	868	1,013	1,020
Elk Hills	3,887	3,830	4,427	3,491	4,363
Fruitvale	3,078	2,377	2,072	2,085	2,312
Greeley	1,164	811	1,475	2,480	2,583
Kern River	4,590	4,133	4,082	4,315	5,707
Kettleman Hills	25,609	19,568	16,730	13,983	13,014
Lost Hills	1,297	1,222	1,405	1,263	1,398
McKittrick	1,289	1,326	1,317	1,422	1,791
Midway-Sunset	22,875	18,960	18,397	17,461	20,470
Mountain View	4,033	2,983	2,415	1,910	1,602
Mount Poso	6,235	4,314	3,425	4,117	7,566
Rio Bravo	1,945	2,875	3,304	4,534	3,579
Round Mountain	5,474	3,528	2,691	2,815	3,917
Ten Section	2,473	3,247	3,518	5,232	4,805
Other San Joaquin Valley	273	1,152	2,003	1,748	2,203
Total San Joaquin Valley	95,395	84,057	87,282	93,811	105,075
Coastal district:					
Capitan	1,067	876	651	740	844
Elwood	2,247	1,545	1,286	1,166	873
Gato Ridge					1,217
Rincon	1,395	1,238	1,609	1,542	1,010
San Miguelito	1,044	952	1,163	1,427	1,238
Santa Maria	6,128	6,305	2,216	3,183	2,726
Santa Maria Valley			6,096	6,908	7,550
Ventura Avenue	12,926	12,935	12,570	12,892	13,644
Ventura-Newhall	1,903	2,317	2,866	4,279	3,041
Other Coastal	186	132	101	87	1,805
Total Coastal	26,896	26,300	28,558	32,224	33,948
Los Angeles Basin:					
Brea Olinda	2,125	2,063	2,070	2,079	3,716
Coyote	4,354	4,013	4,053	4,466	5,848
Dominguez	9,756	7,131	7,665	8,495	7,932
Huntington Beach	11,917	9,983	9,592	10,743	12,096
Inglewood	5,337	4,605	4,366	4,901	6,750
Long Beach	20,599	17,004	16,010	14,697	13,131
Montebello	4,147	7,455	7,240	4,884	3,961
Playa del Rey	2,305	1,801	1,498	1,319	1,227
Richfield	3,333	3,134	3,228	2,719	2,890
Rosecrans	3,732	4,459	4,259	3,434	2,722
Santa Fe Springs	12,630	10,050	9,438	8,552	7,761
Seal Beach	3,198	2,641	2,557	2,430	3,027
Torrance	5,203	6,418	4,007	3,210	3,049
Wilmington	34,168	31,100	30,195	30,672	33,657
Other Los Angeles Basin	4,654	2,140	1,863	1,627	1,536
Total Los Angeles Basin	127,458	113,997	108,041	104,228	109,303
Total California	249,749	224,354	223,881	230,263	248,326

[1] American Petroleum Institute.

[2] Includes Tupman.

Danger to marine transportation and transfer of tankers to other services have restricted production in the Coastal district, where more oil can be produced when transportation facilities are available to move it. The production of 33,948,000 barrels from this district was 1,724,000 barrels more than in 1941. Contributing to this was 1,217,000 barrels from the long-dormant Gato Ridge field, which was brought back to production early in the year. Although 29 wells with an average initial of 586 barrels were completed in the Santa Maria Valley field, the production of 7,550,000 barrels was only 642,000 barrels more than in 1941. Output in the Ventura Avenue field was increased 752,000 barrels to 13,644,000, aided by 16 completions with an average initial of 1,151 barrels.

The Los Angeles Basin produced 109,303,000 barrels—a gain of 5,075,000 barrels. Largest rise was in the Wilmington field, where a 2,985,000-barrel increase raised the total production to 33,657,000 barrels—the second largest in the country. Thirty-eight wells with an average initial of 245 barrels were completed in Wilmington in 1942. Huntington Beach and Inglewood also made large gains in output.

Five hundred fifty-seven oil wells were completed in California in 1942 with an average intial of 358 barrels, compared with 920 wells in 1941 with an average initial of 712 barrels. Dry holes totaled 247 compared with 179 in 1941.

The Wilmington field maintained its place by a generous margin as the largest field in the State, with Midway-Sunset and Coalinga next in order. Further decline in the Kettleman Hills light-oil field dropped it to sixth place.

Colorado.—Production of 2,220,000 barrels represented a small increase over the 2,150,000-barrel output of 1941. The only fields to show material increases were Wilson Creek, which rose from 453,000 barrels in 1941 to 533,000 in 1942, and Rangely, which rose from 220,000 barrels in 1941 to 288,000 in 1942.

Ten wells were completed in Colorado during 1942 compared with 16 in 1941. Four of the completions were in Rangely and 4 in Wilson Creek.

Production of crude petroleum in Colorado, 1938–42, by fields

[Thousands of barrels]

Year	Florence [1]	Fort Collins [2]	Iles	Moffat	Price	Rangely	Tow Creek	Wilson Creek	Other fields	Total
1938	64	109	819	126	185	32	56	----------	21	1,412
1939	62	116	724	112	289	36	53	----------	12	1,404
1940	56	128	581	111	326	29	52	237	[3] 106	1,626
1941	55	118	547	116	324	220	50	453	[3] 267	2,150
1942 [4]	49	111	534	125	272	288	46	533	[3] 262	2,220

[1] Includes Canon City.
[2] Includes Wellington.
[3] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[4] Subject to revision.

Illinois.—Further decline in Illinois production from 132,393,000 barrels in 1941 to 106,456,000 in 1942 forecasts a greater burden on Texas, Kansas, and other sources for supplying the Great Lakes and Eastern United States areas with petroleum in future. The Salem field, whose 70,734,000 barrel output in 1940 was exceeded by the East Texas field only, dropped to second place in the State in 1942, with a

production of 14,705,000 barrels. This was a slump of more than 50 percent from the 29,539,000 barrels produced in 1941. The Louden field, though declining, produced 17,961,000 barrels in 1942 and wrested first place from Salem.

New oil wells completed totaled 1,107—59 percent less than the 2,730 completed in 1941. The average initial dropped to 168 barrels compared with 277 in 1941 and 620 in 1940.

Greatest activity was in the Rural Hill Field in Hamilton County, discovered in 1941. Seventy-six wells were completed in this field, with an average initial of 189 barrels. Production from the Dale-Hoodville field in the same county decreased from 6,195,000 barrels in 1941 to 5,294,000 in 1942 following completion of 74 wells with an average initial of 236 barrels. Notwithstanding 53 completions with an average initial of 119 barrels in the New Harmony field in White County, production in that field declined from 9,939,000 barrels in 1941 to 7,224,000 in 1942.

Production of crude petroleum in Illinois, 1938–42, by fields [1]

[Thousands of barrels]

Field	1938	1939	1940	1941	1942
Aden-North	305	794	1,009	700	405
Albion			1,095	895	499
Benton				5,769	5,488
Boyleston		169	1,306	815	669
Centralia	3,022	2,265	10,642	3,564	2,277
Cisne	421	1,224	479	219	182
Clay City	4,005	7,694	6,922	4,680	2,716
Covington					1,159
Dale			314	2,483	5,294
Dundas		209	2,341	4,438	2,505
Hoodville			353	3,712	(2)
Iron			1,120	801	470
Irvington			509	1,037	753
Johnsonville				5,913	5,146
Keensburg		987	2,709	2,002	1,710
Louden	1,892	18,351	26,596	22,918	17,961
Mount Carmel			26	1,691	1,024
New Harmony		5	1,503	9,939	7,224
Noble	4,232	1,644	2,744	2,507	2,607
North Boos			249	826	528
Parkersburg				785	1,294
Roland			2	1,101	1,889
Rural Hill				1,570	3,738
Salem	2,895	50,179	70,734	29,539	14,705
Sandoval	15	696	704	449	231
Sims				12	1,706
St. James	48	439	1,713	1,871	1,477
Storms		42	1,514	1,398	731
Tonti		835	2,556	1,250	859
Woodlawn				2,465	2,997
Old eastern fields	3,926	2,738	3,329	3,989	4,331
Other fields	1,588	3,663	5,982	9,293	13,707
	22,349	91,934	146,451	128,631	106,282

[1] Oil and Gas Journal.

[2] Included in Dale.

None of the new fields discovered compared with the larger ones of 1941. The Covington pool in Wayne County, discovered in August, was the most important. Twenty-three wells were completed in this pool, with an average initial of 479 barrels and a total production of 1,159,000 barrels up to the end of the year. Oil was found in the Benoist sand of the Boulder pool in Clinton County during the first part of the year; but it was not until October, when a well was completed to the Devonian with an initial of approximately 700 barrels,

that its importance was established. The 23 wells drilled in this field in 1942 had an average initial of 128 barrels. The St. Jacob pool, discovered in Madison County in May, is particularly important because it established a substantial production in the Trenton limestone, which has heretofore been considered unimportant. The 23 wells completed in this pool had an average initial of 213 barrels.

Indiana.—Despite the discovery of 12 new pools during 1942, production in Indiana declined to 6,743,000 barrels from 7,411,000 in 1941. More than half of the production came from the Griffin field.

Oil-well completions totaled 126 compared with 262 in 1941. Greatest activity was in Gibson and Posey Counties. Discovery of production in the Devonian lime in the Dodds Bridge area in Sullivan County was the most important find of the year.

Production of crude petroleum in Indiana, 1938–42, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	203	235	329	314	337	366	400	505	516	583	609	581	4,978
1941	627	572	642	619	648	644	656	627	595	600	566	615	7,411
1942 [1]	620	524	604	594	627	588	579	571	529	532	485	490	6,743

[1] Subject to revision.

Kansas.—A strong demand for Kansas crude oil, brought about by the decline in Illinois and Oklahoma production, resulted in intense activity in that State in 1942. The 1941 record output was exceeded by 17 percent. Reduction in drilling (forced by Regulation M–68) was relatively less than in any of the other major producing States except California, and the relative increase in wildcat wells drilled was greater than in any other major producing State.

The production of 97,636,000 barrels was 14,394,000 higher than the 83,242,000 barrels in 1941. Oil-well completions, totaling 813, had an average initial of 693 barrels compared with 1,420 wells of 1,032 barrels average initial in 1941; 351 wildcat wells were drilled compared with 214 in 1941.

Greatest activity was in the Peace Creek field in Reno County, where 102 wells were completed with an average initial of 827 barrels. Although output for the year totaled 1,650,000 barrels, there are indications that this field will be much more prominent in future. The Kraft-Prusa field in Barton County completed 74 wells with an average initial of 773 barrels. Fifty-two completions in the neighboring Trapp-Sellers field, with an average initial of 738 barrels, gave it the highest production of any in the State—9,726,000 barrels.

The Petroleum Administration for War certified production rate for petroleum liquids in Kansas was raised from 253,400 barrels daily in April to 300,700 for December. Scarcity of equipment makes it difficult for operators who installed small-capacity pumping units adapted to past allowables to obtain larger equipment. They are unable to produce the greater quota, but neighboring operators who have larger pumping units in the same fields are permitted to obtain a greater share of the oil because of the higher allowable.

Production of crude petroleum in Kansas, 1938–42, by counties and selected fields[1]

[Thousands of barrels]

County and field	1938	1939	1940	1941	1942
Barton:					
Silica-Raymond	5,534	5,000	5,763	7,615	9,063
Other fields	2,739	3,109	3,344	5,087	7,251
Butler:					
Eldorado	3,023	2,710	2,651	2,597	2,498
Other fields	2,671	2,353	2,394	2,633	2,202
Cowley	2,318	2,131	2,672	2,802	3,040
Ellis:					
Bemis-Walters	2,826	2,881	3,419	4,866	5,847
Burnett	36	254	1,771	3,291	4,097
Other fields	254	332	342	477	446
Ellsworth	1,140	1,021	1,603	2,900	3,161
Greenwood	3,834	3,793	3,227	3,238	3,601
Harvey:					
Hollow-Nikkel	773	738	511	513	346
Other fields	308	244	176	166	148
McPherson:					
Bornholdt-Welch	173	198	1,029	1,783	1,857
Graber-Hesston	1,082	965	947	951	950
Ritz Canton	1,650	1,753	1,373	1,366	1,145
Voshell	765	574	562	586	535
Other fields	335	377	400	600	1,006
Reno:					
Burrton	3,521	3,187	2,625	2,539	2,101
Other fields	776	770	634	675	2,205
Rice:					
Chase-Campbell	2,127	2,256	2,338	2,746	3,379
Geneseo-Edwards	1,427	1,753	1,814	2,694	3,716
Other fields	1,744	1,695	1,653	1,457	1,255
Russell:					
Hall-Gurney	613	1,211	2,243	3,520	4,057
Trapp-Sellens	4,162	4,255	5,481	7,577	9,726
Other fields	5,081	4,272	4,709	4,826	5,758
Sedgwick	1,418	1,247	1,156	1,093	1,011
Stafford:					
Zenith	365	1,294	1,838	3,176	3,593
Other fields	992	1,074	1,361	2,164	3,058
Sumner	1,698	1,494	1,220	977	901
Other counties	4,769	5,188	5,790	7,506	8,926
	58,154	58,129	65,046	82,421	96,879

[1] Oil and Gas Journal.

Kentucky.—Production in Kentucky continued its downward trend until near the end of 1942, the total for the year being 4,472,000 barrels compared with 4,762,000 in 1941. During the year 48 oil wells were completed compared with 233 in 1941. Production was increased materially during November and December by the development of the Smith Mills field in Henderson County, discovered in August. Production is from the McClosky lime and Cypress sand.

Production of crude petroleum in Kentucky, 1938–42, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	383	422	435	438	442	405	454	449	444	464	424	428	5,188
1941	424	387	414	407	403	385	418	386	391	397	356	394	4,762
1942[1]	344	335	376	356	348	355	361	337	357	346	460	497	4,472

[1] Subject to revision.

Louisiana.—Production of 115,726,000 barrels in Louisiana was slightly less than the 115,908,000-barrel output of 1941.

The output of the Gulf Coast area dropped 4,387,000 barrels from 90,917,000 barrels in 1941 to 86,530,000 in 1942. The decline was general, with little change in the relative standing of the large fields. Ville Platte maintained first place, producing 6,446,000 barrels (a gain of 327,000) as a result of 19 completions, with an average initial of 171 barrels. A smaller decline in the Golden Meadows field than in the Jennings put the former in second place.

The greatest gain—from 1,085,000 barrels in 1941 to 2,246,000 in 1942—and the greatest activity were in the Paradis field in St. Charles Parish. The 27 completions had an average initial of 417 barrels. The Chalkley field in Cameron Parish gained 860,000 barrels to 1,514,000. Sixteen completions in the Bayou Sale field in St. Mary Parish, with an average initial of 196 barrels, raised the year's production from the field to 943,000 barrels.

Production in northern Louisiana declined generally, but gains in the Haynesville, Olla, Little Creek, and Nebo fields raised the total output to 29,196,000 barrels from 24,991,000 in 1941.

Greatest activity during 1942 was in the old Haynesville field, where production in the Pettit lime was discovered late in 1941; 120 wells were completed, with an average initial of 412 barrels, and the output rose from 956,000 barrels in 1941 to 4,621,000 in 1942.

The Olla field proper produced approximately 4,650,000 barrels, placing it slightly ahead of Haynesville, although it should be noted that "Olla" production includes approximately 1,300,000 barrels from the Little Creek field and approximately 200,000 from the Summerville field. The increase in Olla proper was approximately 400,000 barrels and that in Little Creek approximately 900,000. Twelve oil wells were completed in Little Creek, with an average initial of 153 barrels, and 3 in Olla, with an average initial of 106 barrels.

An increase from 974,000 barrels in 1941 to 3,424,000 in 1942 raised the Nebo field to fourth largest in the State, following Rodessa. Nebo was the second most active field, with 52 wells completed, but the average initial was only 44 barrels.

In 1942, 564 oil wells were completed in Louisiana with an average of 227 barrels. Of these, 286 were in the Gulf Coast area, with an average initial of 237 barrels, and 278 were in northern Louisiana, with an average initial of 216 barrels. This compares with 1,081 completions in 1941 (467 in northern Louisiana and 616 in Gulf Louisiana), with an average initial of 189 barrels.

Production of crude petroleum in Louisiana, 1938–42, by districts and fields

[Thousands of barrels]

District and field	1938	1939	1940	1941	1942 [1]
Gulf Coast:					
Anse la Butte	74	24	380	1,446	2,235
Barataria		17	428	989	1,081
Bayou Sale				121	943
Black Bayou	1,285	1,048	1,007	838	895
Bosco	2,085	1,737	1,718	1,494	1,375
Caillou Island	6,249	4,078	2,493	2,002	1,519
Cameron Meadows	1,279	782	665	810	668
Chalkley	1	224	950	654	1,514
Charenton	1,085	2,425	2,724	1,849	1,380
English Bayou	2,176	1,613	1,565	1,301	597
Eola		943	3,935	3,668	3,313
Garden Island	828	591	1,106	1,225	1,256
Gibson	984	1,128	1,335	1,407	1,324
Golden Meadows	1	739	4,074	4,814	4,424
Grand Bay	50	496	1,168	2,022	2,010
Grand Lake		130	1,417	1,625	1,153
Hackberry	3,728	3,216	3,312	3,768	3,316
Iowa	5,641	4,436	3,475	3,400	2,506
Jeanerette	2,485	1,772	1,203	975	670
Jennings	7,537	8,119	5,505	4,991	4,402
Lafitte	5,862	4,745	4,602	4,523	3,750
Lake Barre	657	347	317	219	981
Leeville	1,867	1,303	1,135	1,597	2,287
New Iberia	5,339	4,204	3,076	2,760	1,803
North Crowley	362	827	1,602	2,004	
Paradis		16	350	1,085	2,246
Port Barre	612	681	810	1,025	965
Quarantine Bay	261	901	1,585	2,311	2,107
Roanoke	1,339	1,076	965	851	612
St. Gabriel				554	1,345
Sulphur	1,244	1,381	970	921	700
Sweet Lake	307	385	532	764	641
Tepetate	1,985	2,033	1,656	1,481	1,000
University	170	1,444	3,496	3,591	3,289
Valentine	1,691	1,127	877	512	237
Venice	492	515	855	1,163	1,294
Ville Platte	850	3,352	4,493	6,119	6,446
White Castle	593	628	806	922	907
Other Gulf Coast	7,511	9,760	[2] 12,591	[2] 19,116	[2] 19,339
Total Gulf Coast	66,630	68,243	79,178	90,917	86,530
Northern:					
Caddo	2,659	2,663	2,912	3,077	2,694
Cotton Valley	3,527	4,384	5,189	3,459	1,953
Haynesville	1,107	1,064	987	956	4,621
Homer	952	988	1,041	1,033	1,060
Lisbon	3,368	1,693	1,482	896	758
Nebo [3]			54	974	3,424
Olla [4]			942	4,641	6,107
Rodessa	13,443	9,042	6,859	5,212	4,100
Shreveport	131	1,840	1,555	1,011	923
Urania	1,003	974	869	832	778
Other Northern	2,388	2,755	[2] 2,516	[2] 2,900	[2] 2,778
Total Northern	28,578	25,403	24,406	24,991	29,196
Total Louisiana	95,208	93,646	103,584	115,908	115,726

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[3] Includes Hemphill, Trout Creek, and Jena.
[4] Includes Little Creek and Summerville.

Michigan.—Production from new fields brought the crude-oil output in 1942 to 21,754,000 barrels, which was exceeded only in the record year 1939.

The Reed City pool in Osceola County, discovered late in 1940, was the largest field in 1942, supplying 9,102,000 barrels compared with 2,754,000 in 1941. The Evart pool, discovered in May 1942 in the same county, contributed 169,000 barrels additional. This county had the greatest activity in the State, as 66 wells were drilled in the

Reed City pool and 15 in the Evart, with an average initial of 1,942 barrels for the 81 wells.

The Headquarters pool in Roscommon County was second largest, with an output of 2,321,000 barrels compared with 315,000 in 1941, its discovery year. Sixteen wells were completed in this pool and, with 11 others in the same county, had an average initial of 1,303 barrels. Completion of 43 wells in Bay County, with an average initial of 121 barrels, increased the production to only 485,000 barrels.

In all, 293 oil wells were completed in Michigan during 1942, with an average initial of 827 barrels. The Evart pool, mentioned above, was the most prolific discovery of 1942, in terms of initial production; but the Aetna, Norwich, and Riverside fields, discovered in Missaukee County, are significant because of development of production in hitherto barren territory.

Production of crude petroleum in Michigan, 1938–42, by fields [1]

[Thousands of barrels]

Year	Adams	Bloomingdale	Buckeye	Headquarters	Porter	Redding	Reed City	Sherman	Walker	Winterfield	Other fields	Total
1938	53	514	7,385	-------	1,798	874	-------	1,152	1	-------	6,968	18,745
1939	54	3,371	2,502	-------	1,331	3,083	-------	433	2,821	-------	9,867	23,462
1940	313	1,001	1,004	-------	1,234	3,986	2	461	4,218	8	7,526	19,753
1941	1,118	529	665	315	1,136	1,749	2,754	288	1,292	1,101	5,412	16,359
1942	1,030	283	496	2,321	891	740	9,102	168	681	1,259	4,783	21,754

[1] Data from Department of Conservation, Michigan.

Mississippi.—Although production in 1942 was 28,833,000 barrels compared with 15,327,000 in 1941, the trend during the latter part of the year was downward, dropping from 96,000 barrels daily in April to 60,000 in December. Virtually all of the production was from the Tinsley field, only a small amount coming from the Pickens, Sharpsburg, and Cary fields. All of the locations in the Tinsley field have now been drilled, and there is little probability of output in Mississippi increasing unless further discoveries are made. This is reflected in the drop in completions from 219 in 1941 to 20 in 1942.

Production of crude petroleum in Mississippi, 1939–42, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1939	-------	-------	-------	-------	-------	-------	-------	-------	5	17	32	53	107
1940	117	189	235	231	252	317	276	578	761	480	448	516	4,400
1941	551	603	570	770	901	858	1,425	1,598	1,694	1,932	2,240	2,185	15,327
1942 [1]	2,489	2,601	2,708	2,885	2,648	2,531	2,469	2,366	2,194	2,126	1,953	1,863	28,833

[1] Subject to revision.

Montana.—An increase of 548,000 barrels raised crude-oil production in Montana to 8,074,000 barrels in 1942. Principally responsible was the Cut Bank field, where the production was 5,509,000 barrels—489,000 more than in 1941. Seventy-five wells were completed in this field, with an average initial of 150 barrels. Completion of 46 wells in the Kevin-Sunburst field, with an average initial of 47 barrels,

was reflected in an increase in production from 1,753,000 barrels in 1941 to 1,992,000 in 1942. All the other fields, of small production, declined.

There were 123 wells completed in the State, with an average initial of 109 barrels.

Production of crude petroleum in Montana, 1938–42, by fields

[Thousands of barrels]

Year	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Frannie	Kevin-Sunburst	Lake Basin	Pondera	Other fields	Total
1938	211	2,809	365	8	------	1,290	18	210	35	4,946
1939	196	3,545	319	14	------	1,576	18	276	16	5,960
1940	187	4,091	175	16	5	1,923	18	305	8	6,728
1941	173	5,020	170	17	26	1,753	17	286	[1] 64	7,526
1942 [2]	138	5,509	110	16	21	1,992	13	264	[1] 11	8,074

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Subject to revision.

Nebraska.—Production in 1942 totaled 1,237,000 barrels compared with 1,898,000 in 1941. The output declined rapidly from the peak of 221,000 barrels in October 1941 to 78,000 in December 1942. The Falls City field supplied two-thirds of the total and the Barada field a little less than one-third.

Ten wells were completed in the State in 1942, seven of them in the Barada field and two in the Falls City field.

Production of crude petroleum in Nebraska, 1939–42, by months

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1939	------	------	------	------	------	------	------	------	------	------	1	1	2
1940	3	2	------	------	3	8	7	7	8	65	90	83	276
1941	123	101	113	132	131	134	160	193	216	221	205	169	1,898
1942 [1]	115	117	122	118	116	113	104	99	90	87	78	78	1,237

[1] Subject to revision.

New Mexico.—A sharp decline brought production down to 31,544,000 barrels in 1942 compared with 39,569,000 in the peak year 1941. The decline was general, and Maljamar was the only major field producing more in 1942 than in 1941. The Monument field maintained first place, with the neighboring Eunice field second.

The greatest drilling activity was in the Square Lake pool in Eddy County, discovered early in 1942. Ninety-two wells were completed in this field, with an average initial of 179 barrels. The total output for the year was 290,000 barrels. Completions in the Maljamar field totaled 35, with an average initial of 219 barrels, and 32 wells were completed in the Jackson-Grayburg field, with an average initial of 164 barrels. Although only 9 wells each were completed in the Arrowhead and Loco Hills fields, their average initial was 393 and 372 barrels, respectively.

Production of crude petroleum in New Mexico, 1938–42, by districts and fields [1]

[Thousands of barrels]

Year	Arrowhead	Eunice	Grayburg-Jackson	Hobbs	Loco Hills	Maljamar and South	Monument	Vacuum	Other Southeast	Northwest	Total
1938	(2)	8,966	------	5,040	------	(2)	9,451	886	11,321	345	36,009
1939	(2)	7,863	1,509	4,401	377	330	8,206	3,028	11,651	303	37,668
1940	916	6,561	1,773	3,785	1,959	760	6,887	4,738	11,124	254	38,757
1941	1,429	6,658	1,627	3,686	2,308	1,651	6,960	4,800	10,335	206	39,660
1942 [3]	1,195	5,242	1,566	2,928	1,583	1,740	6,698	3,443	8,417	180	32,992

[1] Oil and Gas Journal.
[2] Included under "Other Southeast."
[3] Subject to revision.

New York.—Greater drilling activity further increased the output in New York to 5,421,000 barrels compared with 5,185,000 in 1941. New completions, according to the Oil Weekly, totaled 711 compared with 674 in 1941. New York was one of the four States where 1942 completions were greater than those in 1941.

Production of crude petroleum in New York, 1938–42, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	458	430	438	444	439	402	425	396	383	408	379	397	4,999
1941	424	372	410	436	435	422	456	438	445	465	414	468	5,185
1942 [1]	453	405	454	458	455	467	474	456	459	461	425	454	5,421

[1] Subject to revision.

Ohio.—The production of 3,543,000 barrels in 1942 was slightly higher than the 3,510,000 produced in 1941. Production of Pennsylvania-Grade oil increased from 1,459,000 barrels in 1941 to 1,637,000 in 1942. Greatest activity was in Perry County, where Pennsylvania-Grade oil is produced and 80 oil wells were completed; the Clayton pool was extended both northward and westward. Washington County had 28 completions and neighboring Monroe County 15. Medina County, in the central part of the State, had 24 completions. Completions for the State totaled 235.

Production of crude petroleum in Ohio, 1938–42, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	207	234	246	264	280	260	286	287	272	296	248	279	3,159
1941	278	255	273	294	300	297	298	286	300	316	289	324	3,510
1942 [1]	277	262	296	317	297	322	319	297	300	308	280	268	3,543

[1] Subject to revision.

Oklahoma.—Production in Oklahoma declined to 140,690,000 barrels from 154,702,000 in 1941. The largest reduction was in the Oklahoma City field, which dropped to 26,484,000 barrels from

32,184,000 in 1941, although the field maintained first place. Seminole, the second largest field, dropped to 20,408,000 barrels from 23,687,000 in 1941. Production in the Hewitt field was 3,304,000 barrels and in Osage 4,716,000, representing losses of 32 percent and 23 percent.

In 1942, 544 wells were completed in the State, with an average initial of 374 barrels, compared with 1,099 wells with an average initial of 226 barrels in 1941. Greatest activity was in the Hotulke field, Pottawatomie County, where new production was discovered in 1941 in the Viola and Wilcox formations. Thirty-four wells were completed in this field, with an average initial of 256 barrels. The St. Louis field in the same county, which was extended north and east in 1941, had 24 completions, with an average initial of 237 barrels. The Apache field, discovered in Caddo County in 1941, had 19 completions, with an average initial of 2,381 barrels.

Outstanding was the discovery of the Pauls Valley field in Garvin County in April. Thirteen wells completed in this field had the unusually high average initial of 5,253 barrels, from the Wilcox and Pennsylvanian formations. The Watchorn field, discovered in Pawnee County in May, had 11 completions, with an average initial of 551 barrels from the Wilcox, and the Ardmore pool discovered in Carter County in October had 2 completions in the Springer Sand, which had an average initial of 666, barrels.

Production of crude petroleum in Oklahoma, 1898–42, by fields [1]

[Thousands of barrels]

Field	1938	1939	1940	1941	1942
Allen	2,475	2,289	2,066	1,780	1,365
Apache				274	1,740
Beebe	1,017	1,005	1,828	1,526	1,152
Billings	2,108	2,178	2,209	2,276	2,064
Bristow-Slick	2,389	2,403	2,213	1,951	1,777
Burbank	2,814	2,689	2,838	3,282	3,356
Cement	1,336	1,826	2,469	3,354	3,211
Coyle		386	637	1,468	1,660
Crescent	1,687	983	769	576	752
Cromwell	1,288	1,175	1,357	1,457	2,380
Cumberland			393	2,543	2,776
Cushing-Shamrock	3,848	3,446	3,353	3,223	3,069
Dill	405	358	635	1,426	548
Edmond	2,030	1,675	1,488	1,224	1,136
Fish	1,224	1,376	1,153	1,359	923
Fitts	16,655	9,120	6,246	4,223	3,050
Healdton	3,401	3,236	3,177	3,086	2,827
Hewitt	1,400	1,362	1,778	4,860	3,304
Keokuk	1,713	1,176	1,091	1,029	1,012
Lucien	3,324	3,017	2,750	2,067	1,877
Nowata County	4,390	4,348	4,306	3,995	3,787
Oklahoma City	38,796	35,728	35,970	32,184	26,484
Olympic	1,889	1,034	739	598	490
Osage (outside Burbank-South Burbank)	6,438	6,063	5,904	6,131	4,716
Ramsey	528	1,489	1,377	1,549	1,664
Seminole field:					
Bowlegs	3,200	2,678	2,464	2,134	1,900
Carr City	1,294	922	840	791	662
Earlsboro	3,751	3,590	3,730	3,757	3,718
Konawa	569	656	766	1,245	670
Little River	3,040	2,865	2,875	2,705	2,333
St. Louis-Pearson	7,766	11,303	9,331	6,997	5,687
Seminole City	2,842	2,618	2,501	2,243	2,854
Other Seminole districts	6,390	5,310	4,482	3,815	2,584
Total Seminole field	28,852	29,942	26,989	23,687	20,408
Sholem-Alechem-Tatums-Tussy	2,249	1,699	2,169	2,826	2,490
South Burbank	3,938	3,150	2,927	2,780	2,728
Other fields	32,271	30,331	31,936	36,523	34,015
Total Oklahoma	168,465	153,484	150,767	153,257	136,761

[1] Oil and Gas Journal.

Pennsylvania.—Although the crude-oil output of 17,779,000 barrels was more than a million barrels higher than in 1941, the trend was downward after midyear, despite a price increase designed to encourage development. Although production was the largest since 1937, crude-oil stocks of Pennsylvania origin declined from 2,142,000 barrels at the end of 1941 to 1,610,000 at the end of 1942.

Pennsylvania and New York suffered less from drilling restrictions than any other State; the oil-well completions in Pennsylvania, as reported by the Oil Weekly, increased from 1,722 to 1,802, although those in the Bradford field (partly in New York) declined from 1,540 to 1,493.

Production of crude petroleum in Pennsylvania, 1938–42, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	1,522	1,505	1,530	1,582	1,585	1,335	1,418	1,387	1,321	1,405	1,319	1,444	17,353
1941	1,416	1,231	1,336	1,382	1,407	1,345	1,419	1,376	1,440	1,501	1,370	1,527	16,750
1942 [1]	1,501	1,332	1,518	1,582	1,522	1,560	1,526	1,508	1,481	1,502	1,359	1,388	17,779

[1] Subject to revision.

Texas.—Texas production receded 4 percent from its 1941 record of 505,572,000 barrels to 483,371,000 in 1942. Only the Panhandle area had a substantial gain, and losses in some areas were relatively large. Oil wells completed totaled 3,049 compared with 7,262 in 1941.

A slight increase brought production in the Gulf Coast area to 135,020,000 barrels. The Conroe field maintained its lead and gained 1,884,000 barrels to produce 13,514,000 in 1942. Hastings, however, had the largest gain—2,789,000 barrels—which brought its production to 10,412,000. Saxet, largest field in 1938, produced only 2,728,000 barrels in 1942.

There were 724 wells completed in the Gulf Coast area, with an average initial of 165 barrels, compared with 1,353 in 1941, with an average of 196 barrels. Greatest activity was in the Withers-Magnet field, where 62 wells were completed, with an average initial of 136 barrels, and where production increased from 2,829,000 barrels in 1941 to 4,165,000 in 1942. The Seeligson field, discovered in Jim Wells County in April 1941, had 61 completions, with an average initial of 125 barrels. There were 55 completions each in the North La Ward and Stratton fields, 38 in the Agua Dulce, and 32 in the Odem field.

The Mercy field, discovered in January 1942 in San Jacinto County, was a most important find, as it is believed to include one of the largest areas of Wilcox sand of any field in the State. There were seven completions, with an average initial of 409 barrels. Another discovery in the Wilcox sand was Camp Eleven in Tyler County, where two completions had an average initial of 594 barrels.

Production in West Texas totaled 81,775,000 barrels, compared with 92,907,000 in 1941. The Wasson field, despite a decline of 3,719,000 barrels—from 13,120,000 to 9,401,000—still ranked first. The Slaughter-Dean pool, however (with a gain of 2,732,000 barrels to 7,531,000), promises to overtake it. A 859,000-barrel gain gave

Yates 6,749,000, displacing Goldsmith, which dropped from 8,232,000 barrels to 6,569,000.

In West Texas, 1,079 oil wells were completed, with an average initial of 825 barrels, compared with 2,123 wells averaging 841 barrels in 1941. This material decline resulted from the lack of pipe-line facilities more than from the restraints on drilling from Regulation M–68 (previously described). Greatest activity was in the Slaughter field, where 421 completions had an average initial of 1,051 barrels from the San Andres lime. Wasson was the next most active field, with 93 completions and an average initial of 555 barrels; despite this, output declined 28 percent. The Keystone-Colby pool had 45 completions and the Abell pool 40, with 233 barrels and 983 barrels average initial, respectively.

Andrews County led in discoveries. Principal among the eight new fields and extensions in this county was Fullerton, discovered in February. Eight wells were completed in the field, with an average initial of 810 barrels from the Clear Fork lime. The Embar pool, discovered in this county in May, had five completions in the Ellenburger formation, with an average initial of 864 barrels. Two other wells that failed to find oil in the Ellenburger were plugged back to the Clear Fork lime and yielded an average initial of 262 barrels.

One of the most significant discoveries relating to reserves was production from the Ellenburger formation in the Monahans pool, Ward County, in May. The one well drilled had an initial of 2,852 barrels. One other well drilled to the Clear Fork lime in this pool had an initial of 759 barrels.

Production from eastern Texas totaled 153,707,000 barrels, compared with 159,960,000 in 1941. The East Texas field proper declined 9,615,000 barrels to 122,871,000. Only five small wells were completed in this field during the year, compared with 428 in 1941. Talco had the next highest production—9,522,000 barrels—and Hawkins was third at 5,451,000.

There were 240 completions in eastern Texas, with an average initial of 228 barrels, compared with 798 wells averaging 160 barrels plus 16 border wells completed in 1941. Greatest activity was in the Hawkins field, Wood County, discovered in 1940; 133 wells were completed, with an average initial of 202 barrels. Chapel Hill, in Smith County, also discovered in 1940, had 29 completions, with an average initial of 289 barrels.

Wood County had two new discoveries in 1942 in the Paluxy sand; these were the Coke and Quitman pools. The Coke pool, found in June, had 25 completions for an average initial of 416 barrels; the Quitman pool was found on December 1, and the discovery well produced an initial of 726 barrels daily. The Kildare pool, discovered in Cass County in March, had eight completions with an average initial of 388 barrels from the Gloyd lime; and the Weiland pool, discovered in Hunt County in June, had 6 completions with an average initial of 183 barrels from the Woodbine sand.

Production in North Texas totaled 49,851,000 barrels compared with 48,529,000 in 1941. Principally responsible for the increase was development of the Ellenburger formation of the K. M. A. pool, output of which rose from 613,000 barrels in 1941 to 2,168,000 in 1942, more than offsetting the drop in yield from the shallower formations in this field. Total production for the field was 11,219,000 barrels. Of the

94 wells drilled in this field, 57 were to the Ellenburger and had an average initial of 849 barrels. The 37 other wells averaged 334 barrels. Before 1941 Ellenburger production was inconsequential in North Texas, but development in the K. M. A. field and other fields where it has since been found has added substantially to North Texas reserves.

The Hull-Silk field, with only five new completions, held second place with 3,819,000 barrels—virtually the same output as in 1941.

North Texas had 527 completions during 1942, with an average initial of 304 barrels, compared with 1,727 in 1941, with an average initial of 192 barrels. Next to K. M. A., greatest activity was in the Wimberly field in Jones County, where 29 wells were completed, with an average initial of 331 barrels.

The Forestburg pool, discovered in May in Montague County, was one of the most important finds of the year. Seven completions in this pool had an average initial of 1,071 barrels. The Sanders pool, discovered in this same county in April, had three completions, with an average initial of 1,320 barrels. The Padgitt pool, discovered in Young County in June, had three completions, with an average initial of 1,448 barrels. Other important discoveries were the Hoefle pool in Jack County, the Cooker pool in Coleman County, and the Reddin pool in Taylor County.

Central Texas had a discovery of especial significance—the South Caesar field in Bee County, found in February. Twelve oil wells have been completed with an average initial of 338 barrels, from the Carrizo sand.

Panhandle Texas reaped the benefit in 1942 from the 1941 drilling activity, which raised the monthly production 50 percent between the beginning and end of 1941. This area, with its increase in production from 27,831,000 barrels in 1941 to 30,881,000 in 1942, was the only one of major importance in Texas to show a substantial gain. Completions totaled 258 compared with 648 in 1941.

Production of crude petroleum in Texas, 1938–42, by districts and fields

[Thousands of barrels]

District and field	1938	1939	1940	1941	1942 [1]
Gulf Coast:					
Amelia	1,294	951	894	1,220	1,375
Anahuac	2,887	2,604	2,683	4,657	3,589
Barbers Hill	3,413	3,165	3,180	3,076	2,879
Conroe	11,606	9,320	9,303	11,630	13,514
Dickinson-Gillock	2,227	2,946	2,940	2,191	2,073
Fairbanks	839	2,668	2,460	2,932	2,784
Flour Bluff	1,736	1,362	1,151	1,336	426
Friendswood	1,078	2,323	2,542	2,959	3,615
Goose Creek	596	619	571	509	484
Greta	4,190	1,993	1,493	2,357	1,132
Hardin	1,621	2,180	1,646	1,659	1,091
Hastings	6,940	6,354	5,421	7,623	10,412
Heyser	3,051	3,470	3,399	2,633	2,926
High Island	900	866	966	985	880
Hull	2,899	2,077	2,005	2,387	2,217
Humble	1,202	1,041	957	913	809
Lolita			215	1,454	2,269
Lovell's Lake	51	245	882	1,334	1,784
Luby	1,578	2,472	1,459	1,396	782
Manvel	3,222	2,718	2,627	1,915	1,906
Old Ocean	1,782	3,209	4,165	4,741	3,701
Orange	483	887	889	862	672
Pierce Junction	1,117	897	628	637	561
Placedo	3,088	2,298	1,882	1,401	1,228
Raccoon Bend	1,206	1,034	1,232	1,329	1,587

See footnotes at end of table.

Production of crude petroleum in Texas, 1938–42, by districts and fields—Continued

[Thousands of barrels]

District and field	1938	1939	1940	1941	1942 [1]
Gulf Coast—Continued.					
Refugio	2,093	2,097	2,111	2,223	1,542
Saxet-Saxet Heights	13,130	8,953	5,634	4,578	2,728
Segno	708	958	1,606	1,538	1,290
Spindletop	837	782	609	486	419
Sugarland	1,222	1,242	1,354	647	614
Thompsons	3,998	4,617	4,384	4,609	5,392
Tomball	2,635	2,630	2,675	3,314	3,146
West Beaumont	571	1,033	1,149	821	738
West Columbia	1,600	2,261	2,353	2,740	1,984
West Ranch	19	280	1,862	3,691	5,249
White Point	387	2,089	3,054	2,864	2,934
Withers-Magnet	925	1,330	1,712	2,829	4,165
Other Gulf Coast	28,456	36,552	[2] 38,073	[2] 40,256	[2] 40,123
Total Gulf Coast	115,587	122,523	122,166	134,732	135,020
East Texas:					
East Texas proper [3]	152,116	144,615	141,023	132,486	122,871
Cayuga	3,191	3,472	4,432	4,303	4,419
Hawkins				1,432	5,451
Long Lake	721	867	828	1,342	1,463
Rodessa	11,373	9,785	6,607	4,712	3,166
Sulphur Bluff	1,653	1,536	1,522	1,582	1,549
Talco	9,593	9,609	8,818	9,038	9,522
Van	5,630	5,333	4,512	3,739	3,444
Other East Texas	611	738	1,177	1,326	1,822
Total East Texas	184,888	175,955	168,919	159,960	153,707
Central Texas:					
Darst Creek	2,816	2,707	2,178	1,845	2,220
Luling	2,497	2,443	2,256	1,974	1,754
Lytton Springs	1,057	867	649	577	456
Mexia [4]	1,635	1,494	1,418	1,531	1,480
Pettus	2,088	1,515	1,276	1,061	384
Salt Flat (Bruner)	1,419	1,594	1,512	1,348	1,118
Other Central Texas	1,175	1,049	1,139	1,259	1,098
Total Central Texas	12,687	11,669	10,428	9,595	8,510
North Texas [5]	36,823	40,371	[6] 48,153	[6] 48,529	[6] 49,851
Panhandle [7]	23,556	24,165	26,716	27,831	30,881
South Texas [8]	29,597	29,392	32,333	32,018	23,627
West Texas:					
Andrews County	1,309	1,587	1,506	2,224	1,345
Big Lake	2,381	2,275	2,075	1,938	1,839
Fisher County	1,208	1,059	835	655	572
Slaughter	73	416	841	4,612	7,403
Ward County	8,878	7,795	7,580	7,189	5,890
Other West Texas	58,863	66,321	[2] 71,657	[2] 76,289	[2] 64,726
Total West Texas	72,712	79,453	84,494	92,907	81,775
Total Texas	475,850	483,528	493,209	505,572	483,371

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[3] Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[4] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[5] Includes the fields in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[6] Includes crude oil consumed on leases and net change in stocks held on leases for East (exclusive of East Texas proper), Central, North, and South Texas.
[7] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[8] Includes fields in Duval, Hidalgo, Jim Hogg, Jim Wells, Starr, Webb, and Zapata Counties.

West Virginia.—A small gain raised the production in West Virginia to 3,574,000 barrels compared with 3,433,000 in 1941. During the year 118 wells were completed, compared with 115 in 1941.

Production of crude petroleum in West Virginia, 1938–42, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	234	301	285	300	311	276	303	291	286	312	264	281	3,444
1941	286	249	276	300	290	280	297	283	289	311	270	302	3,433
1942 [1]	294	267	310	313	297	306	306	305	310	321	267	278	3,574

[1] Subject to revision.

Wyoming.—Production in Wyoming increased from 29,878,000 barrels in 1941 to 31,392,000 in 1942. Lance Creek, the principal field, decreased from 8,838,000 barrels to 7,823,000 despite the completion of 12 wells with an average initial of 171 barrels.

Although Salt Creek again declined, it maintained second place with 4,989,000 barrels output, followed closely by Oregon Basin, with a yield of 4,711,000 barrels compared with 3,197,000 in 1941. Good transportation, the need for heavy oil, and prospects for higher prices for that type of crude combined to focus attention on this field. Accordingly, 27 wells were completed, with an average initial of 451 barrels.

Ninety-three oil wells were completed in the State, with an average initial of 317 barrels, compared with 123 completions averaging 395 barrels in 1941. One of the most important finds of the year was production in November in the deep Tensleep formation of the Elk Basin field. A discovery of promising possibilities was the Horsecreek field in Laramie County in November. The one well completed in this field had an initial production of 580 barrels from the Lakota sand. New production was found in the Pilot Butte field in the Tensleep sand in March and in the Embar lime in September. The Tensleep discovery well had an initial of 750 barrels and the Embar discovery 500 barrels, which later turned to water.

Production of crude petroleum in Wyoming, 1938–42, by fields

[Thousands of barrels]

Year	Big Muddy	Byron-Garland	Cole Creek	Elk Basin	Frannie	Grass Creek	Hamilton Dome-Warm Springs	La Barge	Lance Creek	Lander-Dallas-Derby Dome
1938	441	836	23	94	419	513	346	395	4,846	306
1939	435	867	24	203	496	844	240	379	6,884	278
1940	429	1,411	65	190	812	718	353	585	9,121	290
1941	421	1,516	295	195	939	1,171	264	767	8,838	309
1942 [1]	402	2,163	372	156	1,013	1,524	173	767	7,823	294

Year	Lost Soldier-Ferris-Wertz	Medicine Bow	Oregon Basin	Osage	Poison Spider-South Casper	Quealy	Rock Creek	Salt Creek	Other fields	Total
1938	1,037	1,040	1,648	116	196	271	640	5,705	150	19,022
1939	1,592	544	1,848	132	26	225	1,008	5,331	98	21,454
1940	2,070	251	2,725	59	238	172	928	5,201	[2] 93	25,711
1941	4,745	245	3,197	132	251	158	952	5,146	[2] 337	29,878
1942 [1]	5,118	231	4,711	114	236	170	933	4,989	[2] 203	31,393

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

WELLS

The number of wells drilled in the United States in 1942, including oil and gas wells and dry holes, dropped 39 percent to 17,934 compared with 29,070 in 1941.

Oil-well completions declined 46 percent—from 19,195 in 1941 to 10,302 in 1942. Regulation M–68 (previously described) was the principal reason for such severe curtailment, although exhaustion of drilling sites and lack of transportation to market for production already acquired were contributing causes.

The greatest relative decline was in Mississippi, where exhaustion of drilling locations caused completions to drop 91 percent from 219 in 1941 to 20 in 1942. The 3,049 wells completed in Texas were 58 percent less than the 7,262 completed in 1941, and the ratio of completions to total for the United States dropped from 38 percent in 1941 to 30 in 1942. The 1,107 completions in Illinois were 59 percent less than the 2,730 in 1941, and only 11 percent of the total wells drilled in the United States were drilled in this State compared with 14 percent in 1941. The relative number of oil wells completed in the Eastern States rose from 15 percent in 1941 to 26 percent in 1942, but the actual number declined from 2,895 to 2,662, or 8 percent.

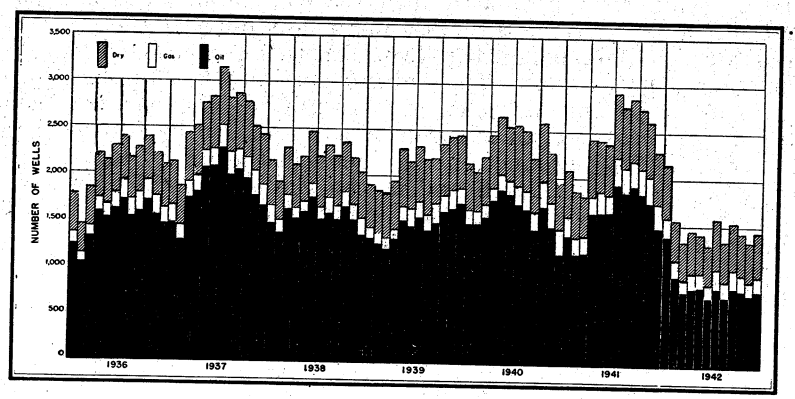

FIGURE 4.—Wells drilled in the United States, 1936–42, by months.

The 5,532 dry holes drilled in 1942 were 20 percent less than the 6,885 drilled in 1941. The smaller decline, compared with oil-well completions, reflects the lack of restrictions under Regulation M–68 against obtaining material for exploratory wells. However, difficulty in getting equipment, even with priorities, and in getting drilling crews because of lack of manpower, as well as narrowing margins of profit as drilling costs advanced against a stable crude-oil price contributed toward curtailment of exploratory operations. The Office of Price Administration proposed that the Government subsidize the cost of drilling exploratory wells to stimulate the search for new reserves yet avoid raising the price of oil. Of the total wells drilled, 3,166 were exploratory; 466 discovered oil and 57 gas, and 2,643 were dry.

The average depth per well drilled, according to the Oil Weekly, was 3,038 feet compared with 2,963 feet in 1941. Deeper drilling to

reach new production discovered in lower formations was partly offset by such factors as relatively fewer wells drilled in Illinois and Texas, where formations are deep, compared with eastern fields in which a relatively greater number of wells were drilled; and emphasis in California on heavy-oil production, the deposits of which are nearer the surface than those of light oil.

Wells drilled for oil and gas in the United States, 1941–42, by months [1]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Percent
1941														
Oil	1,368	1,150	1,184	1,612	1,615	1,599	1,934	1,829	1,913	1,821	1,723	1,447	19,195	66.0
Gas	211	198	182	202	236	220	296	288	272	285	308	292	2,990	10.3
Dry	506	487	434	603	554	533	687	647	660	644	584	546	6,885	23.7
	2,085	1,835	1,800	2,417	2,405	2,352	2,917	2,764	2,845	2,750	2,615	2,285	29,070	100.0
1942														
Oil	1,373	953	778	825	847	726	833	745	836	817	765	804	10,302	57.4
Gas	225	171	144	162	150	157	224	182	204	172	152	157	2,100	11.7
Dry	569	422	404	461	425	426	521	421	505	449	435	494	5,532	30.9
	2,167	1,546	1,326	1,448	1,422	1,309	1,578	1,348	1,545	1,438	1,352	1,455	17,934	100.0

[1] Oil and Gas Journal east of California; American Petroleum Institute in California.

Wells drilled in the United States, 1941–42, by States and districts [1]

State and district	1941				1942			
	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
Arkansas	95	20	83	198	103	7	74	184
California [2]	920	19	179	1,118	557	25	247	829
Colorado	16	4	13	33	10	1	14	25
Illinois	2,730	12	890	3,632	1,107	14	787	1,908
Indiana	262	48	203	513	126	24	195	345
Kansas	1,420	76	517	2,013	813	79	627	1,519
Kentucky	233	275	198	706	48	152	49	249
Louisiana:								
Gulf Coast	614	18	240	872	286	17	141	444
Northern	467	93	231	791	278	27	166	471
Total Louisiana	1,081	111	471	1,663	564	44	307	915
Michigan	433	86	419	938	293	70	300	663
Mississippi	219	4	59	282	20	-------	48	68
Montana	160	70	53	283	123	69	26	218
Nebraska	38	-------	51	89	10	-------	23	33
New Mexico	209	15	53	277	180	9	48	237
Oklahoma	1,099	140	582	1,821	544	92	540	1,176
Pennsylvania, New York, Ohio, and West Virginia	2,895	1,804	771	5,470	2,662	1,306	598	4,566
Texas:								
Gulf Coast	1,353	72	387	1,812	724	67	349	1,140
East Texas	814	-------	14	828	240	22	145	407
West Texas	2,123	13	163	2,299	1,079	11	180	1,270
Rest of State	2,972	210	1,712	4,894	1,006	102	933	2,041
Total Texas	7,262	295	2,276	9,833	3,049	202	1,607	4,858
Wyoming	123	6	33	162	93	6	20	119
Other States	-------	5	34	39	-------	-------	22	22
Total United States	19,195	2,990	6,885	29,070	10,302	2,100	5,532	17,934

[1] Oil and Gas Journal, except California. [2] American Petroleum Institute.

Producing oil wells in the United States and average production per day in 1941, 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	24.5	New York	21,500	0.7
California [2]	16,700	39.7	Ohio	24,400	.4
Colorado	200	30.2	Oklahoma	54,200	7.9
Illinois	22,300	16.9	Pennsylvania	81,700	.6
Indiana	1,750	11.9			
Kansas	23,200	10.1	Texas:		
Kentucky	14,400	1.9	Gulf Coast	12,500	30.5
			East Texas proper	25,850	13.9
Louisiana:			West Texas	14,300	19.1
Gulf Coast	2,600	96.7	Rest of State	47,400	8.6
Northern	3,900	18.4			
			Total Texas	100,050	14.2
Total Louisiana	6,500	50.4	West Virginia	17,400	.5
Michigan	3,160	14.7	Wyoming	3,450	23.5
Mississippi	330	188.7	Other States [3]	140	1.4
Montana	1,920	11.1			
Nebraska	70	104.0	Total wells	399,960	9.7
New Mexico	3,610	31.3			

[1] Figures for 1942 not yet available.
[2] American Petroleum Institute.
[3] Missouri, Tennessee, and Utah.

STOCKS

Total crude-oil stocks declined about 12 million barrels in 1942 compared with about 19 million barrels in 1941. An increase of over 16 million barrels in the first quarter was due to the disruption of transportation, resulting in abnormal liquidation of 27 million barrels of refined stocks that reduced the expected demand for domestic crude petroleum. While the draft on refined stocks continued during the second quarter, a sharp drop in crude production and in crude imports resulted in a decrease of about 11 million barrels in crude stocks. In spite of a substantial recovery in production, crude stocks dropped 12 million barrels more in the third quarter, mainly because of low imports of crude and efforts to rebuild stocks of refined products. In the fourth quarter, the seasonal rise in the demand for all oils resulted in an increased production of crude as well as a further reduction of about 5 million barrels in crude stocks. Total stocks of crude petroleum amounted to 245,219,000 barrels on December 31, 1942, compared with 257,063,000 barrels on December 31, 1942. Stocks of foreign crude declined over 2 million barrels, and stocks of domestic origin were reduced by almost 10 million barrels.

Stocks of crude petroleum, natural gasoline, and refined products in the United States at end of year, 1938–42

[Thousands of barrels]

Product	1938	1939	1940	1941	1942 [1]
Crude petroleum (refinable):					
At refineries	51,551	49,215	52,448	51,319	43,620
Pipe line and tank farm	211,138	178,810	200,726	183,992	177,904
Producers	11,476	11,953	11,535	12,188 / [2] 11,573	12,830
Total refinable	274,165	239,978	264,709	247,499 / [2] 246,884	234,354
California heavy crude	16,467	13,330	11,906	10,179	10,865
Total crude petroleum	290,632	253,308	276,615	257,678 / [2] 257,063	245,219
Natural gasoline	4,830	4,421	5,704	4,275 / [2] 4,437	4,632
Refined products [3]	272,241	268,109	282,265 / [2] 280,958	290,375 / [2] 294,310	247,554
Grand total	567,703	525,838	564,584 / [2] 563,277	552,328 / [2] 555,810	497,405

[1] Subject to revision.
[2] For comparison with succeeding year.
[3] Includes equivalents for wax, coke, and asphalt in barrels.

The data on stocks of crude oil, by States of origin for 1942, show that the largest decreases were 12.7 million for Oklahoma, 9.0 million for Illinois, and 2.1 million for California crude of all grades. Smaller declines occurred in the stocks of all other important producing States except Texas, where stocks increased about 21.7 million barrels. These figures reflect chiefly the result of the decline in tanker movements from the Gulf to the East Coast district and the necessity of liquidating crude stocks located closer to consuming centers during the period of establishing new transport routes.

Stocks of crude petroleum in the United States in 1942, by States of location and origin and by months [1]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
LOCATION													
Arkansas	1,988	1,950	2,040	2,230	2,062	1,924	1,875	1,776	1,727	1,707	1,592	1,595	1,550
California [2] [3]	35,591	37,757	39,186	38,548	38,752	37,255	35,672	36,081	36,256	34,924	33,025	31,744	32,770
Illinois	12,704	12,290	12,363	11,809	11,844	10,923	10,294	9,055	9,371	9,013	9,805	9,039	9,127
Indiana	3,007	3,478	3,418	3,605	3,849	3,787	3,558	3,459	3,524	2,749	2,768	2,975	3,193
Kansas and Nebraska	9,063	9,464	9,095	9,091	8,555	8,444	8,743	9,192	9,199	9,336	9,114	9,108	8,396
Louisiana, Alabama, and Mississippi	11,739	12,109	11,607	11,925	11,493	11,497	11,519	10,736	9,722	9,382	9,439	9,643	9,240
Maryland [4]	2,149	2,142	1,686	1,374	1,470	1,267	1,437	1,174	1,123	1,171	1,232	1,400	1,267
Michigan, Kentucky, and Tennessee	3,890	3,669	3,487	3,384	3,304	3,316	3,317	3,534	3,207	2,971	2,796	2,889	3,063
Missouri [5]	4,421	4,374	4,417	4,103	4,174	4,090	4,089	4,279	4,016	4,100	4,263	4,320	4,152
Montana and Colorado	2,170	2,087	1,993	1,959	2,104	1,966	1,874	1,893	1,727	1,522	1,424	1,324	1,335
New Jersey	5,366	4,716	3,988	3,638	2,720	2,694	2,835	3,153	3,238	3,286	2,734	2,372	2,628
New Mexico	1,209	1,280	1,163	1,202	1,203	1,072	1,188	1,099	1,188	1,165	1,309	1,426	1,374
New York	1,153	1,389	1,338	1,248	1,220	1,007	1,181	1,150	1,170	952	877	850	706
Ohio	8,548	9,342	9,582	9,811	8,803	7,797	7,352	6,546	6,675	6,064	5,956	5,759	6,131
Oklahoma	38,768	38,132	37,891	37,987	38,751	38,049	38,550	36,941	36,080	35,229	33,257	31,932	31,908
Pennsylvania	6,379	6,145	5,776	5,320	5,334	5,445	5,829	5,780	5,553	5,545	5,217	5,562	5,507
Texas	84,051	88,870	97,102	100,189	97,894	99,827	98,230	95,508	96,510	97,606	99,763	99,475	99,231
West Virginia	1,371	1,354	1,311	1,355	1,325	1,293	1,192	1,122	1,167	1,076	1,053	1,027	1,072
Wyoming [6]	13,317	12,983	13,401	13,054	12,904	12,924	12,686	12,548	12,672	12,245	11,737	11,660	11,704
Total United States	246,884	253,531	260,844	261,832	257,761	254,577	251,421	245,026	244,125	240,043	237,361	234,100	234,354
ORIGIN													
Arkansas	2,750	2,855	2,945	3,111	3,020	2,918	2,802	2,618	2,575	2,577	2,312	2,276	2,476
California [3]	35,596	37,767	39,184	38,531	38,737	37,249	35,650	36,073	36,240	34,915	[7] 33,013	31,625	32,757
Illinois and Indiana	18,413	18,734	18,958	19,156	17,584	14,917	13,656	12,194	11,441	10,261	10,080	9,646	9,492
Kansas and Nebraska	7,704	8,174	8,126	8,086	8,465	8,149	8,490	7,876	7,274	7,137	7,362	7,178	7,052
Louisiana and Mississippi	15,318	16,127	15,697	15,619	14,920	15,539	15,759	15,782	14,717	14,392	14,609	14,543	13,916
Michigan and Kentucky	2,943	2,608	2,571	2,601	2,533	2,514	2,849	2,640	2,370	2,351	2,209	2,155	2,236
Montana and Colorado	1,865	1,806	1,677	1,655	1,869	1,693	1,594	1,549	1,422	1,260	1,153	1,197	1,123
New Mexico	7,078	7,548	7,813	7,820	7,188	6,715	6,058	5,720	5,786	5,846	5,871	5,565	5,803
Ohio	509	517	521	489	500	516	480	505	439	487	441	422	500
Oklahoma	51,919	50,964	50,547	49,747	49,243	47,029	45,680	44,184	43,729	42,627	41,511	39,969	39,196
Pennsylvania, New York, and West Virginia	3,454	3,362	3,270	3,248	3,345	3,177	3,215	3,289	3,207	3,053	2,926	2,857	2,710
Texas	82,297	86,667	93,161	96,069	95,322	99,559	100,760	98,583	100,898	101,599	102,919	103,662	104,029
Wyoming	14,455	14,294	14,815	14,341	14,195	14,092	14,003	13,860	13,794	13,334	12,853	12,891	12,866
Foreign	2,583	2,108	1,559	1,359	840	510	425	153	233	204	102	114	198
Total United States	246,884	253,531	260,844	261,832	257,761	254,577	251,421	245,026	244,125	240,043	237,361	234,100	234,354
Heavy crude in California	10,179	10,543	11,229	11,737	11,434	11,168	10,892	10,950	10,706	10,167	[7] 10,868	10,724	10,865

[1] Subject to revision.
[2] Includes Washington.
[3] Heavy crude stocks in California given below.
[4] Includes Georgia, Massachusetts, Rhode Island, South Carolina, and Virginia.
[5] Includes Iowa, Minnesota, South Dakota, and Wisconsin.
[6] Includes Idaho and Utah.
[7] 744,000 barrels transferred from gasoline-bearing to heavy crude.

Stocks of crude petroleum [1] in the United States in 1942, by districts and months [2]

[Thousands of barrels]

District	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries, by field of origin:													
Appalachian:													
Pennsylvania Grade	439	448	490	466	517	437	465	670	620	511	509	491	494
Other Appalachian (including Kentucky)	348	172	234	257	193	191	334	276	235	252	204	254	292
Lima-Northeastern Indiana-Michigan	680	601	650	595	625	614	764	594	486	511	492	470	449
Illinois-Southwestern Indiana	3,423	3,622	3,632	3,237	3,123	2,669	2,283	2,140	1,986	1,976	1,921	1,959	2,043
Northern Louisiana, Arkansas, and Mississippi	3,893	4,251	3,773	3,834	3,867	4,040	3,598	3,490	2,666	2,712	3,035	2,788	2,969
West Texas and Southeastern New Mexico	4,892	4,159	3,586	3,450	3,252	2,969	2,854	3,301	3,030	2,981	3,327	3,086	3,244
East Texas	3,506	3,671	3,971	3,669	2,812	3,350	3,739	3,593	3,608	4,290	3,895	4,343	4,464
Oklahoma, Kansas, North Texas, etc	10,816	12,055	11,824	11,601	12,234	12,132	11,568	11,472	11,221	9,233	9,200	8,842	9,212
Gulf Coast	10,344	11,883	11,466	10,885	10,629	10,822	10,802	10,463	11,314	11,213	10,881	10,975	10,110
Rocky Mountain	2,230	2,115	2,202	2,269	2,399	2,148	2,049	2,049	1,828	1,754	1,723	1,766	1,816
California	8,165	8,123	8,434	8,428	9,034	8,572	8,670	8,718	9,208	8,932	8,263	7,611	8,329
Foreign	2,583	2,108	1,559	1,359	840	510	425	153	233	204	102	114	198
Total at refineries	51,319	53,208	51,821	50,050	49,525	48,454	47,551	46,919	46,435	44,569	43,552	42,699	43,620
Pipe-line and tank-farm stocks, by fields of origin:													
Appalachian:													
Pennsylvania Grade	2,880	2,748	2,605	2,596	2,665	2,580	2,609	2,487	2,438	2,411	2,293	2,231	2,132
Other Appalachian (including Kentucky)	1,124	1,124	1,076	1,086	1,050	1,051	983	1,024	970	985	948	895	1,025
Lima-Northeastern Indiana-Michigan	875	844	742	768	753	744	804	798	687	646	550	513	474
Illinois-Southwestern Indiana	14,405	14,517	14,726	15,329	13,871	11,658	10,773	9,464	8,840	7,680	7,549	7,057	6,814
Northern Louisiana and Arkansas	4,968	5,071	5,224	5,189	4,781	5,068	5,079	5,264	5,271	5,249	4,754	5,068	5,079
West Texas and Southeastern New Mexico	19,602	21,788	24,688	26,486	25,890	25,651	26,271	25,524	25,969	25,740	25,500	25,704	25,476
East Texas	16,791	16,905	18,614	19,875	18,790	20,380	20,505	20,350	18,953	19,532	20,789	20,695	19,784
Oklahoma, Kansas, North Texas, etc	65,002	64,384	65,668	65,945	65,589	64,190	65,237	62,522	62,355	62,258	62,006	59,744	59,748
Gulf Coast	20,958	21,799	22,782	22,604	23,544	24,107	23,054	22,079	23,335	23,837	24,143	24,953	25,593
Rocky Mountain	13,664	13,594	13,883	13,241	13,275	13,237	13,090	12,945	12,980	12,393	11,832	11,852	11,721
California	23,723	25,663	26,720	26,121	25,729	24,668	22,948	23,340	22,959	22,094	20,839	19,693	20,058
Total pipe line and tank farm	183,992	188,437	196,728	199,240	195,937	193,334	191,353	185,797	184,757	182,825	181,203	178,405	177,904
Producers' stocks [3]	11,573	11,886	12,295	12,542	12,299	12,789	12,517	12,310	12,933	12,649	12,606	12,996	12,830
Total United States:													
1942	246,884	253,531	260,844	261,832	257,761	254,577	251,421	245,026	244,125	240,043	237,361	234,100	234,354
1941 [4]	264,709	263,881	265,062	267,005	266,637	262,731	259,695	255,998	250,240	246,731	244,355	244,299	247,499

[1] Excludes stocks of California heavy crude.

[2] Subject to revision.

[3] Revised figures for 1941 are as follows (thousands of barrels): Producers' stocks—January 31, 11,660; February 28, 11,587; March 31, 11,786; April 30, 11,750; May 31, 11,618; June 30, 11,709; July 31, 11,809; August 31, 12,079; September 30, 12,000; October 31, 12,030; November 30, 12,617; December 31, 12,188.

[4] Final figures resulting from revisions indicated in footnote 3.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—Crude runs to stills declined sharply to a total of 1,334 million barrels in 1942—a drop of 75 million barrels (5.3 percent) below the peak level of 1941. The decrease in foreign crude runs was 36 million barrels and in domestic crude runs 39 million barrels. The reduction in refinery output was due to a 2-percent decline in the total demand for all oils and to a liquidation of about 47 million barrels of stocks of refined oils.

The change in refinery operations by districts varied greatly in 1942 compared with a substantial increase in all districts in 1941. Crude runs declined by about 56 million barrels in both the East Coast and Texas Gulf Coast districts, owing to the sharp curtailment in tanker movements and to the necessity of meeting demand by heavy withdrawals from stocks of refined oils in the East Coast area. The new overland movements inaugurated to supply this deficit stimulated refinery operations in the Middle West. Crude runs gained 4 million barrels in the Appalachian district and 13 million barrels in the Indiana-Illinois-Kentucky district. Crude runs in the California district rose to 230 million barrels—a gain of 17 million—owing to the increased demand by war industries, railroads, and the Navy.

Distribution.—The total demand for domestic crude petroleum fell from 1,421 million barrels in 1941 to 1,395 million barrels in 1942, or less than 2 percent. The effects of the reduction in crude runs and the liquidation of refined stocks were materially offset by the decrease of 62 million barrels in the imports of all oils, necessitating replacement of this loss in supply, at least in part, from domestic sources. All of these factors contributed to a disturbance in normal movements of crude petroleum and in the relative demand for domestic crude petroleum by States of origin.

Receipts of domestic and foreign crude petroleum at United States refineries totaled 1,410 million barrels in 1941 and 1,328 million in 1942. In 1942 receipts of foreign crude petroleum at refineries were only about 12 million barrels, or less than 1 percent of the total compared with 3.6 percent in 1941; interstate receipts of domestic crude were 521 million barrels or 39.2 percent compared with 38.6 percent in 1941; and intrastate receipts were almost 795 million barrels or 59.8 percent compared with 57.8 percent in 1941.

Refinery receipts of crude in 1942, by methods of transportation, indicated that 80.0 percent of the total was delivered by pipe lines compared with 73.9 percent in 1941; that 9.9 percent was delivered by boat compared with 22.7 in 1941; and that 10.1 percent was delivered by tank car and truck compared with 3.4 percent in 1941. These figures indicate the sharp decline in boat movements and the relative gain in overland shipments.

The most important changes in the market demand for crude petroleum by States of origin (computed from production and changes in crude stocks by origin) in 1942 compared with 1941 were increases of about 18 million barrels for California, 16 million for Mississippi, 14 million for Kansas, and 7 million for Michigan. The largest declines in crude demand were about 46 million barrels for Texas, 19 million for Illinois, 13 million for Oklahoma, and 7 million for New Mexico. These changes indicate shifts in production trends, in accessibility to market under disturbed transportation conditions, and in the availability of accumulated stocks.

Runs to stills of crude petroleum in the United States in 1942, 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	14,766	12,205	13,135	10,704	10,533	11,121	12,207	13,241	13,028	12,635	12,043	12,467	148,085
Foreign	3,800	3,417	2,111	1,317	809	545	402	212	246	154	17	27	13,057
Total East Coast	18,566	15,622	15,246	12,021	11,342	11,666	12,609	13,453	13,274	12,789	12,060	12,494	161,142
Appalachian	4,736	4,317	4,693	4,704	4,912	4,789	4,918	4,943	4,837	4,979	4,825	4,739	57,392
Indiana, Illinois, Kentucky, etc.	21,690	20,118	21,661	20,720	22,789	21,200	23,083	22,680	22,884	23,199	21,968	22,228	264,220
Oklahoma, Kansas, Missouri, etc.	10,830	9,588	10,080	10,715	11,142	10,575	11,352	11,300	11,025	11,084	10,929	10,762	129,382
Texas Inland	5,686	5,245	5,431	5,345	5,580	5,763	5,862	5,999	5,793	5,939	5,873	5,862	68,378
Texas Gulf Coast:													
Domestic	31,442	26,625	26,117	24,500	22,837	22,776	24,344	24,982	24,061	25,938	25,574	26,020	305,216
Foreign	210	204	143	313	367	75				58	33	136	1,539
Total Texas Gulf Coast	31,652	26,829	26,260	24,813	23,204	22,851	24,344	24,982	24,061	25,996	25,607	26,156	306,755
Louisiana Gulf Coast:													
Domestic	4,948	4,455	4,685	4,253	4,018	4,005	4,582	4,532	4,386	4,487	4,387	4,475	53,213
Foreign													
Total Louisiana Gulf Coast	4,948	4,455	4,685	4,253	4,018	4,005	4,582	4,532	4,386	4,487	4,387	4,475	53,213
Arkansas-Louisiana Inland	2,470	2,367	2,361	2,454	2,311	2,302	2,398	2,498	2,345	2,513	2,289	2,346	28,654
Rocky Mountain	3,117	2,348	2,956	2,647	2,819	2,870	2,963	2,916	3,177	3,153	2,700	2,803	34,469
California	15,337	14,887	17,192	17,210	18,766	19,355	19,444	20,832	21,692	22,242	21,730	21,477	230,164
Total domestic	115,022	102,155	108,311	103,252	105,707	104,756	111,153	113,923	113,228	116,169	112,318	113,179	1,319,173
Total foreign	4,010	3,621	2,254	1,630	1,176	620	402	212	246	212	50	163	14,596
Total United States	119,032	105,776	110,565	104,882	106,883	105,376	111,555	114,135	113,474	116,381	112,368	113,342	1,333,769
Daily average	3,840	3,778	3,566	3,496	3,448	3,513	3,599	3,682	3,782	3,754	3,746	3,656	3,654

[1] Subject to revision.

Demand for crude petroleum by States of origin, 1939–42

[Thousands of barrels]

State	1939		1940		1941		1942 [1]	
	Total	Daily ave.	Total	Daily ave.	Total	Daily ave.	Total	Daily ave.
Arkansas	21,491	58.7	24,992	68.5	27,206	74.5	26,902	73.7
California	228,413	624.1	224,931	616.3	232,246	636.3	250,479	686.2
Colorado	1,427	3.9	1,659	4.5	2.050	5.6	2.212	6.1
Illinois	89,023	243.2	144,658	396.3	134,327	368.0	115,482	316.4
Indiana	1,596	4.4	4,559	12.5	7,869	21.6	6,638	18.2
Kansas	60,733	165.9	64,322	176.2	84,209	230.7	98,281	269.3
Kentucky	5,586	15.3	5,075	13.9	4.677	12.8	4,615	12.6
Louisiana	96,650	264.1	101,185	277.2	116,420	319.0	116,315	318.7
Michigan	23,363	63.8	20,252	55.5	15,616	42.8	22,318	61.2
Mississippi	73	2	3,490	9.6	13,632	37.3	29,646	81.2
Montana	6,227	17.0	6,964	19.1	7,146	19.6	8,824	24.2
Nebraska	2		270	.7	1,881	5.2	1,244	3.4
New Mexico	38,954	106.4	37,600	103.0	40,061	109.8	32,819	89.9
New York	5,352	14.6	4,908	13.4	5,294	14.5	5,364	14.7
Ohio	3,242	8.9	3,164	8.7	3,666	10.0	3,552	9.7
Oklahoma	169,493	463.1	153,083	419.4	166,357	455.8	153,413	420.3
Pennsylvania	17,834	48.7	17,481	47.9	16,771	45.9	18,311	50.2
Texas	503,770	1,376.4	480,454	1,316.3	507,283	1,389.8	461,639	1,264.8
West Virginia	3,821	10.4	3,680	10.1	4,006	11.0	3,843	10.5
Wyoming	24,436	66.8	27,525	75.4	29,737	81.5	32,981	90.3
Other States	94	.3	71	.2	63	.1	60	.1
Total United States	1,301,580	3,556.2	1,330,323	3,644.7	1,420,517	3,891.8	1,394,938	3,821.7

[1] Subject to revision.

Daily average demand for crude petroleum by States of origin, in 1942, by months [1]

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
Arkansas	69.2	70.8	68.9	74.7	75.4	78.0	77.2	73.3	73.6	80.4	75.3	67.7	73.7
California	546.8	572.9	612.0	640.8	682.4	713.3	671.7	727.6	788.5	762.1	778.7	732.8	686.2
Colorado	7.8	6.4	5.3	4.6	6.2	7.3	5.7	7.2	6.7	4.0	5.3	6.2	6.1
Illinois	360.3	342.6	319.4	353.9	380.8	326.2	317.2	294.7	301.8	268.8	276.6	256.7	316.4
Indiana	20.4	17.1	15.8	20.0	17.1	19.5	22.2	20.5	20.4	16.7	14.1	14.3	18.2
Kansas	231.6	240.6	244.7	237.0	254.8	260.1	298.2	293.7	291.2	285.5	300.2	291.1	269.3
Kentucky	17.6	11.6	10.1	15.1	12.4	8.1	12.5	12.6	11.6	12.7	16.1	11.3	12.6
Louisiana	330.9	358.3	326.8	314.3	272.9	290.6	303.2	359.8	319.2	306.6	321.8	335.5	318.7
Michigan	56.5	51.1	50.3	61.5	62.9	58.7	67.6	69.5	64.4	66.1	61.8	62.4	61.2
Mississippi	73.7	91.0	89.7	112.0	82.1	91.0	89.6	83.1	76.4	66.9	59.7	47.8	81.2
Montana	22.3	25.5	22.4	15.9	27.1	25.2	24.7	25.2	27.7	28.1	21.6	24.3	24.2
Nebraska	3.7	4.1	4.0	4.0	3.7	3.8	3.1	3.2	3.0	2.8	3.0	2.6	3.4
New Mexico	101.0	100.4	82.2	88.3	77.2	90.5	85.4	85.4	88.5	92.9	104.5	84.1	89.9
New York	14.7	14.0	15.2	13.6	14.6	15.3	13.3	13.8	17.0	15.1	14.7	15.0	14.7
Ohio	8.7	9.2	10.6	10.2	9.0	11.9	9.5	11.7	8.4	11.4	10.0	6.1	9.7
Oklahoma	439.0	407.1	426.6	406.4	459.8	439.3	437.2	394.0	416.9	410.7	421.7	383.9	420.3
Pennsylvania	50.2	50.1	50.4	50.3	54.2	48.9	45.5	52.3	51.4	51.9	45.5	51.0	50.2
Texas	1,444.2	1,318.1	1,171.4	1,105.9	1,060.8	1,139.3	1,215.1	1,300.4	1,329.2	1,346.4	1,356.6	1,390.9	1,264.8
West Virginia	10.6	10.7	8.8	11.3	10.0	12.2	13.3	9.7	11.7	10.7	10.4	7.1	10.5
Wyoming	86.6	62.9	103.2	90.3	91.6	92.0	89.1	86.4	105.4	101.6	86.2	86.8	90.3
Other States [2]	.2	.2	.2	.2	.2	.2	.2	.2	.1	.2	.1	.1	.1
Total United States	3,896.0	3,764.7	3,638.0	3,630.3	3,655.2	3,731.4	3,801.5	3,924.3	4,013.1	3,941.6	3,983.9	3,877.7	3,821.7

[1] Subject to revision.

[2] Missouri and Tennessee.

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The total demand for Texas crude declined from 507 million barrels in 1941 to 462 million in 1942—a loss of about 9 percent. In 1942 about 310 million barrels of Texas crude were delivered to refineries within the State—a decrease of 34 million compared with 1941. Shipments to refineries in other States amounted to about 138 million barrels or 8 million less than in 1941. Deliveries to East Coast refineries declined from 108 million barrels to 76 million but increased to the Illinois, Indiana, Kentucky, etc., district from 23 million barrels to 42 million in 1942. The sharp drop in the demand for crude petroleum resulted in an increase of almost 22 million barrels in stocks of Texas origin.

The demand for California crude increased from 232 million barrels in 1941 to over 250 million in 1942—a gain of almost 8 percent. Crude production was about 16 million barrels higher and was supplemented by a decrease of about 2 million barrels in stocks. Most of the crude was refined in the State, except for small exports to western Canada. The increase in crude demand was supplemented further by a decline of about 9 million barrels in stocks of refined oils.

The market demand for Oklahoma crude declined from 166 million barrels in 1941 to 153 million in 1942. This decrease was due primarily to a further decline in production, as the liquidation of about 13 million barrels in stocks of origin was only 1 million barrels greater than in 1941. Deliveries to refineries within the State declined by about 4 million barrels to 52 million barrels. About 15 million barrels were delivered to refineries in Kansas and Missouri, 62 million barrels to Illinois-Indiana, Ohio, and Michigan refineries, about 15 million barrels to East Coast refineries, about 6 million to the Appalachian district, and about 7 million barrels to refineries in Texas.

The market demand for Illinois crude continued to decline as production decreased. Crude production was only about 106 million barrels in 1942—26 million less than in 1941. A decrease of 9 million barrels in stocks of Illinois origin raised crude demand to over 115 million barrels in 1942, but this amount was still 19 million barrels less than in 1941. Deliveries to refineries in Illinois amounted to 34 million barrels in 1942—a decrease of 7 million compared with 1941. Shipments to refineries in other States totaled 63 million barrels, of which 35 million went to other States in the Indiana, Illinois, Kentucky, etc., district, 19 million to the Appalachian district, and 9 million to the East Coast district. The decline in the available supply of Illinois crude contributed to the transportation problems in 1942.

The demand for Louisiana crude in 1942—116 million barrels—was virtually the same as in 1941. Deliveries to refineries within the State showed a substantial increase in 1942 to a total of about 44 million barrels, and shipments to refineries in the East Coast district increased slightly, approximating 22 million barrels. Deliveries to the Texas Gulf Coast district decreased in proportion to gains in other districts.

The demand for Kansas crude rose to 98 million barrels in 1942. The gain of 14 million barrels, compared with 1941, approximated the increase in crude production. Deliveries to refineries in Kansas amounted to 44 million barrels; and interstate shipments increased substantially, with a total of 34 million barrels to Indiana and Illinois and about 7 million to refineries in the East Coast district.

The demand for New Mexico crude totaled 33 million barrels in 1942—a decline of 7 million compared with 1941. About 2 million barrels were delivered to refineries in the State. Shipments to the East Coast district declined about 5 million barrels and to Texas refineries about 3 million, whereas deliveries to the Illinois-Indiana district gained 1 million barrels.

The demand for Wyoming crude increased about 3 million barrels to total 33 million in 1942. An increase in production and stock liquidation contributed to this gain in about equal proportions. Deliveries of almost 14 million barrels to refineries in the State were slightly less than in 1941. Deliveries to adjacent States in the Mountain district rose from 9 million barrels in 1941 to 10 million in 1942, and deliveries to Kansas and Indiana refineries increased over 2 million barrels.

The demand for Mississippi crude increased from almost 14 million barrels in 1941 to almost 30 million in 1942. Deliveries to Louisiana and Texas refineries declined from about 9 million barrels in 1941 to less than 5 million in 1942. Shipments to the East Coast district rose from about 1 million barrels in 1941 to 10 million in 1942; deliveries to Kentucky, Ohio, and Illinois refineries amounted to over 14 million barrels—a gain of 9 million compared with 1941.

The demand for Arkansas crude remained virtually stationary at about 27 million barrels in 1942. Intrastate deliveries represented about half of the total demand. Shipments to Louisiana declined, but the northward movements increased substantially.

The demand for Michigan crude rose from less than 16 million barrels in 1941 to over 22 million in 1942, owing primarily to a gain in production. Over 17 million barrels were delivered to refineries in the State; most of the balance went to Ohio refineries.

The demand for Pennsylvania crude amounted to over 18 million barrels in 1942 compared with less than 17 million in 1941. About two-thirds of the increase was due to a gain in production and the remainder to stock liquidation.

Distribution of crude petroleum in the United States in 1942, by States [1]

[Thousands of barrels]

State	Production	Refinery receipts of domestic crude, by origin							Runs to stills	Transfers to fuel
		Illinois	Kansas	Louisiana	New Mexico	Oklahoma	Texas	Other		
Arkansas	26,628			1				13,410	13,636	347
California	248,326							231,158	[2] 230,164	14,670
Colorado	2,220							3,758	3,769	35
Georgia [3]									762	
Illinois	106,456	34,107	12,541	217	6,516	20,599	12,841	5,090	[4] 91,769	615
Indiana	6,743	2,806	21,538		258	27,763	20,727	4,998	77,898	10
Kansas [5]	98,873		43,720			10,622	989	4,148	59,933	322
Kentucky [6]	4,484	4,440		256				12,220	17,101	49
Louisiana:										
Gulf	86,530			40,027			8,089	3,981	[7] 53,213	995
Inland	29,196			3,604			4,539	5,208	13,159	353
Maryland		927		2,514	23		2,817	1,674	8,461	
Massachusetts [8]		1,379	2,074	4,498	11	260	4,780	1,761	15,322	
Michigan	21,754	1,732	990			4,149	3,237	17,358	27,753	354
Mississippi	28,833							1,859	1,859	58
Missouri	44		2,806			4,609	2,273	45	9,721	44
Montana	8,074							9,801	10,198	36
New Jersey		4,093	114	11,884	843	3,119	20,556	12,039	58,355	
New Mexico	31,544				2,170		468	28	2,654	33
New York:										
East		1,808		131		962	3,895		8,500	
West	5,421	6,205	410			2,637	164	4,665	14,074	
Ohio:										
East	3,246	12,472				770		5,269	18,449	
West	297	25,833		2,116		9,419	4,978	6,996	49,699	201
Oklahoma	140,690		3,933			52,050	3,404		59,728	773
Pennsylvania:										
East		719	4,360	2,566	1,611	10,160	43,538	898	69,742	
West	17,779	233		290		1,379	583	17,566	20,061	9
Texas:										
Gulf	135,020			34,579	19,228	5,435	245,503	835	306,755	1,360
Inland	348,351				2,672	1,922	63,914		68,378	1,260
Utah	4							3,755	3,838	
West Virginia	3,574	346				1,011		3,424	4,808	
Wyoming [9]	31,392							14,091	[9] 14,010	252
Total United States	1,385,479	97,100	92,486	102,683	33,332	156,866	447,295	386,035	1,333,769	21,776

[1] Subject to revision.
[2] Includes Washington.
[3] Includes Delaware, South Carolina, and Virginia.
[4] Includes Minnesota and Wisconsin.
[5] Includes Nebraska and South Dakota.
[6] Includes Tennessee.
[7] Includes Alabama.
[8] Includes Rhode Island.
[9] Includes Idaho.

Receipts of crude petroleum at refineries in the United States, 1938–42,[1] by methods of transportation

[Millions of barrels]

Method of transportation	1938	1939	1940	1941	1942
By boat:					
Intrastate	74.1	72.7	72.1	69.1	45.2
Interstate	182.8	188.6	205.6	199.9	74.3
Foreign	26.4	33.1	42.6	50.6	12.2
Total by boat	283.3	294.4	320.3	319.6	131.7
By pipe lines:					
Intrastate	600.1	651.3	671.0	728.9	731.2
Interstate	254.3	250.5	268.9	313.1	330.5
Total by pipe lines	854.4	901.8	939.9	1,042.0	1,061.7
By tank car and truck:					
Intrastate	21.9	29.5	26.1	17.2	18.0
Interstate	7.8	10.9	12.7	31.3	116.3
Total by tank car and truck	29.7	40.4	38.8	48.5	134.3
Grand total	1,167.4	1,236.6	1,299.0	1,410.1	1,327.7

[1] Subject to revision.

PRICES AND VALUE

No year since 1934 has been so uneventful as 1942 in price changes for crude. The Office of Price Administration permitted only one change throughout the year in fields of major importance—an advance of 25 cents per barrel for Pennsylvania-Grade crude oil on March 26.

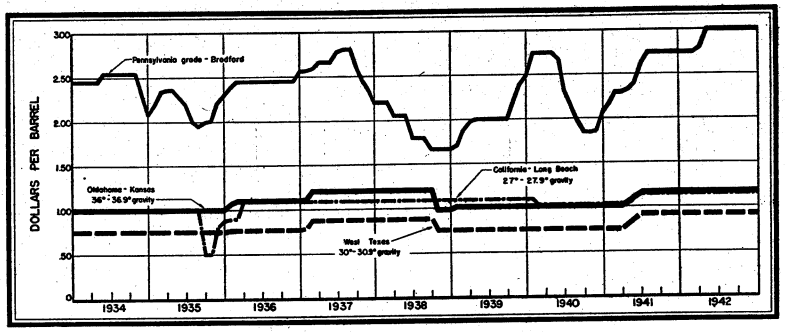

FIGURE 5.—Posted prices of selected grades of crude petroleum in the United States, 1934–42, by months.

Average monthly prices per barrel for selected grades of crude petroleum at wells in the United States in 1942

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	$1.37	$1.17	$1.02	$0.92	$1.25	$1.28	$1.15
February	2.75	2.40	1.37	1.17	1.02	.92	1.25	1.28	1.15
March	2 80	2.45	1.37	1.17	1.02	.92	1.25	1.28	1.15
April	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
May	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
June	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
July	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
August	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
September	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
October	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
November	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
December	3.00	2.65	1.37	1.17	1.02	.92	1.25	1.28	1.15
Average for year	2.94	2.59	1.37	1.17	1.02	.92	1.25	1.28	1.15

Posted price per barrel of petroleum at wells in the United States in 1942, 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	$1.31	$1.32	$1.37	$1.44	$1.13	$1.17
Mar. 26	3.00	2.65						
	2.94	2.59	1.30	1.32	1.37	1.44	1.13	1.17

Date	Panhandle, Texas (Carson and Hutchinson Counties), 35°–35.9° [7]	West Texas, 30°–30.9° [7]	Lea County, N. Mex., 30°–30.9° [7]	Southwest Texas, Duval-Mirando, 22°–22.9° [7]	East Texas [7]	Gulf Coast			
						Conroe, Tex. [8]	30°–30.9° [8]	20°–20.9° [8]	Tepetate, La. [9]
Jan. 1	$1.02	$0.92	$0.92	$1.09	$1.25	$1.43	$1.28	$1.08	$1.18
	1.02	.92	.92	1.09	1.25	1.43	1.28	1.08	1.18

Date	Rodessa, La., 36°–36.9° [10]	Smackover, Ark. [10]	Salt Creek, Wyo., 36°–36.9° [11]	Lance Creek, Wyo. [4]	California [12]			
					Kettleman, 38°–38.9°	Long Beach, 27°–27.9°	Midway-Sunset, 19°–19.9°	Santa Fe Springs, 33°–33.9°
Jan. 1	$1.12	$0.83	$1.12	$1.12	$1.29	$1.15	$0.81	$1.26
	1.12	.83	1.12	1.12	1.29	1.15	.81	1.26

[1] The Tide Water Associated Oil Co.
[2] The South Penn Oil Co.
[3] Sohio Corporation.
[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] Continental Oil Co.
[10] Standard Oil Co. of Louisiana.
[11] Stanolind Oil & Gas Co.
[12] Standard Oil Co. of California.

Value of crude petroleum at wells in the United States, 1940–41, by States [1]

State	1940		1941	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas	21,700	$0.84	24,500	$0.93
California	216,720	.97	239,500	1.04
Colorado	1,480	.91	2,300	1.07
Illinois	156,500	1.06	172,100	1.30
Indiana	5,200	1.04	9,400	1.27
Kansas	68,700	1.04	95,700	1.15
Kentucky	5,400	1.04	6,200	1.30
Louisiana:				
Gulf Coast	83,200	1.05	102,600	1.13
Northern	24,300	1.00	29,500	1.18
Total Louisiana	107,500	1.04	132,100	1.14
Michigan	20,150	1.02	21,900	1.34
Mississippi	3,750	.85	14,000	.91
Montana	6,660	.99	8,000	1.06
Nebraska	220	.80	1,600	.84
New Mexico	32,500	.83	37,200	.94
New York	11,600	2.32	13,300	2.57
Ohio	4,100	1.30	5,750	1.64
Oklahoma	162,500	1.04	174,800	1.13
Pennsylvania	39,700	2.29	42,500	2.54
Texas:				
Gulf Coast	134,500	1.10	167,000	1.24
East Texas proper	146,900	1.04	151,000	1.14
West Texas	67,600	.80	90,000	.97
Rest of State	145,000	1.00	160,000	1.10
Total Texas	494,000	1.00	568,000	1.12
West Virginia	6,400	1.86	7,390	2.15
Wyoming	20,600	.80	25,700	.86
Other States [2]	60	.85	60	.95
Total United States	1,385,440	1.02	1,602,000	1.14

[1] Figures for 1942 not yet available.
[2] Missouri, Tennessee, and Utah.

REFINED PRODUCTS

GENERAL REVIEW

The first full year of war brought revolutionary changes in the petroleum industry. The importance of petroleum in the last war is insignificant compared with the responsibilities the industry is carrying in the present conflict. The tremendous tasks in meeting these responsibilities have brought about major alterations in the refining, transportation, and marketing of petroleum products.

War economy necessitated conversion by the refiners from a basis of producing motor fuel for automobiles as their principal output to the production of larger proportions of fuel oils, high-octane gasoline for aviation fuel, butadiene for rubber, and aromatics for toluene, cumene, and styrene; and to the construction of alcohol plants for the manufacture of rubber and explosives. The changes required entirely new sections for some refineries, whereas others had to be used with minimum changes because of scarcity of material.

Transfer of tankers to war functions threw the burden of supplying the heavily populated East Coast States on other modes of transportation—principally tank cars and pipe lines. With these facilities already insufficient to bring the full requirements to the East, the situation was aggravated by the need of shipping part of the military requirements for the North African campaign from East Coast ports.

Comparative analyses of statistics for the major refined products in the United States, 1938–42

[Thousands of barrels, except as otherwise indicated]

	1938	1939	1940	1941	1942 [1]
Motor fuel:					
Production	569,162	611,043	616,695	701,294	607,011
Imports	79	47	97	335	99
Exports	50,109	44,638	25,377	27,083	36,214
Stocks, end of period	70,779	81,722	83,647	90,688 / [2] 90,596	75,404
Domestic demand	523,003	555,509	589,490	667,505	586,088
Kerosine:					
Production	64,580	68,521	73,882	72,586	67,474
Imports			204	191	418
Exports	7,504	8,241	3,374	3,221	2,729
Stocks, end of period	7,799	7,576	9,512	9,599 / [2] 14,515	10,064
Domestic demand	56,360	60,503	68,776	69,469	69,614
Distillate fuel oil:					
Production	151,774	161,746	183,304	189,177	196,714
Transfers [3]	623	2,741	2,576	2,513	2,496
Imports			3,333	5,074	3,428
Exports	29,641	32,020	19,140	16,925	22,716
Stocks, end of period	36,224	33,718	42,940 / [2] 42,911	49,926 / [2] 49,330	44,940
Domestic demand	117,449	134,973	160,851	172,824	184,312
Residual fuel oil:					
Production	294,890	305,944	316,221	342,367	358,901
Transfers [3]	10,037	9,668	7,699	12,969	19,283
Imports	21,065	15,680	29,366	37,369	17,645
Exports	17,920	17,485	16,109	14,114	13,532
Stocks, end of period	101,971	92,290	89,304 / [2] 88,026	83,195 / [2] 82,959	61,783
Domestic demand	291,833	323,488	340,163	383,422	403,473
Lubricating oil:					
Production	30,826	35,036	36,765	39,539	38,626
Imports	7	5	11		
Exports	9,417	11,881	10,461	9,924	8,311
Stocks, end of period	7,695	7,142	8,767	8,127	9,424
Domestic demand	21,233	23,713	24,690	30,255	29,018
Wax (thousands of pounds):					
Production	435,400	464,520	513,240	670,040	700,560
Imports	28,927	39,913	83,102	16,542	9,749
Exports	201,447	232,664	189,794	213,075	153,410
Stocks, end of period	129,340	75,648	125,272	74,814	85,400
Domestic demand	278,532	325,461	356,924	523,965	546,313
Coke (thousands of short tons):					
Production	1,602.2	1,666.4	1,526.6	1,648.8	1,338.4
Exports	155.6	286.2	298.7	279.1	328.2
Stocks, end of period	707.5	666.0	487.0	228.0	233.8
Domestic demand	1,117.7	1,421.7	1,406.9	1,628.7	1,004.4
Asphalt (thousands of short tons):					
Production	4,341.4	4,954.2	5,346.7	6,557.6	6,296.5
Imports	33.2	73.9	137.7	158.3	142.5
Exports	49.9	42.4	296.4	274.1	171.8
Stocks, end of period	490.4	550.0	614.0	604.0	411.0
Domestic demand	4,391.7	4,926.1	5,124.0	6,451.8	6,460.2
Road oil:					
Production	7,543	7,868	7,771	9,149	8,039
Stocks, end of period	680	702	624	793	348
Domestic demand	7,847	7,846	7,849	8,980	8,484
Other finished products:					
Production	1,921	2,359	3,202	6,266	7,795
Exports	112	123	708	660	657
Stocks, end of period	263	276	359	384 / [2] 489	597
Domestic demand	1,776	2,223	2,411	[4] 11,862	[4] 14,225

[1] Subject to revision.
[2] New basis—to compare with following year.
[3] Net transfers from crude oil to fuel oil; California only, 1938.
[4] Includes transfers of liquefied petroleum gases from natural gasoline: 1941, 6,281,000 barrels; 1942, 7,195,000 barrels.

Runs to stills and production at refineries in the United States of the various refined products, 1938–42

[Thousands of barrels, except as otherwise indicated]

Product	1938	1939	1940	1941	1942 [1]
Input:					
Crude petroleum:					
Domestic	1,138,828	1,204,350	1,252,364	1,358,246	1,319,173
Foreign	26,187	33,490	41,798	50,946	14,596
Total crude petroleum	1,165,015	1,237,840	1,294,162	1,409,192	1,333,769
Natural gasoline	39,961	39,606	39,547	47,825	56,929
Total input	1,204,976	1,277,446	1,333,709	1,457,017	1,390,698
Output:					
Gasoline	556,012	596,501	597,375	671,110	586,971
Kerosine	64,580	68,521	73,882	72,586	67,474
Distillate fuel oil	151,774	161,746	183,304	189,177	196,714
Residual fuel oil	294,890	305,944	316,221	342,367	358,901
Lubricating oil	30,826	35,036	36,765	39,539	38,626
Wax	1,555	1,659	1,833	2,393	2,502
Coke	8,011	8,332	7,633	8,244	6,692
Asphalt	23,878	27,248	29,406	36,067	34,631
Still gas	65,890	68,779	75,950	83,354	76,404
Wax—thousands of pounds	435,400	464,520	513,240	670,040	700,560
Coke—thousands of short tons	1,602.2	1,666.4	1,526.6	1,648.8	1,338.4
Asphalt—do	4,341.4	4,954.2	5,346.7	6,557.6	6,296.5
Still gas—millions of cubic feet	250,382	261,360	273,420	300,074	275,054
Road oil	7,543	7,868	7,771	9,149	8,039
Other finished products	1,921	2,359	3,202	6,266	7,795
Crude gasoline (net)	[2] 1,616	[2] 439	902	1,219	1,669
Other unfinished oils (net)	[2] 4,530	[2] 11,731	[2] 3,848	[2] 3,204	[2] 3,353
Shortage	4,242	5,623	3,313	[3] 1,250	7,633
Total output	1,204,976	1,277,446	1,333,709	1,457,017	1,390,698

[1] Subject to revision.
[2] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.
[3] Negative quantity (overage).

The inadequate receipts of oil on the eastern seaboard necessitated steps to conserve the supply, including pooling of stocks and facilities of the various companies and the rationing of gasoline and heating oil. Domestic demand for motor fuel in the East Coast district during the four summer months of 1942 was cut 29 percent below that of 1941. Individual sales were of smaller gallonage, partly to permit retailers to ration their limited stocks among their customers and partly because the customers filled their tanks more frequently to avoid letting supplies get low.

Fuel-oil rationing started with a prohibition against filling home owners' tanks in the East Coast and Great Lakes areas during the summer, the usual time for replenishing the supply. This, together with an unusually cold winter and the greater number of trips necessitated because of the smaller quantity they were permitted to deliver at one time, made it difficult for retailers to deliver even the reduced quantities permitted by the rations.

The effect of these disruptions in the industry on other economic phases of national life was shown in the loss of investment by the closing of thousands of service stations and the release of their owners and workers for other branches of the war industry; the closing of roadside restaurants, tourist camps, and similar businesses; and the drop of $146,000,000 in State and Federal gasoline taxes, with a certainty of even less income from gasoline taxes in 1943.

Domestic demand for motor fuel dropped 12 percent—from 667 million barrels in 1941 to 586 million in 1942. An increase in exports from 27 to 36 million barrels, however, made the loss in total demand only 72 million barrels. Domestic demand for distillate fuel oil rose from 173 million to 184 million barrels and for residual fuel oil from 383 million to 403 million barrels. Exports of distillate fuel—23 million barrels—were 6 million higher than the 1941 exports, but exports of residual fuel oil declined about ½ million barrels.

Summary of percentage yields of refined products in the United States, 1934–42

[Computed on total crude runs to stills]

Product	1934	1935	1936	1937	1938	1939	1940	1941	1942 [1]
Finished products:									
Gasoline:									
Cracked	20.4	21.5	22.4	22.6	23.2	23.9	22.7	24.4	22.2
Straight run	23.0	22.7	21.7	21.3	21.1	21.1	20.4	19.8	17.5
Total gasoline	43.4	44.2	44.1	43.9	44.3	45.0	43.1	44.2	39.7
Kerosine	6.0	5.8	5.2	5.5	5.5	5.5	5.7	5.2	5.1
Distillate fuel oil	10.6	10.4	11.8	12.4	13.0	13.1	14.2	13.4	14.7
Residual fuel oil	26.8	26.9	27.0	26.4	25.3	24.7	24.4	24.3	26.9
Lubricating oil	2.9	2.9	2.9	3.0	2.6	2.8	2.8	2.8	2.9
Wax	.2	.2	.2	.2	.1	.1	.1	.2	.2
Coke	.7	.7	.6	.6	.7	.7	.6	.6	.5
Asphalt	1.8	1.8	2.0	1.9	2.1	2.2	2.3	2.6	2.6
Road oil	.7	.6	.7	.7	.6	.6	.6	.6	.6
Still gas	5.0	5.3	5.3	5.4	5.7	5.5	5.5	5.9	5.7
Other	.2	.2	.2	.2	.2	.2	.3	.4	.6
Unfinished products:									
Gasoline	[2] 3	.1	[3]	[2] 3	[2] 1	[2] 3	.1	.1	.1
Other	.2	[2] 3	[2] 8	[2] 7	[2] 4	[2] 9	[2] 3	[2] 2	[2] 2
Shortage	1.8	1.2	.8	.5	.4	.5	.6	[2] 1	.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.
[2] Negative percentage: represents excess percentage rerun over percentage produced.
[3] Less than 0.1 percent.

Greater need for heavy oils and diminishing requirements for motor fuel forced modification in refinery operations that resulted in a drop in gasoline yield from 44.2 percent of the crude oil run to stills in 1941 to 39.7 percent in 1942. Distillate fuel-oil yields rose from 13.4 percent in 1941 to 14.7 percent in 1942 and residual fuel-oil yields from 24.3 percent to 26.9, but kerosine yields declined from 5.2 percent to 5.1.

The East Coast and Texas Gulf Coast districts were almost entirely responsible for the decline in crude-oil runs to stills. Transportation difficulties, restricting the supply of crude oil for East coast refiners

and depriving the Texas Gulf Coast district of its principal market for gasoline, resulted in a drop of 26 percent—from 217 million barrels in 1941 to 161 million in 1942—in the East Coast district and a drop of 16 percent—from 363 million barrels in 1941 to 307 million in 1942—in the Texas Gulf Coast district. California, with an 8-percent gain, had the greatest increase in crude runs; and the Appalachian district, with a gain of 7.3 percent, and the Indiana, Illinois, Kentucky, etc., district, with a 5.2-percent increase, followed in relative gains.

The freezing of refined-oil prices, effective November 7, 1941, was followed in 1942 by more definite regulations from the Office of Price Administration. Schedule 88, signed February 2, covered most prices except those at the service stations and provided that prices in effect

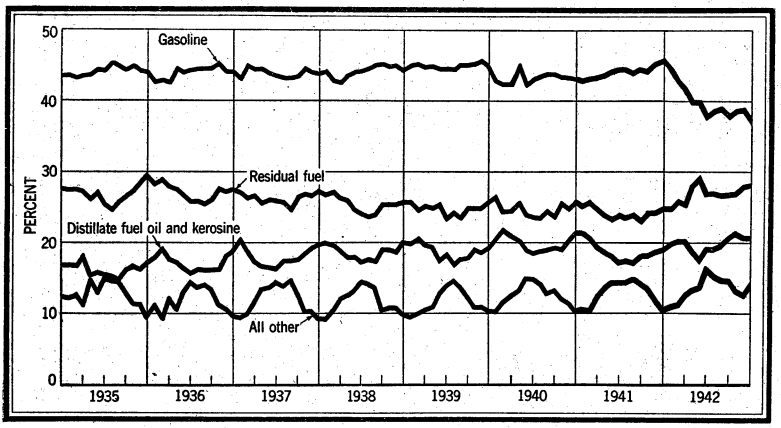

FIGURE 6.—Yields of principal petroleum products from crude oil run to stills in the United States, 1935-42, by months.

October 1, 1941, should be ceiling prices for petroleum and petroleum products. Maximum Price Regulation 137, issued April 28 and effective May 18, froze all retail prices for motor fuel and Diesel fuel at the highest March 1942 level. The General Maximum Price Regulation, also issued April 28, applied to all commodities and services not covered specifically by individual price schedules. It became effective for producer, manufacturer, and wholesaler prices on May 11, for retail prices on May 18, and for services on July 1 and likewise established the highest price charged by the individual seller during March 1942 as his maximum. As most oil prices were covered by Schedule 88 and Regulation 137, this General Regulation applied principally to services.

Stocks of refined products in the United States, 1941–42, 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
1941												
Gasoline	83,310	88,609	91,501	88,414	85,425	82,411	77,429	73,094	72,761	74,698	79,378	[1] 86,413
Kerosine	8,312	7,634	6,724	7,063	8,421	9,609	10,635	11,636	11,662	11,670	10,843	[1] 9,599
Distillate fuel oil	37,926	34,790	29,805	31,725	35,389	38,274	43,037	47,163	51,412	55,385	55,073	[1] 49,926
Residual fuel oil	85,092	82,902	81,634	79,138	79,218	79,948	80,760	82,268	83,752	84,960	83,730	[1] 83,195
Lubricating oil	8,809	8,790	8,637	8,363	7,835	7,353	7,107	7,206	7,415	7,487	7,752	8,127
Wax	429	426	435	415	423	395	362	306	284	270	272	267
Coke	2,030	1,875	1,875	2,000	1,925	1,910	1,835	1,860	1,850	1,810	1,950	1,140
Asphalt	3,735	4,180	4,571	5,132	5,302	4,626	3,922	3,328	2,607	2,481	2,816	3,322
Wax—thousands of pounds	120,027	119,150	121,887	116,096	118,456	110,481	101,404	85,824	79,458	75,467	76,413	74,814
Coke—thousands of short tons	406.0	375.0	375.0	400.0	385.0	382.0	367.0	372.0	370.0	362.0	390.0	228.0
Asphalt—do	679.0	760.0	831.0	933.0	964.0	841.0	713.0	605.0	474.0	457.0	512.0	604.0
Road oil	717	760	892	1,047	1,123	1,150	1,028	812	658	701	690	793
Other finished products	360	365	369	459	378	381	382	385	344	379	426	[1] 384
Unfinished gasoline	7,056	6,949	7,205	7,355	7,406	7,347	7,272	7,283	7,202	7,605	7,900	7,685
Other unfinished oils	39,542	39,284	40,227	40,857	41,992	41,825	41,389	42,005	42,464	42,258	40,975	39,524
Total	277,318	276,564	273,875	271,968	274,837	275,229	275,158	277,346	282,411	289,704	291,805	[1] 290,375
1942 [2]												
Gasoline	93,489	100,186	99,184	94,127	87,461	80,080	71,657	71,403	69,293	67,669	64,224	70,772
Kerosine	11,007	9,324	7,900	7,806	8,433	9,497	10,933	12,176	12,363	12,645	12,630	10,064
Distillate fuel oil	40,801	33,711	30,205	28,792	30,281	32,501	37,729	42,918	45,817	49,701	50,709	44,940
Residual fuel oil	78,386	75,386	70,098	67,658	68,388	66,341	66,935	67,613	69,264	68,873	66,664	61,783
Lubricating oil	8,266	8,429	8,470	8,470	8,768	8,756	8,945	9,301	9,278	9,421	9,336	9,424
Wax	260	270	268	249	247	249	243	275	278	308	309	305
Coke	1,229	1,294	1,262	1,005	956	909	875	895	864	918	988	1,169
Asphalt	3,823	4,210	4,074	3,957	3,395	2,826	2,398	2,181	2,018	1,887	1,871	2,261
Wax—thousands of pounds	72,800	75,600	75,040	69,720	69,160	69,720	68,040	77,000	77,840	86,240	86,520	85,400
Coke—thousands of short tons	245.8	258.8	252.4	201.0	101.2	181.8	175.0	179.0	172.8	183.6	197.6	233.8
Asphalt—do	695.0	765.4	740.7	719.5	617.3	513.8	436.0	396.5	366.9	343.1	340.2	411.0
Road oil	863	909	965	1,006	980	900	833	565	475	394	356	348
Other finished products	453	503	526	556	595	552	517	502	534	537	553	597
Unfinished gasoline	7,724	8,111	7,549	7,695	7,220	7,437	7,789	8,123	8,853	8,953	8,992	9,354
Other unfinished oils	38,114	36,367	36,418	35,997	35,319	36,254	36,361	36,453	36,747	36,621	36,081	36,537
Total	284,415	278,700	266,919	257,538	252,043	246,302	245,215	252,405	255,784	257,927	252,713	247,554

[1] Stocks on new basis for January 1, 1942, are as follows: Gasoline, 86,159; kerosine, 14,515; distillate fuel oil, 49,330; residual fuel oil, 82,959; other finished products, 489; total stocks, 294,310.

[2] Subject to revision.

Runs to stills and production at refineries in the United States of the various refined products, 1941–42, by months

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1941													
Input:													
Crude petroleum	110,683	100,445	111,059	111,106	119,435	115,935	121,180	124,572	121,481	126,772	121,539	124,985	1,409,192
Natural gasoline	3,828	3,312	3,774	3,498	3,399	3,518	3,628	4,130	4,751	4,997	4,518	4,472	47,825
Total input	114,511	103,757	114,833	114,604	122,834	119,453	124,808	128,702	126,232	131,769	126,057	129,457	1,457,017
Output:													
Gasoline	51,173	46,841	51,950	52,009	56,188	55,136	57,714	58,954	58,988	61,037	59,480	61,640	671,110
Kerosine	6,661	5,888	6,033	6,068	6,033	5,218	5,406	5,850	5,949	6,355	6,443	6,682	72,586
Distillate fuel oil	17,018	14,732	15,387	14,692	15,546	14,697	15,746	15,409	16,024	16,554	16,230	17,142	189,177
Residual fuel oil	27,880	25,944	27,677	26,748	27,994	27,882	28,624	29,836	28,118	30,871	29,666	31,127	342,367
Lubricating oil	2,943	2,522	2,813	3,213	3,322	3,520	3,563	3,561	3,427	3,494	3,607	3,554	39,539
Wax	138	139	183	201	205	195	198	194	237	242	246	215	2,393
Coke	629	513	625	641	700	722	671	685	789	768	747	754	8,244
Asphalt	1,667	1,685	2,053	2,689	3,310	3,490	3,779	4,074	3,741	3,819	3,194	2,566	36,067
Still gas	5,904	5,515	6,806	6,998	7,614	7,314	7,531	7,546	7,040	7,189	6,825	7,072	83,354
Wax thousands of pounds	38,640	38,920	51,240	56,280	57,400	54,600	55,440	54,320	66,360	67,760	68,880	60,200	670,041
Coke thousands of short tons	125.8	102.6	125.0	128.2	140.0	144.4	134.2	137.0	157.8	153.6	149.4	150.8	1,648.8
Asphalt do	303.1	306.4	373.3	488.9	601.8	634.5	687.1	740.7	680.2	694.4	580.7	466.5	6,557.6
Still gas millions of cubic feet	21,254	19,854	24,502	25,193	27,410	26,330	27,112	27,166	25,344	25,880	24,570	25,459	300,074
Road oil	218	107	198	347	846	1,383	1,700	1,478	1,308	793	428	343	9,149
Other finished products	452	442	548	531	580	540	556	533	506	545	545	488	6,266
Unfinished gasoline (net)	590	[1] 107	256	150	51	[1] 59	[1] 75	11	[1] 81	403	295	[1] 215	1,219
Other unfinished oils (net)	[1] 824	[1] 484	567	372	780	[1] 551	[1] 620	509	336	[1] 306	[1] 1,407	[1] 1,576	[1] 3,204
Shortage	62	20	[2] 263	[2] 55	[2] 335	[2] 34	15	62	[2] 150	5	[2] 242	[2] 335	[2] 1,250
Total output	114,511	103,757	114,833	114,604	122,834	119,453	124,808	128,702	126,232	131,769	126,057	129,457	1,457,017

See footnotes at end of table.

Runs to stills and production at refineries in the United States of the various refined products, 1941–42, by months—Continued

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1942 [3]													
Input:													
Crude petroleum [4]	119,032	105,776	110,565	104,882	106,883	105,376	111,555	114,135	113,474	116,381	112,368	113,342	1,333,769
Natural gasoline	5,351	4,456	4,414	4,046	4,272	4,423	4,577	4,909	5,108	5,455	4,989	4,929	56,929
Total input	124,383	110,232	114,939	108,928	111,155	109,799	116,132	119,044	118,582	121,836	117,357	118,271	1,390,698
Output:													
Gasoline	58,400	49,688	50,652	45,889	46,975	44,250	47,611	49,488	48,078	50,357	48,538	47,045	586,971
Kerosine	6,634	6,133	6,035	5,529	5,302	4,929	5,134	5,340	5,421	5,907	5,759	5,351	67,474
Distillate fuel oil	16,902	15,194	16,214	14,002	13,436	15,210	16,149	17,052	18,062	18,858	17,562	18,073	196,714
Residual fuel oil	29,405	27,254	28,095	29,440	30,971	28,352	30,096	30,446	30,402	31,239	31,311	31,890	358,901
Lubricating oil	3,497	3,174	3,533	3,438	3,439	3,231	3,133	3,141	2,951	3,057	2,983	3,049	38,626
Wax	197	189	220	186	185	207	181	218	204	269	214	232	2,502
Coke	699	606	542	457	417	438	505	554	540	615	610	709	6,692
Asphalt	2,101	2,105	2,355	2,491	2,753	2,848	3,461	3,407	3,475	3,613	3,020	3,002	34,631
Still gas	6,609	6,105	6,219	6,025	6,306	6,033	6,509	6,592	6,146	6,764	6,550	6,546	76,404
Wax—thousands of pounds	55,160	52,920	61,600	52,080	51,800	57,960	50,680	61,040	57,120	75,320	59,920	64,960	700,560
Coke—thousands of short tons	139.8	121.2	108.4	91.4	83.4	87.6	101.0	110.8	108.0	123.0	122.0	141.8	1,338.4
Asphalt—do	382.0	382.7	428.2	452.9	500.5	517.8	629.3	619.5	631.8	656.9	549.1	545.8	6,296.5
Still gas—millions of cubic feet	23,792	21,978	22,389	21,690	22,702	21,719	23,432	23,731	22,126	24,350	23,580	23,565	275,054
Road oil	435	321	475	450	862	1,339	1,132	810	744	515	472	484	8,039
Other finished products	543	592	667	652	777	745	712	648	608	547	592	712	7,795
Unfinished gasoline (net)	39	387	[1] 562	146	[1] 475	217	352	334	730	100	39	362	1,669
Other unfinished oils (net)	[1] 1,473	[1] 1,868	[1] 10	[1] 421	[1] 678	935	107	92	294	[1] 215	[1] 572	456	[1] 3,353
Shortage	395	352	544	644	885	1,065	1,050	922	927	210	279	360	7,633
Total output	124,383	110,232	114,979	108,928	111,155	109,799	116,132	119,044	118,582	121,836	117,357	118,271	1,390,698

[1] Negative quantity; represents net excess rerun over production.
[2] Negative quantity (overage).
[3] Subject to revision.
[4] Detailed 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, 1941–42, by districts

[Thousands of barrels, except as otherwise indicated]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	United States
1941											
Input:											
Crude petroleum	217,046	53,499	251,257	127,130	66,640	363,252	54,300	29,365	33,570	213,133	1,409,192
Natural gasoline	1,984	483	7,371	4,700	7,782	9,349	779	803	789	13,785	47,825
Total input	219,030	53,982	258,628	131,830	74,422	372,601	55,079	30,168	34,359	226,918	1,457,017
Output:											
Gasoline	85,379	25,606	138,481	71,388	44,143	168,204	21,265	13,079	17,831	85,734	671,110
Kerosine	9,169	3,166	11,864	7,505	2,987	24,448	7,304	3,080	906	2,157	72,586
Distillate fuel oil	40,827	4,863	26,288	13,431	2,430	59,591	8,631	2,535	2,778	27,803	189,177
Residual fuel oil	50,113	7,709	46,761	22,408	14,280	84,806	13,070	7,180	7,629	88,411	342,367
Lubricating oil	8,608	6,414	4,307	3,976	358	9,677	2,093	679	187	3,240	39,539
Wax	834	400	176	160	5	438	319	----------	61	----------	2,393
Coke	22	130	4,470	907	597	925	----------	----------	247	946	8,244
Asphalt	11,759	1,419	7,303	2,757	1,342	1,995	2,294	1,566	739	4,893	36,067
Still gas	11,720	2,796	15,649	7,702	4,698	26,501	2,357	1,224	1,631	9,076	83,354
Wax ---------- thousands of pounds	233,520	112,000	49,280	44,800	1,400	122,640	89,320	----------	17,080	----------	670,040
Coke ---------- thousands of short tons	4.4	26.0	894.0	181.4	119.4	185.0	----------	----------	49.4	189.2	1,648.8
Asphalt ---------- do	2,138.0	258.0	1,327.8	501.3	244.0	362.7	417.1	284.7	134.4	889.6	6,557.6
Still gas ---------- millions of cubic feet	42,192	10,065	56,336	27,727	16,913	95,404	8,485	4,406	5,872	32,674	300,074
Road oil	366	42	2,477	697	----------	173	3	138	1,651	3,602	9,149
Other finished products	1,574	295	1,213	176	146	126	158	33	56	2,489	6,266
Unfinished gasoline (net)	212	[1] 173	[1] 30	[1] 88	126	618	99	[1] 14	[1] 12	481	1,219
Other unfinished oils (net)	[1] 181	204	372	[1] 662	1,012	[1] 1,333	[1] 2,695	541	100	[1] 562	[1] 3,204
Shortage	[2] 1,372	1,111	[2] 703	1,473	2,298	[2] 3,568	181	127	555	[2] 1,352	[2] 1,250
Total output	219,030	53,982	258,628	131,830	74,422	372,601	55,079	30,168	34,359	226,918	1,457,017

See footnotes at end of table.

Runs to stills and production at refineries in the United States of the various refined products, 1941–42, by districts—Continued

	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
1942 [3]											
Input:											
Crude petroleum	161,142	57,392	264,220	129,382	68,378	306,755	53,213	28,654	34,469	230,164	1,333,769
Natural gasoline	871	511	7,585	4,096	6,312	17,799	3,359	1,379	797	14,220	56,929
Total input	162,013	57,903	271,805	133,478	74,690	324,554	56,572	30,033	35,266	244,384	1,390,698
Output:											
Gasoline	61,135	24,793	131,347	64,946	39,500	128,181	23,182	11,876	16,763	85,248	586,971
Kerosine	7,929	3,640	15,802	8,984	3,015	17,364	5,219	2,460	698	2,363	67,474
Distillate fuel oil	31,132	6,769	34,388	18,344	3,664	60,697	9,428	4,112	3,782	24,398	196,714
Residual fuel oil	45,653	9,498	55,545	24,788	16,586	74,778	11,772	6,734	9,292	104,255	358,901
Lubricating oil	7,798	6,417	4,326	4,277	260	9,356	2,066	1,220	234	2,672	38,626
Wax	763	426	207	207	12	502	305	----------	80	----------	2,502
Coke	12	126	4,236	720	375	708	81	----------	188	246	6,692
Asphalt	4,495	1,867	7,273	2,896	2,137	2,736	2,859	2,035	984	7,349	34,631
Still gas	10,425	2,767	15,666	6,002	4,208	23,705	2,807	1,004	1,543	8,277	76,404
Wax ---------- thousands of pounds	213,640	119,280	57,960	57,960	3,360	140,560	85,400	----------	22,400	----------	700,560
Coke ---------- thousands of short tons	2.4	25.2	847.2	144.0	75.0	141.6	16.2	----------	37.6	49.2	1,338.4
Asphalt ---------- do	817.2	339.3	1,322.4	526.7	388.3	497.6	519.8	370.1	178.9	1,336.2	6,296.5
Still gas ---------- millions of cubic feet	37,531	9,961	56,398	21,608	15,148	85,337	10,104	3,613	5,556	29,798	275,054
Road oil	−5	30	1,169	396	----------	48	−1	150	1,363	4,889	8,039
Other finished products	1,786	447	1,424	214	236	564	349	86	73	2,616	7,795
Unfinished gasoline (net)	[1] 1,396	32	373	[1] 227	470	1,503	[1] 87	[1] 9	8	1,002	1,669
Other unfinished oils (net)	[1] 7,311	[1] 15	[1] 488	[1] 926	1,788	5,877	[1] 1,685	31	[1] 140	[1] 484	[1] 3,353
Shortage	[2] 403	1,106	537	2,857	2,439	[2] 1,465	277	334	398	1,553	7,633
Total output	162,013	57,903	271,805	133,478	74,690	324,554	56,572	30,033	35,266	244,384	1,390,698

[1] Negative quantity; represents net excess rerun over production.

[2] Negative quantity (overage).

[3] Subject to revision.

A number of amendments have changed the ceiling prices for refined oils; the chief of them are increases to offset higher transportation costs, the rescinding of 2½ cents of the increase in gasoline prices in eastern cities when the Defense Supply Corporation assumed a like amount of the cost, and the amendment of December 26 permitting retailers to maintain a 3-cent margin between the cost and selling price of gasoline.

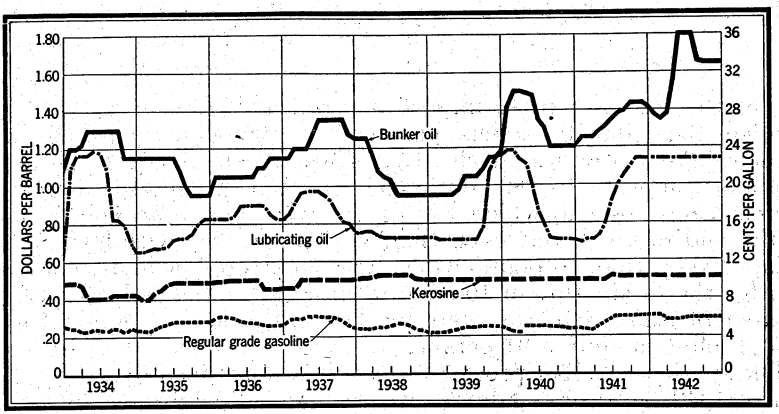

FIGURE 7.—Prices of Bunker "C" fuel oil at New York, bright stock at Oklahoma refineries, tank-wagon price of kerosine at Chicago, and regular-grade gasoline at refineries in Oklahoma, 1934–42, by months.

REFINING

Refinery capacity.—The total number of refineries dropped from 523 on January 1, 1942, to 472 on January 1, 1943, but crude-oil capacity rose from 4,999,999 barrels daily to 5,092,411.

Cracking capacity retired in 1942 was virtually the same as that added, resulting in almost no change in completed capacity as of the beginning of 1943. Capacity in the process of construction on January 1, 1943, however, amounted to 154,984 barrels daily, which would bring the total capacity on that date to 1,347,867 barrels, compared with 1,222,684 on January 1, 1942. New processes are developing so rapidly in cracking that equipment becomes obsolete in a very short time; and it is possible that retirement of capacity will keep pace with additions, particularly in view of the declining need for gasoline and the difficulty in supplying demands for heavy oils.

The small gain in crude-oil capacity during 1942 belies the turmoil of construction throughout the country. All new refinery construction had the object of supplying war requirements, including aviation gasoline, butadiene, toluene, and alcohol, in addition to less-emphasized products. Much of the new equipment was to be used in making special commodities from certain unfinished fractions, which explains why the crude-oil capacity did not increase commensurately with activity.

Government interest in the production of aviation gasoline increased rapidly during 1942. When Lease-Lend requirements began depleting stocks during the latter months of 1941 and the declaration of war shocked authorities into the realization that plant capacity must be expanded rapidly, 100-octane gasoline production became

Summary of refinery capacity in the United States, January 1, 1939–43

Year	Number of refineries				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
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
1942	430	92	1	523	4,496,843	459,756	43,400	4,999,999
1943	386	85	1	472	4,404,213	493,098	195,100	5,092,411

one of the Nation's most important projects. Late in 1941 it was decided that 40,000 barrels per day of 100-octane gasoline were needed. After war was declared this was trebled, only to be raised in about 2 months to 180,000 barrels and soon thereafter to 250,000 barrels a day—a goal which was on the way toward accomplishment at the end of 1942, but even then was threatened with lack of material. More than 50 plants were either completed or under construction for the production of 100-octane gasoline at the end of 1942. A number of other refineries were producing the lower grades of aviation gasoline, mainly a 91-octane.

The synthetic rubber program was still handicapped by delay at the end of 1942 because of adverse weather and difficulties in obtaining priorities for critical materials. The delay in getting construction under way had prompted the appointment by the President of the Baruch Committee to investigate the rubber situation and make recommendations for expediting the program. The report of this committee, in addition to the appointment of a rubber director, led to rationing of gasoline to save tires and modified earlier plans for synthetic rubber manufacture.

Two plans were promulgated for producing rubber from petroleum—a long-range plan for permanent plants and a refinery-conversion or "quick" butadiene plan. Contracts were made in pursuance of the long-range plan for plants with a capacity of 310,000 tons annually to produce butadiene by catalytic dehydrogenation of butane and butylene in addition to 220,000 tons' capacity of plants to produce butadiene from alcohol. The first of the dehydrogenation plants, started in 1941, was completed early in 1943, and three others were completed during the immediately succeeding months. Under the second plan, 14 refineries with an annual capacity of approximately 160,000 tons had been authorized for conversion at the end of 1942, but the contracts for several of them were canceled later.

Technical developments.—During recent years technical research has taken a role of greater importance than ever before, and the discoveries and developments therefrom have changed refining from simple fractionation of petroleum to a complicated chemical industry. Wartime secrecy prevents disclosing most of the new discoveries, which include solvents, plastics, alcohol, ammonia, synthetic silks, and many others.

Developments announced during the year included moving catalysts, which foreshadow abandonment of fixed catalysts. A moving catalyst momentarily contacts the oil vapor, which travels in a parallel stream; then, the reaction completed, the two separate, and the

catalyst is regenerated away from the cracking chamber. The moving catalyst, in addition to the time saved in regeneration and the yield of a better product, presents a saving in steel that is important at this time.

Other progress during the year promises higher-octane gasoline and includes new developments in cracking and isomerization. The first oil company to receive the Army-Navy "E" was cited for its performance in producing 100-octane gasoline, toluene, and marine lubricants, particularly turbine oils.

TRANSPORTATION

This Nation and its allies were fortunate that it had been customary to supply Atlantic coast oil needs from the Gulf coast by boat. Because of this, the second-largest and one of the best-equipped tanker fleets in the world was available for military use upon declaration of war.

Shifting a large part of these boats to military and Lend-Lease service, however, brought radical changes in the methods of transporting oil and in the social and economic life of the American people. The transfer, plus interference by submarines, resulted in tanker shipments of petroleum and its products from the Gulf area to the East coast being reduced from 430,769,000 barrels in 1941 to 123,831,000 in 1942. The daily average during the last 5 months of 1942 had dwindled to 143,000 barrels compared with 1,180,000 for 1941. The largest part of the oil requirements for the eastern United States had to be supplied by overland transportation, and a sizable proportion of the military needs was also shipped from East coast ports.

Every means available was used to move oil to the Atlantic seaboard, although economic considerations kept some facilities unavailable during the first part of 1942. Ceiling prices were too low to pay the cost of transportation in many cases, particularly on boat shipments of fuel oil from the Great Lakes area, and this kept some facilities idle that should have been in service. This defect was largely remedied later in the year; the Defense Supplies Corporation assumed the excessive carrying costs when it was deemed expedient to involve greater transportation expenses than customary without a compensatory increase in prices.

Greatest dependence for moving oil to the East coast was placed upon the railroads. Tank-car shipments in December 1941, already increased because of difficulties in marine transportation, averaged 62,000 barrels daily. From this average they mounted to a peak of 856,710 barrels daily for 1 week in September. Tank cars were pooled, loading and unloading time was cut to the minimum, and shipments from individual refiners were grouped at assembly points from which full trains of oil cars were dispatched as express freight. Further readjustment was required and in August transportation of gasoline by tank car was prohibited in 20 of the Midwestern and Southwestern States.

Other developments and projects to aid in the distribution of oil included improvement in barge transportation, expansion and confining of tank trucks to short hauls, use of steel drums for transporting kerosine in box cars, and revamping and expanding the pipe-line system.

Although by far the greatest dependence was put upon the railroads in 1942 for moving oil to the East coast, pipe lines did their part, and projects completed or under construction will relieve the railroads of a large part of the burden of supplying the Atlantic seaboard with petroleum and its products.

The war concept of the pipe line is that it is merely a part of a whole, to be used as best serves the national war strategy. Changes resulting from this war concept involve much new construction and relocation, reversing, and other rearrangement of old pipe lines. Projects initiated included the laying of more than 2,300 miles of new line, taking up and relocating 1,700 miles of second-hand pipe, and converting 2,800 miles of other lines.

The most important of these changes was the construction of the "Big Inch"—the 24-inch line from east Texas to southern Illinois. It is the longest and largest pipe line ever laid for transporting oil. Oil began to move through this line in February 1943. Construction of an extension to carry the products from Illinois to the East coast was initiated toward the end of 1942.

A 60,000-barrel feeder line was started from Houston and Port Arthur to Baton Rouge to contribute toward the supplies for the Plantation line, completed early in 1942. In addition, the terminus of the Plantation line was being extended from Greensboro, N. C., to Richmond, Va.

Other projects started or planned during 1942 include a 35,000-barrel-daily products line across Florida, a 15,000-barrel-daily line across Ohio, and the Sinclair line from Steubenville, Ohio, across Pennsylvania. Pipe-line completions during 1942 include reversal and conversion of the Keystone line across Pennsylvania, reversal of the Sun-Susquehanna line from Cleveland to the eastern seaboard, enlargement of the Shell line from Wood River, Ill., to Lima, Ohio, enlargement of the Texas-Empire line between Tulsa and Chicago, and reversal and conversion of a Texas Co. pipe line between Port Arthur and Dallas, Tex. The 24- to 26-inch Stanpac natural-gas pipe line, extending from Kettleman Hills to San Francisco, has been converted to crude-oil service, with a capacity of 100,000 barrels daily.

MARKETING

Curtailment of oil along the Atlantic seaboard introduced a new experience to people living in that area—the rationing of gasoline and fuel oil and the regulation of the use of automobiles for certain purposes. Although lack of fuel oil caused considerable inconvenience and some suffering, the rationing of gasoline probably necessitated more severe readjustments in living habits.

The responsibility of rationing was placed under control of the Office of Price Administration. Gasoline rationing was initiated in the 17 Atlantic Coast States and the District of Columbia on May 17. Rationing was extended to the rest of the country on December 1, but the purpose was to save tires rather than to conserve a deficient supply of gasoline.

Heating-oil rationing was initiated in 30 Eastern and Midwestern States on October 1, after prohibition of sales during the summer. Rationing of heating oil was necessitated by an actual shortage in fuel oil as well as by difficulties in transportation. The problem of

fuel oil, however, differed from that of gasoline in that abundant supplies of coal exist close to the centers of population, and fuel-oil users were urged to convert their facilities to coal-burning equipment wherever possible.

MOTOR FUEL

Domestic demand for motor fuel in 1942 was influenced by factors tending in opposite directions, but the elevating factors exerted less influence than the depressing ones.

Accelerated military demand came to represent a material share of the consumption in 1942, and the increasing need for transportation of war workers took an additionally larger proportion of civilian consumption as the year progressed.

The depressing factors were shortage of tires and rationing of gasoline. Realization of the limited future supply of tires was reflected in some curtailment of traffic early in 1942, although the momentum of the up-sweep of gasoline consumption largely concealed this retarding influence, and it was not until the second quarter that it began to be obvious.

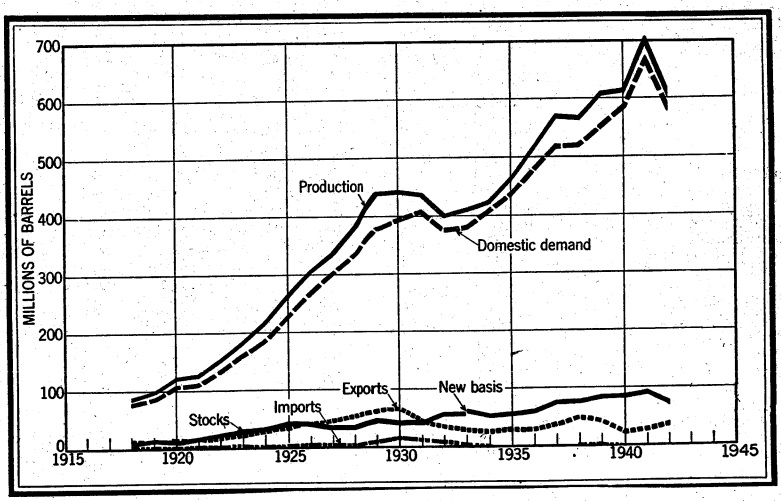

FIGURE 8.—Trends of production, domestic demand, exports, imports, and stocks of motor fuel in the United States, 1918–42.

Transportation difficulties prompted the Office of Petroleum Coordinator to issue its Curtailment Order L–70, which limited deliveries of gasoline to the East Coast area and the Pacific Northwest, effective April 16, to two-thirds of normal. Considerable confusion resulted from the difficulty of service stations in accommodating customers, and limited sales and "No Gas" signs became common. This condition was improved only slightly when the Office of Price Administration, under authority from the War Production Board, instituted gasoline rationing on May 15 in the 17 East Coast States and the District of Columbia. Ration allowances for larger quantities than the retailers were permitted to obtain under Order L–70 complicated the retailers' difficulty in supplying the demand. Coupon rationing, instituted July 15, whereby the retailer exchanged

Comparative analyses of statistics for motor fuel in the United States in 1942, by months [1]

[Thousands of barrels]

	1942						
	Jan.	Feb.	March	April	May	June	July
Production:							
Refinery gasoline:							
Cracked	30,324	26,006	25,629	23,504	23,130	22,423	24,080
Straight-run	22,725	19,226	20,609	18,339	19,573	17,404	18,954
Natural gasoline	7,488	6,768	7,020	6,257	6,718	6,558	6,804
Less L. P. G. sales	710	577	556	572	483	498	536
Benzol	208	189	200				
Total production	60,035	51,612	52,902	47,528	48,938	45,887	49,302
Daily average	1,937	1,843	1,707	1,584	1,579	1,530	1,590
Imports	14	85					
Exports	3,131	2,178	3,053	2,766	2,567	3,374	3,426
Daily average	101	78	98	92	83	112	111
Stocks, end of period:							
Finished gasoline	93,489	100,186	99,184	94,127	87,461	80,080	71,657
Natural gasoline	4,802	5,209	5,620	6,043	6,568	6,517	6,588
Total stocks	98,291	105,395	104,804	100,170	94,029	86,597	78,245
Domestic demand	49,223	42,415	50,440	49,396	52,512	49,945	54,228
Daily average	1,588	1,515	1,627	1,647	1,694	1,665	1,749

	1942						1941 (total)
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Production:							
Refinery gasoline:							
Cracked	25,387	23,882	24,905	24,433	23,225	296,928	344,013
Straight-run	19,192	19,088	19,997	19,116	18,891	233,114	279,272
Natural gasoline, etc.	7,028	6,998	7,256	7,156	7,516	83,567	80,855
Less L. P. G. sales	502	579	663	687	832	7,195	6,281
Benzol						597	3,435
Total production	51,105	49,389	51,495	50,018	48,800	607,011	701,294
Daily average	1,649	1,646	1,661	1,667	1,574	1,663	1,921
Imports						99	335
Exports	2,936	2,020	3,958	3,478	3,327	36,214	27,083
Daily average	95	67	128	116	107	99	74
Stocks, end of period:							
Finished gasoline	71,403	69,293	67,669	64,224	70,772	70,772	86,413 [2] 86,159
Natural gasoline	6,405	6,056	5,424	4,996	4,632	4,632	4,275 [2] 4,437
Total stocks	77,808	75,349	73,093	69,220	75,404	75,404	90,688 [2] 90,596
Domestic demand	48,606	49,828	49,793	50,413	39,289	586,088	667,505
Daily average	1,568	1,661	1,606	1,680	1,267	1,606	1,829

[1] Subject to revision.
[2] Preliminary figures for January 1, 1942

the coupons he collected from the motorist for new supplies, largely eliminated the excessive demand, although there were frequent instances of dry tanks at service stations.

Nation-wide rationing of gasoline was instituted on December 1. Whereas rationing in the East Coast area resulted from insufficient supplies because of transportation difficulties, that consideration did not enter into the Nation-wide rationing, which was adopted to conserve tires.

Under the coupon system the basic ration was 4 gallons a week for each car, supplemental quantities being issued where it was necessary

for a motorist to use his car to drive to war work or in performing war work, or where commercial users were assisting the production of war needs. During the winter coupon values were reduced to 3 gallons in the East Coast area, and early in 1943 pleasure driving was prohibited. When it was again permitted in March 1943, the basic ration was cut to 1½ gallons a week.

Domestic demand.—Domestic demand for motor fuel was 586,088,000 barrels, or 12 percent less than the 667,505,000 barrels in 1941. Automotive demand dropped 18 percent—from 583,957,000 barrels in 1941 to 478,691,000 in 1942.

Distribution of domestic motor-fuel demand in the United States, 1938–42

[Thousands of barrels]

	1938	1939	1940	1941	1942 [1]
Passenger cars:					
Highway	163,092	171,468	182,816	204,886	151,170
City	187,923	198,053	210,199	238,017	190,414
Total passenger cars	351,015	369,521	393,015	442,903	341,584
Trucks:					
Highway	41,077	45,478	47,436	51,604	54,184
City	61,616	67,104	71,220	75,470	67,923
Total trucks	102,693	112,582	118,656	127,074	122,107
Busses	11,765	12,300	12,975	13,980	15,000
Total automotive demand	465,473	494,403	524,646	583,957	478,691
Other demand	57,530	61,106	64,844	83,548	107,397
Grand total	523,003	555,509	589,490	667,505	586,088

[1] Subject to revision.

Traffic statistics indicate that at many points truck traffic was greater on the highways in 1942 than in 1941 notwithstanding difficulty in obtaining tires and gasoline. This was particularly true in California, where there were large increases on some highways; there was even a gain in long-distance travel (indicated by trucks entering the State), which was 1 percent higher than in 1941, compared with a drop of 44 percent for passenger cars. The instances were rare where passenger-car traffic on the highways was greater than in 1941, some points in California being the principal exceptions.

Excepting California, city traffic was lower for both trucks and passenger cars, although traffic for the latter was affected considerably more than the former.

Passenger cars in use July 1 declined from 27,635,000 in 1941 to 26,399,000 in 1942 and trucks from 4,817,200 to 4,677,000. Gasoline consumption per passenger car dropped from 16.03 barrels (673 gallons) in 1941 to 12.94 barrels (543 gallons) in 1942, and consumption per truck dropped from 26.38 barrels (1,108 gallons) to 26.11 barrels (1,097 gallons).

Exports.—Exports of motor fuel were 36,214,000 barrels in 1942 compared with 27,083,000 in 1941.

Motor-fuel consumption per motor-vehicle unit in use on July 1, 1938–42 [1]

Year	Passenger cars			Trucks		
	Consumption (thousands of barrels)	Number of vehicles	Consumption per unit (barrels)	Consumption (thousands of barrels)	Number of vehicles	Consumption per unit (barrels)
1938	351,015	23,875,400	14.70	102,693	4,258,100	24.12
1939	369,521	24,342,900	15.18	112,582	4,340,600	25.94
1940 [2]	393,015	25,385,900	15.48	118,656	4,531,700	26.18
1941 [2]	442,903	27,635,000	16.03	127,074	4,817,200	26.38
1942 [2]	341,584	26,399,000	12.94	122,107	4,677,000	26.11

[1] Excludes gasoline consumed by busses and for nonautomotive uses.
[2] Subject to revision.

Production.—Motor-fuel output dropped 13 percent—from 701,294,000 barrels in 1941 to 607,011,000 in 1942. The production in 1942 comprised 233,114,000 barrels of straight-run gasoline, 296,928,000 barrels of cracked gasoline, 597,000 barrels of benzol, and 76,372,000 barrels of natural gasoline. Natural gasoline used in producing motor fuel consisted of 56,929,000 barrels blended at refineries, 19,248,000 barrels sold as such, and 195,000 barrels contributed to the increase in motor-fuel stocks.

Production of gasoline in the United States in 1942, 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
Cracked:													
East Coast	4,877	3,731	3,138	2,397	2,335	2,774	3,044	3,372	3,257	3,073	3,359	2,882	38,239
Appalachian	1,209	1,172	1,290	1,094	1,095	1,028	1,062	1,043	1,155	1,107	1,169	999	13,483
Indiana, Illinois, Kentucky, etc	6,327	5,558	6,393	5,701	5,783	5,841	6,057	5,821	5,804	5,826	5,314	5,394	69,819
Oklahoma, Kansas, and Missouri	3,292	2,705	2,668	2,698	2,408	2,357	2,602	2,640	2,382	2,522	2,471	2,309	31,054
Texas Inland	1,542	1,262	1,356	1,142	1,209	1,134	1,109	1,196	1,133	1,172	1,215	1,289	14,759
Texas Gulf Coast	8,386	7,171	5,977	6,008	5,485	5,153	6,020	6,478	5,170	5,992	5,796	5,353	72,989
Louisiana Gulf Coast	1,005	880	940	910	1,023	897	873	909	963	1,080	947	1,103	11,530
Arkansas and Louisiana Inland	419	397	376	477	350	355	363	381	309	417	423	344	4,611
Rocky Mountain	718	692	596	495	699	476	566	621	531	547	699	514	7,154
California	2,489	2,438	2,895	2,582	2,743	2,408	2,384	2,926	3,178	3,169	3,040	3,038	33,290
Total straight-run	30,324	26,006	25,629	23,504	23,130	22,423	24,080	25,387	23,882	24,905	24,433	23,225	296,928
Percent yield [2]	25.5	24.6	23.2	22.4	21.6	21.3	21.5	22.2	21.1	21.4	21.8	20.5	22.2
Straight-run:													
East Coast	2,792	2,136	2,648	1,597	1,652	1,539	1,643	1,733	1,536	1,837	1,174	1,738	22,025
Appalachian	901	815	905	889	933	860	928	952	857	1,001	899	859	10,799
Indiana, Illinois, Kentucky, etc	5,034	4,471	4,615	4,479	4,577	3,739	4,435	4,397	4,563	4,774	4,731	4,128	53,943
Oklahoma, Kansas, and Missouri	2,462	2,230	2,252	2,594	2,629	2,430	2,583	2,524	2,646	2,555	2,537	2,354	29,796
Texas Inland	1,438	1,395	1,369	1,368	1,456	1,664	1,725	1,651	1,685	1,650	1,553	1,475	18,429
Texas Gulf Coast	4,908	3,487	3,466	2,737	3,269	2,385	2,851	2,684	2,713	2,732	2,936	3,225	37,393
Louisiana Gulf Coast	917	685	699	648	735	566	696	830	658	623	706	530	8,293
Arkansas and Louisiana Inland	586	566	553	526	453	438	453	447	445	491	426	502	5,886
Rocky Mountain	807	609	802	704	687	761	741	722	781	824	648	726	8,812
California	2,880	2,832	3,300	2,797	3,182	3,022	2,899	3,252	3,204	3,510	3,506	3,354	37,738
Total cracked	22,725	19,226	20,609	18,339	19,573	17,404	18,954	19,192	19,088	19,997	19,116	18,891	233,114
Percent yield [2]	19.1	18.2	18.6	17.5	18.3	16.5	17.1	16.8	16.8	17.2	17.0	16.7	17.5
Total production including natural gasoline:													
East Coast	7,847	5,998	5,866	4,060	4,014	4,363	4,755	5,184	4,861	4,952	4,586	4,649	61,135
Appalachian	2,226	2,029	2,236	2,021	2,065	1,926	2,040	2,027	2,048	2,155	2,122	1,898	24,793
Indiana, Illinois, Kentucky, etc	11,939	10,560	11,540	10,659	10,911	10,217	11,158	10,962	11,159	11,370	10,707	10,165	131,347
Oklahoma, Kansas, and Missouri	6,131	5,307	5,249	5,592	5,330	5,088	5,473	5,470	5,384	5,466	5,427	5,029	64,946
Texas Inland	3,671	3,353	3,236	2,898	3,137	3,250	3,327	3,355	3,339	3,430	3,311	3,193	39,500
Texas Gulf Coast	15,283	11,963	10,712	10,044	10,109	8,929	10,224	10,759	9,447	10,315	10,245	10,151	128,181
Louisiana Gulf Coast	2,119	1,770	2,020	1,848	1,996	1,743	1,836	1,933	1,875	2,086	1,973	1,983	23,182
Arkansas and Louisiana Inland	1,123	1,038	994	1,076	901	892	974	973	915	1,064	967	965	11,876
Rocky Mountain	1,619	1,374	1,462	1,241	1,412	1,268	1,347	1,391	1,366	1,471	1,461	1,351	16,763
California	6,442	6,296	7,337	6,456	7,100	6,574	6,477	7,434	7,684	8,048	7,739	7,661	85,248
Total United States: 1942	58,400	49,688	50,652	45,889	46,975	44,250	47,611	49,488	48,078	50,357	48,538	47,045	586,971
1941	51,173	46,841	51,950	52,009	56,188	55,136	57,714	58,954	58,988	61,037	59,480	61,640	671,110

[1] Subject to revision.

[2] Based upon crude runs to stills.

The straight-run gasoline proportion of total motor fuel produced continued downward, declining from 39.8 percent in 1941 to 38.4 in 1942. The proportion of cracked gasoline also declined from 49.1 percent to 48.9, but natural gasoline increased from 10.6 percent to 12.6. Blended natural gasoline, which increased from 6.8 percent to 9.4, accounted for the rise, as other natural gasoline declined from 3.8 percent to 3.2. Prohibition of the use of benzol in motor fuel is reflected in the decline from 3,435,000 barrels to 597,000. Statistics on disposition of the benzol manufactured have been restricted because of military secrecy. Some of it may have gone into the production of explosives and some into the production of styrene for polymerization with butadiene for the manufacture of synthetic rubber, but a considerable quantity, not included in the above figures, was being used in the production of cumene for aviation gasoline.

Yields.—Gasoline yields, subjected to conflicting forces during 1942, dropped to 39.7 percent from 44.2 percent in 1941. Primarily, the demand for motor fuel was lessened because of the rationing of tires throughout the year and the Nation-wide rationing of gasoline in December. Contrarily, the demand for heating oil and heavy oil fuel was considerably stronger, making it necessary for the usual balance of refinery operations to be modified to produce the minimum requirement of heavy oil without accumulating excessive stocks of gasoline. At the same time, the production of aviation gasoline was one of the most vital functions of the industry, and this kept the yield of gasoline from dropping as low as it would have otherwise.

Yields of 22.2 percent for cracked and of 17.5 percent for straight-run gasoline were both lower than in 1941. The greater loss in cracked gasoline, however, reflected the diversion of cracking stock to fuel-oil uses, notwithstanding the heavy operations to supply base stock for aviation gasoline. The cracked-gasoline yield dropped from its peak of 25.8 percent in December 1941 to 21.3 percent in June 1942; it fluctuated about this point until the end of the year, when it dropped to 20.5 percent in December. The yield of straight-run gasoline dropped only about half as much—from 19.9 percent in December 1941 to 16.7 percent in December 1942.

The greatest drop in yield was in Texas; the Texas Gulf Coast district lost 7.7 percent—from 43.7 percent for 1941 to 36.0 for 1942—and Inland Texas lost 6.1 percent—from 54.6 percent to 48.5. The yield in the Gulf Coast Louisiana district, where emphasis on aviation gasoline production caused the yield of cracked gasoline to rise during the year, experienced the smallest reduction of any district—from 37.7 percent to 37.3. Aviation gasoline production in the East Coast district also, notwithstanding the great need for fuel oil in this district, held the gasoline yield to a loss of only 1 percent—from 38.4 percent to 37.4.

Prices.—The average group 3 refinery price for gasoline in 1942 was 5.91 cents per gallon. Office of Price Administration Schedule 88, signed February 2, provided that prices in effect October 1, 1941, should be ceiling prices for petroleum and its products, except at service stations. As a consequence, the maximum price, which had been 6.375 cents during January and February, was fixed early in March at 6.00 cents—the lowest price prevailing on October 1, 1941. Fluctuations during the balance of the year represent averages between this ceiling price and lower prices for which gasoline sold.

Average monthly prices of gasoline in the United States, 1941–42, in cents per gallon

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1941													
Monthly average at refineries in Oklahoma, 72–74 octane [1]	4.72	4.69	4.71	5.09	5.47	5.99	6.18	6.19	6.19	6.19	6.19	6.19	5.65
Average of 50 cities on 1st of month: [2]													
Dealer's net	8.54	8.54	8.62	8.78	9.40	9.85	9.94	10.04	10.02	10.04	10.02	10.04	9.49
Service station (including State tax)	16.57	16.58	16.67	16.82	17.53	18.14	18.26	18.32	18.39	18.49	18.49	18.52	17.73
1942													
Monthly average at refineries in Oklahoma, 72–74 octane [1]	6.19	6.16	5.77	5.72	5.76	5.81	5.87	5.92	5.94	5.94	5.94	5.94	5.91
Average of 50 cities on 1st of month: [2]													
Dealer's net	9.98	10.16	10.10	10.25	10.40	10.38	11.31	11.26	10.33	10.33	10.37	10.37	10.44
Service station (including State tax)	18.41	18.59	18.54	18.76	18.87	18.87	19.86	19.79	18.86	18.85	18.87	18.91	18.93

[1] National Petroleum News.
[2] American Petroleum Institute; compiled by The Texas Co.

The 50-city service-station average price, which gained 1.84 cents during 1941, was permitted by the Office of Price Administration (see Maximum Price Order 137) to rise another 1.45 cents from January to July 1942, only to be reduced almost 1 cent in August. The year ended with a net gain of .52 cent. Most of the gain represented compensation to the dealers along the East coast for the increased cost of transporting gasoline by tank car instead of by boat, as is normal in peacetimes. The Defense Supplies Corporation assumed 2.5 cents per gallon of this cost in August—the same amount prices had been raised in the East coast area in June—and retail prices were reduced a corresponding sum. General price changes in the East coast area were as follows:

January 23, plus 0.3 cent.
March 27, plus 0.5 cent.
April 30, plus 0.4 cent.
June 29, plus 2.5 cents.
August 5, minus 2.5 cents.

The net change for the East coast cities in general was an increase of 1.2 cents.

Although there were a number of changes during the year in some cities in the Central States, there was little difference in the price at the end of the year from that at the beginning, except for Des Moines, Iowa, and Little Rock, Ark., where prices increased 3 cents. These two increases and a rise of 1.4 cents in St. Louis were responsible principally for an increase of .39 cent in the average price for the cities in the Central States. Even with this rise, these cities had the lowest average price—13.31 cents, ex-tax—of any section of the country.

Decreases in the Rocky Mountain cities brought the average price of 15.15 cents below that of the unchanged Pacific coast area and only slightly above that of the East Coast cities—15.11 cents. Changes were most violent in Salt Lake City, Utah, where cuts reduced the price 4.5 cents in February. One cent of the cut was restored in

March, another cent in October, and 1.5 cents more in November making the year-end price only 1 cent less than that at the beginning of the year. One cent of a drop of 3.6 cents in Denver in July was restored in August, leaving the price at the end of the year 2.6 cents less than at the beginning. A loss of 2.0 cents in the price at Butte, Mont., was the only other change in the Rocky Mountain cities included in the 50-city price average.

Twin Falls, Idaho, still had the most costly gasoline for the motorist; the service-station price in that city was 25.6 cents, including 6.6 cents tax, and Boise, Idaho, followed with a price of 24.1 cents. Birmingham, Ala., with a price of 23.5 cents (including 8.5 cents city, State, and Federal taxes) and Charleston, S. C. (with a price of 23.2 cents, including 7.5 cents taxes), were next. The price in Kansas City, Mo., of 15.6 cents was lowest, with the 15.9-cent price in Wichita, Kans., next, followed by St. Louis, Mo. (16.3 cents); all three prices included 4.5 cents taxes.

There were no changes in either State or Federal motor-fuel tax rates during 1942, but the revenue from State gasoline taxes dropped from $950,956,410 in 1941 to $839,457,000 in 1942, and that from Federal gasoline taxes from $371,135,781 to $336,684,645.

Aviation gasoline.—The program for the production of aviation gasoline launched in 1941 was well under way by the end of 1942, when approximately 16 times as much 100-octane gasoline was being produced as at the beginning of 1941. With the largest part of the proposed plants yet unfinished, however, that production was still considerably short of the goal of 250,000 barrels a day.

The change from production of motor fuel to production of high-octane gasoline sufficient to fly the planes of the United States and its allies can be appreciated better when it is realized that iso-octane was merely a laboratory curiosity until a few years ago; that the first output of 100-octane gasoline in commercial quantities was to fill a War Department order in 1934 for 1,000 gallons; that the first commercial catalytic polymerization plant was put in operation in 1937 and the first alkylation plant in 1938—in fact, it was only recently that the chemical world learned that olefins could be combined with parafins, from which discovery the alkylation process developed.

Stocks.—Stocks of finished and unfinished gasoline mounted to a record peak of 108,297,000 barrels on February 28, 1942, then plunged to 73,216,000 barrels on November 30—the lowest point since 1939. They totaled 80,126,000 barrels at the end of the year, compared with 93,844,000 at the end of 1941, although the smaller amount on hand at the end of 1942 represented 63.3 days' supply compared with 55.6 days' supply on hand at the end of 1941.

The Gulf Coast Texas and Louisiana, California, and Inland Louisiana-Arkansas districts had larger stocks at the end of 1942 than at the end of 1941; in fact, stocks in the last district more than doubled during the year. In the East Coast district the stocks dropped 47 percent. Such a severe cut was made possible in this district by pooling stocks and eliminating brand identities, by stopping cross-hauls, and by pooling facilities.

Figure 9 shows the monthly quantities of finished gasoline stocks, in millions of barrels, from January 1, 1940, to December 31, 1942. 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 the same years, to stress the contrast in seasonal variations in stocks of the two products. It also shows how distillate fuel-oil stocks, although not declining as greatly as gasoline stocks, were on a considerably lower level throughout most of 1942 than in 1941 despite a demand in 1942 9 percent higher than that in 1941.

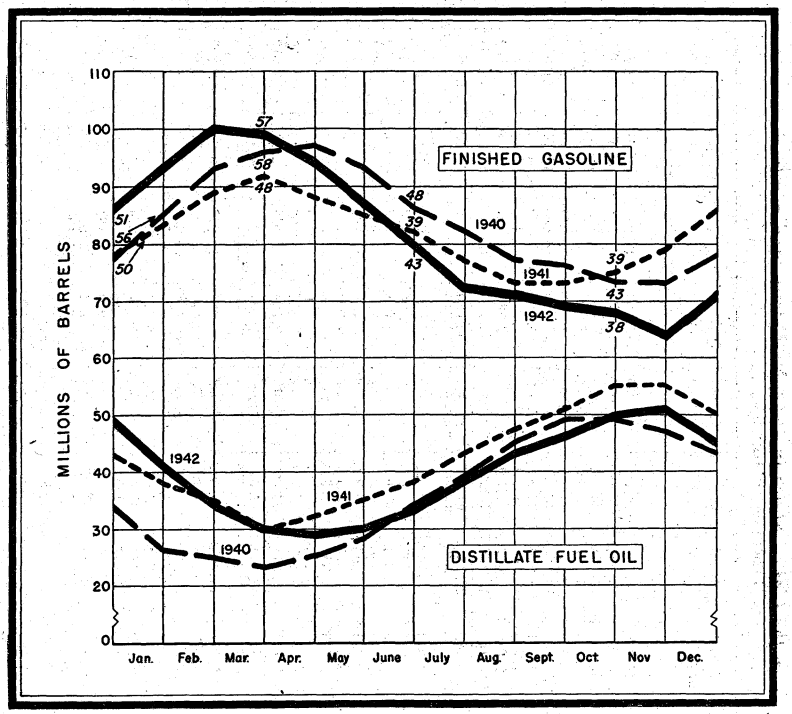

FIGURE 9.—Stocks of finished gasoline in the United States, 1940–42, by months, with figures representing days' supply at certain periods; also stocks of distillate fuel oil, 1940–42, by months.

Days' supply [1] *of motor fuel on hand in the United States at end of month, 1940–42*

Month	1940			1941			1942 [2]		
	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel
January	62.3	3.3	65.6	53.0	3.5	56.5	58.7	3.0	61.7
February	61.3	3.2	64.5	53.5	3.2	56.7	58.1	3.0	61.1
March	58.2	3.2	61.4	47.8	2.8	50.6	57.1	3.2	60.3
April	54.5	3.4	57.9	44.4	2.8	47.2	53.0	3.4	56.4
May	48.3	3.3	51.6	42.5	2.9	45.4	49.2	3.7	52.9
June	48.1	3.9	52.0	39.0	3.0	42.0	43.1	3.5	46.6
July	44.2	4.1	48.3	36.2	3.0	39.2	43.1	4.0	47.1
August	42.7	4.2	46.9	35.2	3.0	38.2	41.3	3.7	45.0
September	42.0	3.9	45.9	36.4	2.7	39.1	40.0	3.5	43.5
October	42.9	3.8	46.7	38.8	2.5	41.3	37.7	3.0	40.7
November	47.0	3.9	50.9	42.6	2.4	45.0	46.7	3.6	50.3
December	51.0 [3] 50.1	3.7 [3] 3.7	54.7 [3] 53.8	51.0	2.6	53.6	55.9	3.6	59.5

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Subject to revision.
[3] For comparison with 1941.

Stocks of gasoline in the United States in 1942, by districts and months [1]

[Thousands of barrels]

District	January 31	February 28	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	19,011	18,378	16,139	14,625	12,209	13,703	11,982	12,723	12,054	11,221	10,150	9,926
Appalachian	3,667	3,709	3,793	3,713	3,043	2,271	2,170	2,360	2,406	2,245	2,034	2,356
Indiana, Illinois, Kentucky, etc	20,380	22,111	22,568	20,977	18,453	15,977	14,497	13,985	13,330	12,858	11,614	14,369
Oklahoma, Kansas, and Missouri	9,381	10,293	9,921	9,439	8,428	7,326	6,404	5,886	5,668	5,627	5,118	5,984
Texas Inland	3,126	3,429	3,527	3,356	2,868	2,421	1,833	1,795	1,752	1,709	1,490	2,023
Texas Gulf Coast	15,923	19,136	19,861	18,979	19,916	17,555	15,694	15,740	14,827	14,962	14,407	14,322
Louisiana Gulf Coast	3,780	4,031	4,000	3,899	3,640	3,142	3,390	3,533	3,689	3,368	3,407	3,600
Arkansas and Louisiana Inland	1,158	1,339	1,360	1,270	1,206	1,223	1,130	931	1,171	1,287	1,165	1,709
Rocky Mountain	2,209	2,660	2,817	2,576	2,488	2,189	1,907	1,546	1,202	1,110	1,076	1,347
California	14,854	15,100	15,198	15,293	15,210	14,273	12,650	12,904	13,194	13,282	13,763	15,136
Total finished gasoline	93,489	100,186	99,184	94,127	87,461	80,080	71,657	71,403	69,293	67,669	64,224	70,772
Unfinished gasoline:												
East Coast	931	913	769	897	827	733	994	1,188	1,245	1,052	1,111	1,010
Appalachian	357	370	403	389	410	405	423	417	409	372	321	306
Indiana, Illinois, Kentucky, etc	650	709	643	611	543	538	523	653	732	763	762	995
Oklahoma, Kansas, and Missouri	412	415	496	487	383	396	353	276	273	254	280	289
Texas Inland	490	484	205	362	346	249	162	195	172	182	179	221
Texas Gulf Coast	2,129	2,493	2,515	2,451	2,303	2,302	2,280	2,164	2,596	2,902	2,951	2,871
Louisiana Gulf Coast	406	413	357	338	289	304	395	278	402	347	326	376
Arkansas and Louisiana Inland	10	8	8	7	8	6	4	5	5	3	5	3
Rocky Mountain	93	103	109	91	98	105	106	103	100	98	93	88
California	2,246	2,203	2,044	2,062	2,013	2,399	2,549	2,844	2,919	2,980	2,964	3,195
Total unfinished gasoline	7,724	8,111	7,549	7,695	7,220	7,437	7,789	8,123	8,853	8,953	8,992	9,354
Total finished and unfinished:												
East Coast	19,942	19,291	16,908	15,522	13,036	14,436	12,976	13,911	13,299	12,273	11,261	10,936
Appalachian	4,024	4,079	4,196	4,102	3,453	2,676	2,593	2,777	2,815	2,617	2,355	2,662
Indiana, Illinois, Kentucky, etc	21,030	22,820	23,211	21,588	18,996	16,515	15,020	14,638	14,062	13,621	12,376	15,364
Oklahoma, Kansas, and Missouri	9,793	10,708	10,417	9,926	8,811	7,722	6,757	6,162	5,941	5,881	5,398	6,273
Texas Inland	3,616	3,913	3,732	3,718	3,214	2,670	1,995	1,990	1,924	1,891	1,669	2,244
Texas Gulf Coast	18,052	21,629	22,376	21,430	22,219	19,857	17,974	17,904	17,423	17,864	17,358	17,193
Louisiana Gulf Coast	4,186	4,444	4,357	4,237	3,929	3,446	3,785	3,811	4,091	3,715	3,733	3,976
Arkansas and Louisiana Inland	1,168	1,347	1,368	1,277	1,214	1,229	1,134	936	1,176	1,290	1,170	1,712
Rocky Mountain	2,302	2,763	2,926	2,667	2,586	2,294	2,013	1,649	1,302	1,208	1,169	1,435
California	17,100	17,303	17,242	17,355	17,223	16,672	15,199	15,748	16,113	16,262	16,727	18,331
Total United States: 1942	101,213	108,297	106,733	101,822	94,681	87,517	79,446	79,526	78,146	76,622	73,216	80,126
1941	90,366	95,558	98,706	95,769	92,831	89,758	84,701	80,377	79,963	82,303	87,278	{94,098 [3] 93,844

[1] Subject to revision.

[2] Includes stocks of finished gasoline at refineries, bulk terminals, and in pipe lines.

[3] For comparison with 1942.

Production and consumption by States.—Although the relative proportion of gasoline produced by Texas dropped from 32 percent in 1941 to 29 in 1942, its output was almost twice the 15 percent of California, next in importance. Percentages for other important States were: Illinois, 8; Pennsylvania and Indiana, 7 each.

Military requirements caused gasoline consumption in California and Texas to increase in 1942, but tire and rationing restrictions brought material declines for New York, Pennsylvania, and other States. As a result, the States did not follow their usual order of importance. The percentage consumption of the principal States was as follows: California, 9.5; Texas, 7.4; New York, 6.7; Ohio, 6.2; Illinois, 6.0; Pennsylvania, 5.9; Michigan, 5.1.

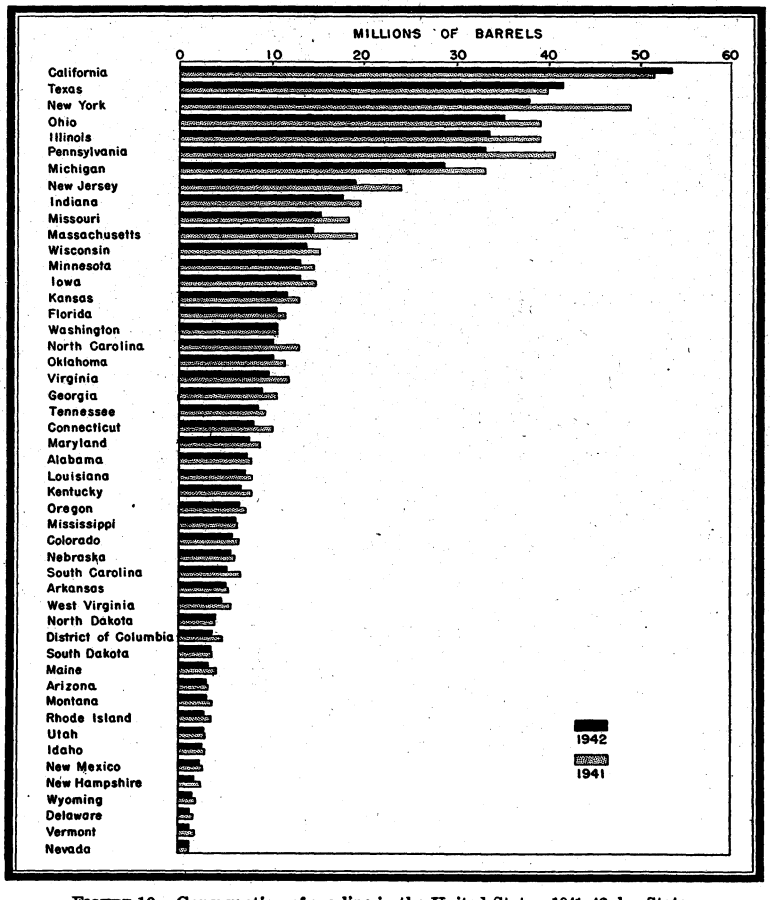

FIGURE 10.—Consumption of gasoline in the United States, 1941–42, by States.

Production and consumption of gasoline in the United States, 1940–42, by States
[Thousands of barrels]

State	1940		1941		1942 [1]	
	Production	Consumption [2]	Production	Consumption [2]	Production	Consumption [2]
Alabama	(3)	6,307	(3)	7,819	(3)	7,376
Arizona		2,637		3,051		3,029
Arkansas	3,702	4,546	4,044	5,340	4,033	4,923
California	[4] 76,885	45,904	[4] 85,734	51,251	[4] 85,248	53,220
Colorado	2,020	5,976	2,334	6,358	2,312	5,832
Connecticut		9,068		10,035		8,035
Delaware		1,495		1,622		1,300
District of Columbia		4,027		4,561		3,565
Florida		9,713		11,326		10,503
Georgia	[5] 4,329	9,346	[5] 4,983	10,713	[5] 3,104	9,096
Idaho	(6)	2,547	(6)	2,786	(6)	2,526
Illinois	[7] 41,386	35,944	[7] 49,377	38,987	[7] 46,825	33,707
Indiana	43,180	17,175	43,704	19,564	39,017	17,658
Iowa		13,637		14,578		12,951
Kansas	[8] 33,208	11,943	[8] 37,434	12,872	[8] 33,878	11,600
Kentucky	[9] 7,049	6,954	[9] 8,523	7,939	[9] 7,949	6,698
Louisiana	[3] 23,673	6,627	[3] 30,300	8,179	[3] 31,024	7,181
Maine		3,747		4,138		3,188
Maryland	(5)	7,491	(5)	8,703	(5)	7,463
Massachusetts	[10] 6,554	17,791	[10] 5,791	19,155	[10] 5,023	14,454
Michigan	10,216	29,979	11,180	33,149	11,073	28,613
Minnesota	(7)	13,861	(7)	14,481	(7)	13,030
Mississippi	(3)	5,219	(3)	6,163	(3)	6,079
Missouri	(8)	16,623	(8)	18,472	(8)	15,336
Montana	3,836	3,276	4,293	3,533	4,245	3,022
Nebraska	(8)	5,629	(8)	5,989	(8)	5,593
Nevada		1,043		1,102		1,160
New Hampshire		2,282		2,582		1,847
New Jersey	25,451	22,023	28,312	23,838	19,677	19,241
New Mexico	1,121	2,630	1,193	2,909	1,473	2,349
New York	7,826	46,918	9,044	48,797	8,220	37,746
North Carolina		10,938		12,923		10,132
North Dakota		3,638		3,947		3,928
Ohio	31,603	35,022	34,804	39,031	34,706	35,061
Oklahoma	32,603	10,584	34,190	11,368	31,071	10,067
Oregon		6,250		7,230		6,662
Pennsylvania	46,550	37,666	51,431	40,594	39,149	33,073
Rhode Island	(10)	3,190	(10)	3,507	(10)	2,839
South Carolina	(5)	5,577	(5)	6,555	(5)	5,189
South Dakota	(8)	3,422	(8)	3,634	(8)	3,419
Tennessee	(9)	7,785	(9)	9,186	(9)	8,591
Texas	184,885	33,806	212,347	39,839	167,681	41,453
Utah	(6)	2,552	(6)	2,783	(6)	2,697
Vermont		1,686		1,790		1,282
Virginia		9,943		11,842		9,596
Washington	(4)	9,024	(4)	10,536	(4)	10,569
West Virginia	2,017	5,262	2,317	5,719	2,529	4,664
Wisconsin		14,049	(7)	15,148	(7)	13,606
Wyoming	[6] 9,185	1,668	[6] 9,775	1,882	[6] 8,734	1,471
Total United States	597,279	574,420	671,110	637,506	586,971	562,620

[1] Subject to revision.
[2] American Petroleum Institute.
[3] Alabama and Mississippi included with Louisiana.
[4] Washington included with California.
[5] Maryland and South Carolina included with Georgia.
[6] Idaho and Utah included with Wyoming.
[7] Minnesota and Wisconsin included with Illinois.
[8] Missouri, Nebraska and South Dakota included with Kansas.
[9] Tennessee included with Kentucky.
[10] Rhode Island included with Massachusetts.

Distribution.—The methods of moving petroleum products were greatly altered by the war, as much of the burden was shifted from marine to rail transportation. Gasoline shipments by barge and tanker from the Gulf Coast to the East Coast district amounted to only 32,289,000 barrels in 1942 compared with 130,534,000 in 1941. Movement by barge from Texas and Louisiana to points on the Mississippi River, however, increased from 13,736,000 barrels in 1941 to 15,960,000 in 1942.

Pipe-line shipments of motor fuel increased from 111,077,000 barrels in 1941 to 125,341,000 in 1942. Details of pipe-line construction and other developments in transportation appear in the section on Transportation.

Shipments of motor fuel by pipe lines in the United States in 1942, by months

[Thousands of barrels]

	1942													1941 total
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
Motor fuel turned into lines	10,122	8,478	9,846	9,895	10,453	9,694	10,242	10,615	10,538	12,255	11,664	12,430	126,232	112,976
Motorfuel delivered from lines	9,151	7,937	9,855	10,338	11,112	9,953	10,412	10,912	10,004	12,260	12,144	11,263	125,341	111,077
Shortage	35	[1] 1	10	139	6	4	138	45	144	45	22	90	677	615
Stocks in lines and working tanks, end of month	7,294	7,836	7,817	7,235	6,570	6,307	5,999	5,657	6,047	5,997	5,495	6,572	6,572	6,358

[1] Overage.

556250—43——70

KEROSINE AND RANGE OIL

An expected increase in domestic demand for kerosine in 1942 did not materialize, owing to transportation difficulties and rationing of deliveries in some areas; consequently, the 1942 total was practically the same as 1941 requirements. Exports of kerosine declined in 1942; while imports, though of relatively unimportant volume, more than doubled the 1941 total. Lower crude runs to stills and a smaller percentage yield resulted in less kerosine production in 1942 than in 1941. A deficiency in kerosine supply in 1942 due to a lower output resulted in a heavy draft on stocks.

Petroleum refiners produced 7 percent less kerosine in 1942 than in 1941, the output declining from 72,586,000 barrels in 1941 to 67,474,000 in 1942. The yield dropped slightly from 5.2 percent in 1941 to 5.1 percent in 1942; however, lower runs of crude petroleum to stills in 1942 (5 percent under the 1941 volume), tanker transportation difficulties, and the effort of refiners to produce much-needed fuel oils were the principal reasons for the smaller production of kerosine.

Comparative analyses of statistics for kerosine in the United States, 1941–42, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousand of barrels)	
	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]
By months:								
January	6,661	6,634	6.0	5.6	7,769	9,750	8,312	11,007
February	5,888	6,133	5.9	5.8	6,484	7,690	7,634	9,324
March	6,033	6,035	5.4	5.5	6,821	7,230	6,724	7,900
April	6,068	5,529	5.5	5.3	5,549	5,516	7,063	7,806
May	6,033	5,302	5.1	4.9	4,504	4,580	8,421	8,433
June	5,218	4,929	4.5	4.7	3,918	3,653	9,609	9,497
July	5,406	5,134	4.5	4.6	4,270	3,266	10,635	10,933
August	5,850	5,340	4.7	4.7	4,530	4,039	11,636	12,176
September	5,949	5,421	4.9	4.8	5,621	5,012	11,662	12,363
October	6,355	5,907	5.0	5.1	5,519	5,367	11,670	12,645
November	6,443	5,759	5.3	5.1	7,080	5,684	10,843	12,630
December	6,682	5,351	5.3	4.7	7,404	7,827	9,599	10,064
Total United States	72,586	67,474	5.2	5.1	69,469	69,614	{ 9,599 [2] 14,515 }	10,064
By districts:								
East Coast	9,169	7,929	4.2	4.9			6,561	2,853
Appalachian	3,166	3,640	5.9	6.3			366	337
Indiana, Illinois, Kentucky, etc.	11,864	15,802	4.7	6.0			1,660	1,554
Oklahoma, Kansas, and Missouri	7,505	8,984	5.9	6.9			678	576
Texas Inland	2,987	3,015	4.5	4.4	(3)	(3)	282	178
Texas Gulf Coast	24,448	17,364	6.7	5.7			3,036	2,456
Louisiana Gulf Coast	7,304	5,219	13.5	9.8			630	1,290
Arkansas and Louisiana Inland	3,080	2,460	10.5	8.6			246	214
Rocky Mountain	906	698	2.7	2.0			129	81
California	2,157	2,363	1.0	1.0			927	525
Total United States	72,586	67,474	5.2	5.1	69,469	69,614	[2] 14,515	10,064

[1] Subject to revision.
[2] New basis to compare with 1942. Monthly figures for 1941 do not include bulk terminal stocks which were not available until December 31, 1941.
[3] Figures not available.

East Coast, Texas Gulf Coast, Louisiana Gulf Coast, and Arkansas and Louisiana Inland, important districts for the production of

kerosine, all showed sharp declines in production in 1942 compared with 1941. An exception to this general trend was the Indiana-Illinois refinery district, an area second in national importance as a source of kerosine, where production increased by a third in 1942 over 1941. Gains in kerosine output were also realized in the Appalachian, Oklahoma-Kansas, Texas Inland, and California districts. It should be noted that the Gulf refinery districts, which depend on tankers to transport kerosine to East coast and export markets, showed declines in production, whereas inland districts, which could make rail shipments advantageously to important consuming centers, reported gains in output. In other words, transportation, or the lack of it, largely determined kerosine production in most districts during 1942.

The indicated domestic demand for kerosine in 1942—69,614,000 barrels, calculated from production, change in stocks, exports, and imports—varied little from the 1941 total—69,469,000 barrels. It is believed that the 1942 quantity would have increased at least 5 percent had normal conditions prevailed. The potential market demand was not fully supplied, especially in the North Atlantic Coast area, because of the tanker shortage.

The shrinkage in kerosine exports during present war years continued into 1942, when shipments abroad totaled 2,729,000 barrels compared with 3,221,000 in 1941. Available information for 1941 shows that most of the kerosine shipped abroad went to the United Kingdom (1,941,000 barrels) and to Brazil (223,000 barrels), while in 1942 the United Kingdom and its Dependencies received the larger share—United Kingdom 1,671,000 barrels, Canada 236,000, and Australia 179,000.

Imports of kerosine, though relatively unimportant in volume, increased from 191,000 barrels in 1941 to 418,000 in 1942.

Year-end kerosine stocks for 1941 were revised to include quantities held at bulk terminals. Kerosine in storage at the close of 1942 was 31 percent below the comparative total for 1941—a draft made necessary in order to supplement a curtailed supply resulting from lower refinery production. Kerosine stocks of 10,064,000 barrels in 1942 represented a 40-day supply at the prevailing rate of demand compared with 14,515,000 barrels or a 61-day supply at the close of 1941.

Kerosine inventories on December 31, 1942, were lower in all refinery districts than at the end of 1941 except for the Louisiana Gulf Coast where a gain was indicated. The stock increase in the Louisiana Gulf district (1,290,000 barrels in 1942 compared with 630,000 in 1941) represents a "back-up" of kerosine intended for East coast and other markets due to the shortage of tankers. The pronounced drop in kerosine stocks in the East coast from 6,561,000 barrels at the end of 1941 to 2,853,000 for 1942 was outstanding. Oil companies operating on the Atlantic coast could not obtain their usual supplies of kerosine from the Gulf area because of the tanker situation, so a drastic draft of local stocks was necessary. The extent of the shrinkage in the kerosine inventory on the East coast in 1942 is better illustrated when it is noted that such supplies represented 45 percent of total national stocks in 1941 and only 28 percent in 1942. Higher kerosine production in the Indiana-Illinois district in 1942 and the difficulty of moving the surplus freely to other markets kept

up stocks there almost to the 1941 level. Kerosine held in the Texas Gulf coast declined from 3,036,000 barrels in 1941 to 2,456,000 in 1942 as supplies were taken from storage to supplement a declining production. Increased kerosine output in California was not adequate to meet the demand in 1942 so an added quantity was taken from stocks.

Sales of kerosine in the United States, 1940–41, by regions, States, and uses [1]

[Thousands of barrels]

Region and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1940	1941	1940	1941	1940	1941	1940	1941
Pacific Coast:								
California	91	98	13	19	985	1,188	1,089	1,305
Oregon	11	10	6	10	53	116	70	136
Washington	5	14	-------	-------	130	157	135	171
Arizona	5	12	2	5	90	133	97	150
Nevada	-------	-------	-------	-------	11	26	11	26
Rocky Mountain:								
Idaho	1	2	9	11	9	19	19	32
Montana	34	39	97	45	50	69	181	153
Wyoming	4	8	29	15	17	18	50	41
Utah	9	5	14	4	14	16	37	25
Colorado	20	28	69	54	46	37	135	119
New Mexico	18	15	41	53	61	95	120	163
North Central:								
North Dakota	54	65	168	129	66	56	288	250
South Dakota	102	84	143	115	59	63	304	262
Minnesota	278	307	262	193	457	516	997	1,016
Nebraska	130	158	180	186	144	160	454	504
Iowa	191	217	282	194	659	645	1,132	1,056
Wisconsin	188	221	208	149	516	508	912	878
Illinois	1,114	1,216	340	258	1,615	1,551	3,069	3,025
Indiana	179	200	168	197	1,211	1,183	1,558	1,580
Michigan	334	282	136	95	756	801	1,226	1,178
Ohio	322	312	212	237	791	741	1,325	1,290
Kentucky	60	79	60	59	510	533	630	671
Tennessee	116	102	68	78	460	483	644	663
South Central:								
Missouri	380	423	157	166	653	610	1,190	1,199
Kansas	178	163	191	158	209	226	578	547
Texas	306	411	509	516	1,611	1,740	2,426	2,667
Oklahoma	148	146	212	268	550	524	910	938
Arkansas	140	136	150	190	420	460	710	786
Louisiana	142	108	101	162	714	730	957	1,000
Mississippi	36	52	144	130	376	346	556	528
Alabama	61	66	18	44	377	405	456	515
New England:								
Maine	1,562	1,697	-------	4	42	36	1,604	1,737
New Hampshire	894	906	-------	2	39	34	933	942
Vermont	560	638	-------	1	73	88	633	727
Massachusetts	13,029	12,931	-------	-------	460	453	13,489	13,384
Rhode Island	2,547	2,434	-------	-------	80	93	2,627	2,527
Connecticut	3,793	3,852	2	-------	140	126	3,935	3,978
Middle Atlantic:								
New York	7,110	7,261	148	117	1,352	1,427	8,610	8,805
New Jersey	3,316	3,437	28	22	1,295	1,170	4,639	4,629
Pennsylvania	830	919	124	162	1,412	1,450	2,366	2,531
Delaware	118	95	4	3	63	68	185	166
Maryland	529	490	28	9	685	624	1,242	1,123
District of Columbia	78	85	5	9	92	82	175	176
South Atlantic:								
Virginia	198	173	19	11	658	687	875	871
West Virginia	29	53	10	13	191	168	230	234
North Carolina	573	665	80	76	678	710	1,331	1,451
South Carolina	171	170	32	31	425	429	628	630
Georgia	214	277	76	105	499	549	789	931
Florida	507	599	138	162	460	519	1,105	1,280
Total United States	40,715	41,661	4,683	4,467	22,264	22,868	67,662	68,996

[1] Figures for 1942 by States not yet available.

The Bureau's annual survey of kerosine sales shows deliveries of 68,996,000 barrels in 1941 compared with 67,662,000 in 1940, a gain of 2 percent. The above quantities were divided as follows: Range oil, 41,661,000 barrels in 1941 and 40,715,000 in 1940; tractor fuel, 4,467,000 barrels in 1941 and 4,683,000 in 1940; all other uses, 22,868,000 barrels in 1941 and 22,264,000 in 1940. The range oil market absorbed about 60 percent of total kerosine deliveries for both 1940 and 1941.

Some No. 1 fuel oil, which varies only slightly from kerosine, is also sold for range fuel. This light fuel oil, (4,449,000 barrels in 1941 and 3,977,000 in 1940) must be added to the kerosine reported as range fuel to determine total requirements for range oil. Making this adjustment, total sales of range oil were 46,110,000 barrels in 1941 compared with 44,692,000 in 1940, a gain of 3 percent.

Representative kerosine prices in 1942 changed very little from those prevailing during the last 6 months of 1941. An average monthly price of 4.56 cents a gallon for 41°–43° gravity water-white kerosine at refineries in Oklahoma, starting in June 1941, was maintained until March 4, 1942, when it dropped to an average of 4.44 cents a gallon, a quotation that ruled until the end of the year. The tank-wagon price of kerosine at Chicago (10.3 cents a gallon dating from June 1941) remained unchanged until December 31, 1942, when it increased to 10.6 cents a gallon.

Sales of range oil in the United States, 1939–41, by States [1]

[Thousands of barrels]

State	1939	1940	1941	
			Total	Percent of total
Massachusetts	10,814	13,419	13,187	28.6
New York	6,255	7,613	7,711	16.7
Connecticut	3,322	3,921	3,963	8.6
New Jersey	3,026	3,556	3,626	7.9
Rhode Island	2,172	2,619	2,495	5.4
Illinois	1,387	1,733	2,185	4.7
Maine	1,328	1,704	1,827	4.0
Pennsylvania	698	920	949	2.1
New Hampshire	781	898	907	2.0
Michigan	479	620	712	1.5
Minnesota	403	555	670	1.5
North Carolina	532	577	667	1.4
Vermont	468	560	638	1.4
Florida	439	542	628	1.4
Wisconsin	446	516	616	1.3
Maryland	492	531	518	1.1
Missouri	355	485	477	1.0
Ohio	320	398	457	1.0
Iowa	291	335	456	1.0
Texas	304	325	416	.9
Indiana	202	272	355	.8
Georgia	214	234	324	.7
Other States	2,333	2,359	2,326	5.0
Total United States	37,061	44,692	46,110	100.0

[1] Figures for 1942 by States not yet available.

FUEL OIL

An anticipated large increase in the domestic demand for fuel oils in 1942 was not realized. Rationing of fuel oil in the East coast and Pacific Northwest in 1942, which became necessary because of trans-

portation difficulties and military needs, reduced deliveries to a level little above 1941 requirements. The fuel-oil supply in 1941 (production plus imports and transfers from crude) was not only sufficient to cover the domestic demand and export trade, but there was also a surplus to add to stocks. The whole situation was changed in 1942, when imports of fuel oil dropped to half the 1941 quantity and as a result a heavy draft on stocks was made to cover this loss.

The record-breaking fuel-oil requirements of recent years continued into 1942, even though rationing, transportation difficulties, and conversions to other fuels by important consumers all tended to lower deliveries. The indicated domestic demand for fuel oils in 1942—587,785,000 barrels—was 6 percent above the 1941 total—556,246,000 barrels. The domestic market for distillate fuel oils increased from 172,824,000 barrels in 1941 to 184,312,000 barrels in 1942 and for residual grades from 383,422,000 barrels in 1941 to 403,473,000 in 1942. It is noted that the respective percentage gains in domestic demand for distillate fuel oils (7 percent) and residuals (5 percent) were about the same in 1942 as in 1941. These percentage increases are quite different from those in 1940, when an unusual cold spell in the first quarter forced up the requirements for distillates (domestic heating oils) to a 19-percent gain for the year compared with a 5-percent nominal increase for residual grades, and in 1941, when the larger gain (13 percent) was in residual fuel oils, reflecting the demand for fuel by expanding war industries, contrasted with only a 7-percent increase in requirements for distillate grades.

Salient statistics of fuel oil in the United States, 1941–42

[Thousands of barrels]

	1941			1942 [1]		
	Distillate fuel oil	Residual fuel oil	Total	Distillate fuel oil	Residual fuel oil	Total
Stocks at beginning of year:						
Refinery	32,082	83,548	115,630	[2] 36,322	[2] 68,727	[2] 105,049
Bulk terminal	10,829	4,478	15,307	[2] 13,008	[2] 14,232	[2] 27,240
Production	189,177	342,367	531,544	196,714	358,901	555,615
Transfers from crude oil to fuel oil:						
California	130	8,874	9,004	12	14,658	14,670
East of California	2,383	4,095	6,478	2,484	4,625	7,109
Imports	5,074	37,369	42,443	3,428	17,645	21,073
Exports	16,925	14,114	31,039	22,716	13,532	36,248
Stocks at end of year:						
Refinery	38,895	78,054	116,949	32,659	49,961	82,620
Bulk terminal	11,031	5,141	16,172	12,281	11,822	24,103
Indicated domestic demand:						
Class I railroads, purchases [3]	(4)	(4)	83,609	(4)	(4)	104,072
Public-utility power plants [5]	(4)	(4)	20,248	(4)	(4)	15,300
All other demands	(4)	(4)	452,389	(4)	(4)	468,413
	172,824	383,422	556,246	184,312	403,473	587,785

[1] Subject to revision.
[2] Stocks on new basis.
[3] Interstate Commerce Commission; total includes Diesel fuel.
[4] Figures not available.
[5] Federal Power Commission.

A review of domestic demand statistics for distillate fuel oil, by quarters, reveals an 11-percent increase in the first 3 months, due largely to the requirements for domestic heating oils, as January and February 1942 were considerably colder than the same months in 1941. The percentage gain in the first quarter of 1942 would have been even greater had not mild weather in March reduced the requirements for

that month by 1.3 million barrels and lowered the quarterly demand correspondingly. There was a nominal gain of 5 percent in the domestic market for distillates in the second quarter of 1942, followed by a 1-percent decline in the third quarter compared with similar periods of 1941. The drop in the third quarter of 1942 was directly connected with the order preventing the delivery of fuel oil for heating or cooling purposes in District 1 (17 East Coast States and the District of Columbia) during the period August 3–September 15. Deliveries of distillate fuel oil gained 7 percent in the final quarter of 1942, compared with the same period of 1941, even with coupon rationing of light heating oils, which became effective October 1, 1942.

Larger percentage gains (13 percent in the first quarter and 6 percent in the second quarter compared with the respective periods of 1941) were realized in the domestic demand for residual fuel oils than for distillate grades, reflecting the rapidly growing industrial expansion connected with the all-out war program. Restricted deliveries in the July–September period 1942 are evident in the slight loss when the demand is compared with the 1941 market in the same months. There was only a 2-percent gain in domestic demand for heavy fuel oils in the final quarter of 1942 over the 1941 quarter, as many important users of liquid fuel had by that time converted to coal or other sources of energy.

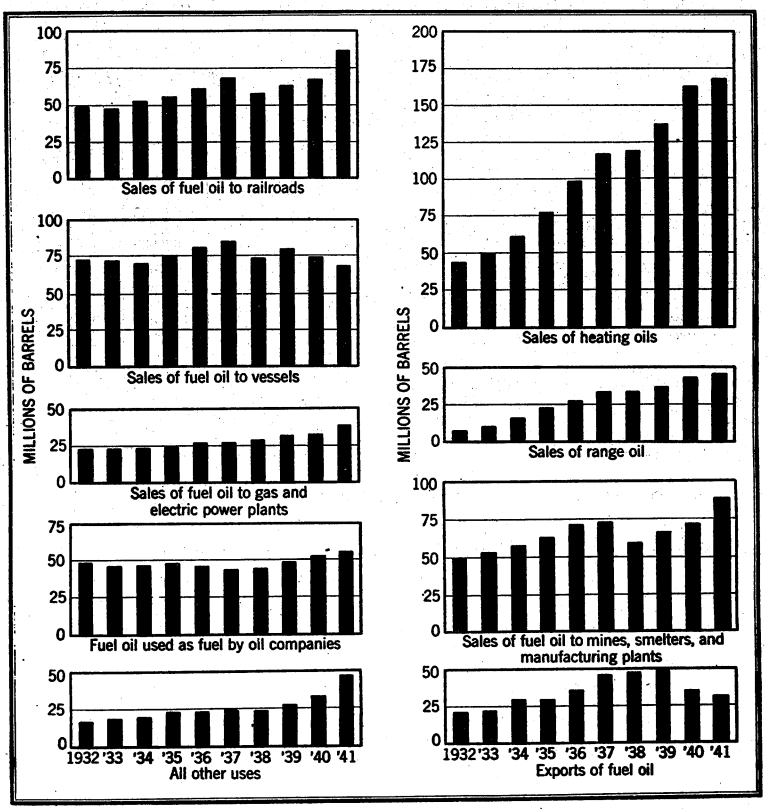

FIGURE 11.—Sales of fuel oil and range oil in the United States, 1932–41, by uses.

At present, with the Bureau's annual survey of fuel-oil sales incomplete, little is known about the distribution of fuel oil by principal uses in 1942. Preliminary monthly statistics released by the Interstate Commerce Commission give total railroad purchases of 104,072,000 barrels in 1942, a 24-percent gain over 1941 requirements of 83,609,000 barrels. Records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, show 25,148,000 barrels of bunker fuel oil delivered to vessels engaged in foreign trade in 1942—a decrease of 11 percent below the 1941 total of 28,337,000 barrels. Many power plants that formerly used fuel oil for producing electric energy converted to coal or other fuels in 1942; this cooperation in the national emergency resulted in considerable saving of fuel oil, the total consumption declining from 20,248,000 barrels in 1941 to 15,300,000 in 1942, a drop of 24 percent. Rationing, temporary stoppages of deliveries, conversions to other fuels, and shortage of spot supplies were factors that probably reduced the consumption of fuel oil by smelters, mines, and manufacturing industries, by oil companies, and in space heating in 1942 compared with 1941.

Figure 11 shows graphically the distribution of fuel-oil sales by principal uses for 1932–41. The volume of yearly sales for each principal use, as indicated by the different columns, is based upon totals derived from the annual fuel-oil survey of the Bureau. Distillate fuel oil, residual fuel oil, and kerosine sold as range oil are included.

Sales of fuel oil [1] and of range oil in the United States, 1937–41, by uses [2]

[Thousands of barrels]

Use	1937	1938	1939	1940	1941
Fuel oil:					
Railroads	69,458	57,829	63,235	68,098	85,510
Ships' bunkers (including tankers)	84,990	74,266	79,254	74,803	67,635
Gas and electric power plants	26,510	27,567	32,039	32,795	38,774
Smelters and mines	74,798	60,038	67,043	73,940	88,387
Manufacturing industries					
Heating oils	116,617	118,323	136,232	160,379	167,514
Fuel oil (No. 1) sold as range oil	2,747	2,902	3,220	3,977	4,449
Oil company fuel	42,924	43,517	49,045	51,928	55,297
All other uses	23,759	23,408	26,875	32,838	46,763
Total United States	441,803	407,850	456,943	498,758	554,329
Exports and shipments to noncontiguous Territories	45,433	47,561	49,505	35,249	31,039
Total	487,236	455,411	506,448	534,007	585,368
Range oil	32,259	33,707	37,061	44,692	46,110

[1] Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.
[2] Figures for 1942 not yet available.

Sales of distillate fuel oil [1] in the United States, 1937–41, by uses [2]

[Thousands of barrels]

Use	1937	1938	1939	1940	1941
Railroads	1,629	1,720	2,258	3,194	4,945
Ships' bunkers (including tankers)	13,494	13,088	14,108	13,249	10,957
Gas and electric power plants	2,989	3,685	4,131	4,561	5,152
Smelters, mines, and manufacturing industries	5,691	5,224	6,192	7,330	10,363
Heating oils	81,235	82,388	97,131	115,533	120,908
Fuel oil (No. 1) sold as range oil	2,747	2,902	3,220	3,977	4,449
Oil company fuel	803	939	804	1,064	1,116
All other uses	8,056	7,495	10,726	11,744	15,449
Total United States	116,644	117,441	138,570	160,652	173,339
Exports and shipments to noncontiguous Territories	30,129	29,641	32,020	19,140	16,925
Total	146,773	147,082	170,590	179,792	190,264

[1] Includes Diesel fuel.
[2] Figures for 1942 not yet available.

Sales of residual fuel oil [1] in the United States, 1937–41, by uses [2]

[Thousands of barrels]

Use	1937	1938	1939	1940	1941
Railroads	67,829	56,109	60,977	64,904	80,565
Ships' bunkers (including tankers)	71,496	61,178	65,146	61,554	56,678
Gas and electric power plants	23,521	23,882	27,908	28,234	33,622
Smelters, mines, and manufacturing industries	69,107	54,814	60,851	66,610	78,024
Heating oils	35,382	35,935	39,101	44,846	46,606
Oil company fuel	42,121	42,578	48,241	50,864	54,181
All other uses	15,703	15,913	16,149	21,094	31,314
Total United States	325,159	290,409	318,373	338,106	380,990
Exports and shipments to noncontiguous Territories	15,304	17,920	17,485	16,109	14,114
Total	340,463	308,329	335,858	354,215	395,104

[1] Includes Navy grade and crude oil burned as fuel.
[2] Figures for 1942 not yet available.

The overseas market for fuel oil made a net gain in 1942 over 1941, as a large increase in distillate exports was partly counteracted by a loss for residual grades. Total exports of fuel oil (including shipments to noncontiguous Territories of the United States) was 36,248,000 barrels in 1942, a gain of 17 percent over the 1941 total of 31,039,000 barrels. The foreign demand for distillates increased from 16,925,000 barrels in 1941 to 22,716,000 in 1942, a gain of 34 percent, while the market for residuals (totaling 13,532,000 barrels in 1942) was lower by 4 percent than the 1941 quantity of 14,114,000 barrels.

Greatly increased exports of fuel oil went to the United Kingdom and its Dependencies through Lend-Lease arrangements in 1942. Exports of distillate fuel oil to the United Kingdom increased from 7,158,000 barrels in 1941 to 15,714,000 in 1942 and to Canada from 394,000 barrels in 1941 to 493,000 in 1942, while shipments to Australia of 1,002,000 barrels and to New Zealand of 855,000 barrels in 1942 compared with trivial quantities to those countries of the British Empire in 1941. In other words, an export trade in distillate fuel oil, which formerly favored Japan (3,348,000 barrels in 1941) was shifted to our British allies in the South Pacific.

The export market for residual grades of fuel oil was also changed in 1942. Japan and the Philippines were cut off entirely; and unusually large shipments to Chile in 1941 (2,294,000 barrels) slumped to 52,000 barrels in 1942, largely because of the lack of tankers. Exports of residual fuel oil to the United Kingdom increased from 1,542,000 barrels in 1941 to 2,696,000 in 1942.

The production of fuel oil increased 5 percent—from 531,544,000 barrels in 1941 to 555,615,000 in 1942. The gain must be attributed entirely to an increased percentage yield (41.6 percent in 1942 compared with 37.7 percent in 1941), as crude runs to stills were lower by 5 percent in 1942 than in 1941. Unusual conditions prevailing in 1942 enabled refiners to expand the yield of fuel oil to the extent indicated, as motor gasoline was not wanted to the limit of the crude content because of rationing on the East coast (to save gasoline and rubber tires) dating from May 17, 1942, and for the entire country (to save rubber tires) from December 1, 1942. Consequently producers adjusted their runs to make less motor fuel and more of the demand product—fuel oil.

Sales of fuel oil [1] in the United States, 1937–41, by regions and States [2]

[Thousands of barrels]

Region and State	1937	1938	1939	1940	1941
Pacific Coast:					
Washington	11,352	9,241	9,193	9,688	12,199
Oregon	10,879	9,308	8,752	11,089	12,562
California	70,952	59,316	69,790	71,516	77,201
Arizona	3,994	2,838	2,220	3,693	4,431
Nevada	3,790	2,690	3,109	3,418	4,286
Rocky Mountain:					
Idaho	520	420	483	565	750
Montana	1,802	1,451	1,947	2,077	3,220
Wyoming	1,799	1,654	1,853	2,012	2,262
Utah	508	471	485	603	692
Colorado	644	636	880	1,097	1,474
New Mexico	561	502	557	630	701
North Central:					
North Dakota	416	442	594	647	677
South Dakota	613	777	891	891	909
Minnesota	5,184	4,974	5,909	6,939	7,309
Nebraska	1,955	1,982	2,483	2,721	2,766
Iowa	2,261	2,325	2,969	3,449	3,998
Wisconsin	4,823	4,748	5,793	6,885	7,344
Illinois	20,964	19,930	22,561	26,182	28,943
Indiana	7,905	7,824	8,977	9,965	12,782
Michigan	9,847	8,228	10,119	11,967	13,584
Ohio	8,030	7,105	8,161	9,084	10,970
Kentucky	973	840	1,110	1,355	1,697
Tennessee	593	557	695	1,045	1,263
South Central:					
Missouri	8,980	8,502	9,339	10,404	10,948
Kansas	7,364	6,687	7,605	8,162	9,277
Texas	43,231	37,672	42,012	43,222	51,634
Oklahoma	9,083	8,269	8,112	8,544	9,303
Arkansas	2,658	2,056	2,156	2,562	3,136
Louisiana	12,350	10,871	11,318	11,810	17,151
Mississippi	796	529	631	619	999
Alabama	1,889	2,113	2,127	1,976	2,780
New England:					
Maine	2,490	2,150	2,645	3,040	3,892
New Hampshire	1,513	1,431	1,812	2,153	2,565
Vermont	566	539	675	803	901
Massachusetts	21,798	21,362	24,392	26,857	29,996
Rhode Island	7,283	6,839	7,893	8,839	9,594
Connecticut	7,822	7,482	9,064	10,675	11,358
Middle Atlantic:					
New York	43,428	43,389	48,154	54,520	56,780
New Jersey	44,232	42,862	48,087	49,578	47,904
Pennsylvania	26,320	26,213	27,285	29,269	31,479
Delaware	1,666	1,400	1,596	1,717	1,803
Maryland	9,549	9,003	10,218	12,286	13,436
District of Columbia	2,108	2,137	2,541	2,986	3,459
South Atlantic:					
Virginia	3,638	4,824	4,539	4,794	4,462
West Virginia	807	912	1,046	1,128	1,261
North Carolina	591	699	930	1,112	1,384
South Carolina	679	757	1,109	1,253	1,404
Georgia	1,787	2,022	2,288	2,418	2,958
Florida	8,810	8,871	9,838	10,513	12,445
Total United States	441,803	407,850	456,943	498,758	554,329

[1] Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.
[2] Figures for 1942 not yet available.

The output of distillate fuel oil, the larger share of which is used for space heating, increased by 4 percent—from 189,177,000 barrels in 1941 to 196,714,000 in 1942. The yield of light fuel oil moved up from 13.4 percent in 1941 to 14.7 percent in 1942. The production of residual fuel oil, in great demand in 1942 because of expanded industrial activities in connection with the war, increased 5 percent—from 342,367,000 barrels in 1941 to 358,901,000 in 1942—and the upward shift in percentage yield (26.9 percent in 1942 compared with 24.3 percent in 1941) was even greater than in the case of light fuel oil.

Production of distillate fuel oil increased in all refinery districts except the East Coast and California. The inability to obtain domestic or foreign crude to full requirements on the East coast in 1942, because of transportation difficulties, forced down crude runs materially (161,142,000 barrels in 1942 compared with 217,046,000 in 1941); consequently, there was a decline in the production of distillate fuel oil from 40,827,000 barrels in 1941 to 31,132,000 in 1942, a 24-percent shrinkage. The percentage yield of distillate was stepped up slightly (18.8 percent in 1941 and 19.3 percent in 1942), but this adjustment added very little to the distillate output, considering the much smaller volume of crude processed in 1942. The production of distillate fuel oil in the California district declined from 27,803,000 barrels in 1941 to 24,398,000 in 1942. Although crude runs to stills increased in California in 1942, the percentage yield of distillate was reduced materially (13.0 percent in 1941 and 10.6 percent in 1942) to increase the output of residual grades, which were in great demand. The production of distillate fuel oil increased considerably in the Appalachian, Indiana-Illinois, Oklahoma-Kansas, Texas Inland, Arkansas and Louisiana Inland, and Rocky Mountain districts, all areas either of high consumption, or areas where rail shipment of light fuel oil could be made to important markets to the north and east. Percentage gains in the output of distillate fuel oil were not so high in the Texas and Louisiana Gulf districts, because of the disrupted tanker traffic and the resulting inability to make normal shipments to East coast consuming centers.

Production of residual fuel oil declined in 4 of the 10 refinery districts in 1942 even though the national total was up 5 percent for the year. A 9-percent drop (45,653,000 barrels in 1942 compared with 50,113,000 in 1941) in the output of residuals in the East Coast district was the result of lower crude runs to stills, which even a much higher percentage yield of 28.3 percent in 1942 over 23.1 percent in 1941 could not fully overcome. The production of heavy fuel oils in 1942 was considerably less in the Texas Gulf district, a source of residual fuel oil second only to California in importance, because of a 16-percent decline in runs to stills, an adverse factor that was only partly offset by a slightly higher percentage yield (23.3 percent in 1941 and 24.4 percent in 1942). Lack of an active market for residual fuel oils, lower crude runs, and smaller percentage yields were all reflected in a declining production of heavy fuel oils in the Louisiana Gulf and Arkansas and Louisiana Inland districts in 1942 compared with 1941. Large percentage gains in residual fuel-oil production were realized in the Indiana-Illinois, Oklahoma-Kansas, and Texas Inland districts in 1942, as the fuel oil could be rail-shipped to consumers. High gains in residual output were likewise made in the Appalachian and Rocky Mountain districts, but the quantities produced were relatively unimportant. An 18-percent gain in residual fuel-oil production in California in 1942 (104,255,000 barrels in 1942 compared with 88,411,000 in 1941) was not sufficient to satisfy a very active demand, and the balance was supplied from storage and increased transfers from the crude account.

Some crude oils, of little value for refining, are burned directly as fuel. Such crudes are termed "transfers," being changed from the crude to the fuel-oil account on oil-company books. Transfers of fuel oil increased from 15,482,000 barrels in 1941 to 21,779,000 in 1942, a gain of 40 percent. Practically all this increase was limited to residual grades transferred in California (14,658,000 barrels in 1942 compared with 8,874,000 in 1941) where there was a very active market for heavy fuel oils in 1942. Transfers of heavy crudes for areas east of California increased but slightly from 4,095,000 barrels in 1941 to 4,625,000 in 1942. The lower-gravity crudes covered in the above totals, both for California and east of California, are consumed as fuel on leases and in industrial plants. Some light-gravity crudes are used by pipe lines as fuel and are classified as "transfers" to the distillate fuel-oil account in the Bureau's petroleum statistics. Transfers of light crudes were insignificant in California both in 1941 and 1942; however, east of California these transfers increased from 2,383,000 barrels in 1941 to 2,484,000 in 1942.

Disrupted tanker traffic due to sinkings and shifts of boats to military use was reflected in the sharp drop in imports of fuel oils in 1942. Receipts of these products from foreign sources dropped 50 percent—from 42,443,000 barrels in 1941 to 21,073,000 in 1942. In other words, imported fuel oil supplied 8 percent of the domestic demand in 1941 compared with only 4 percent in 1942. The decline in imports of residual fuel oils was more pronounced than for the lighter grades. Receipts of heavy fuel oils from abroad were down by 53 percent from 37,369,000 barrels in 1941 to 17,645,000 in 1942, while distillate imports of 3,428,000 barrels in 1942 were 32 percent below the 1941 total of 5,074,000 barrels.

The large reduction of 26,000,000 barrels in year-end fuel-oil stocks in 1942 compared with 1941 was partly attributable to greatly reduced imports in 1942. In other words, supplies to meet the demand were taken from storage to offset diminishing receipts from foreign sources. Fuel-oil stocks reported for the end of 1942 (106,723,000 barrels) were 19 percent below the total of 132,289,000 barrels for the same period of 1941. The greater part of fuel-oil stocks (79 percent of the 1941 total and 77 percent of the 1942 total) was held at refineries, where year-end inventories decreased by 21 percent—from 105,049,000 barrels in 1941 to 82,620,000 in 1942. Fuel oil held at bulk terminal points decreased by 12 percent—from 27,240,000 barrels in 1941 to 24,103,000 in 1942—and furthermore constituted 23 percent of the 1942 final inventory compared with 21 percent in 1941.

Reviewing light and heavy fuel-oil stocks separately, it is noticed that the shrinkage in volume in 1942 was far more critical in residual grades that for distillates. Heavy fuel oils held at the end of 1942, totaling 61,783,000 barrels, were 26 percent below the comparative 1941 quantity of 82,959,000 barrels, while light fuel oils dropped by only 9 percent—from 49,330,000 barrels in 1941 to a final total of 44,940,000 in 1942. Both light and heavy fuel-oil stocks at refineries and at bulk terminals showed marked declines in 1942 compared with 1941. Refinery stocks of residual fuel oils declined by 27 percent—from 68,727,000 barrels in 1941 to 49,961,000 at the close of 1942—while a 10-percent drop was recorded for distillate grades from 36,322,000 barrels in 1941 to 32,659,000 in 1942. Residuals at refineries made up 83 percent of the total heavy fuel-oil stocks at the

Comparative analyses of statistics for distillate fuel oil in the United States, 1941–42, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1]				Imports		Exports		Domestic demand		Stocks	
					East of Calif.		California									
	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]
By months:																
January	17,018	16,902	15.4	14.2	176	225	5	2	421	403	1,595	1,080	21,010	24,981	37,926	40,801
February	14,732	15,194	14.7	14.4	172	178	51	-------	483	369	791	1,160	17,783	21,671	34,790	33,711
March	15,387	16,214	13.9	14.7	182	186	44	1	277	407	1,028	1,797	19,847	18,517	29,805	30,205
April	14,692	14,002	13.2	13.4	172	185	1	2	195	92	876	1,925	12,264	13,769	31,725	28,792
May	15,546	13,436	13.0	12.6	195	200	12	-------	300	195	1,156	1,151	11,233	11,191	35,389	30,281
June	14,697	15,210	12.7	14.4	200	188	10	7	211	54	1,380	2,052	10,853	11,187	38,274	32,501
July	15,746	16,149	13.0	14.5	201	206	4	-------	626	40	1,161	4,180	10,653	6,987	43,037	37,729
August	15,409	17,052	12.4	14.9	221	213	-------	-------	463	142	2,300	1,569	9,667	10,649	47,163	42,918
September	16,024	18,062	13.2	15.9	210	217	-------	-------	814	125	1,283	1,705	11,516	13,800	51,412	45,817
October	16,554	18,858	13.1	16.2	216	227	2	-------	656	421	1,703	2,572	11,752	13,050	55,385	49,701
November	16,230	17,562	13.4	15.6	222	215	-------	-------	340	647	1,445	1,516	15,659	15,900	55,073	50,709
December	17,142	18,073	13.7	16.0	216	244	1	-------	288	533	2,207	2,009	20,587	22,610	49,926	44,940
Total United States	189,177	196,714	13.4	14.7	2,383	2,484	130	12	5,074	3,428	16,925	22,716	172,824	184,312	{ 49,926 [3] 49,330 }	44,940
By districts:																
East Coast	40,827	31,132	18.8	19.3	-------	-------	-------	-------							18,035	8,415
Appalachian	4,863	6,769	9.1	11.8	-------	-------	-------	-------							704	860
Indiana, Illinois, Kentucky, etc.	26,288	34,388	10.5	13.0	503	552	-------	-------							5,552	5,783
Oklahoma, Kansas, and Missouri	13,431	18,344	10.6	14.2	699	861	-------	-------							1,766	2,155
Texas Inland	2,430	3,664	3.6	5.4	718	658	-------	-------	(4)	(4)	(4)	(4)	(4)	(4)	301	331
Texas Gulf Coast	59,591	60,697	16.4	19.8	234	186	-------	-------							7,801	12,336
Louisiana Gulf Coast	8,631	9,428	15.9	17.7	97	98	-------	-------							1,798	1,671
Arkansas and Louisiana Inland	2,535	4,112	8.6	14.4	13	38	-------	-------							341	826
Rocky Mountain	2,778	3,782	8.3	11.0	119	91	-------	-------							319	378
California	27,803	24,398	13.0	10.6	-------	-------	130	12							12,713	12,185
Total United States	189,177	196,714	13.4	14.7	2,383	2,484	130	12	5,074	3,428	16,925	22,716	172,824	184,312	[3] 49,330	44,940

[1] Figures represent crude oil used as fuel on pipe lines.
[2] Subject to revision.
[3] New basis to compare with 1942.
[4] Figures not available.

Comparative analyses of statistics for residual fuel oil in the United States, 1941–42, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1]				Imports		Exports		Domestic demand		Stocks	
					East of California		California									
	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]	1941	1942 [2]
By months:																
January	27,880	29,405	25.2	24.7	299	589	495	1,041	2,279	3,357	1,002	1,264	32,885	37,701	85,092	78,386
February	25,944	27,254	25.8	25.8	277	450	560	1,060	2,651	3,297	975	786	30,647	34,275	82,902	75,386
March	27,677	28,095	24.9	25.4	294	304	366	1,309	4,191	2,724	1,170	917	32,626	36,803	81,634	70,098
April	26,748	29,440	24.0	28.1	327	361	193	1,465	2,968	1,483	1,378	1,080	31,354	34,109	79,138	67,658
May	27,994	30,971	23.4	29.0	360	366	561	1,638	2,474	539	981	1,370	30,328	31,414	79,218	68,388
June	27,882	28,352	24.0	26.9	281	336	789	1,274	2,458	342	1,267	1,311	29,413	31,040	79,948	66,341
July	28,624	30,096	23.6	27.0	277	360	667	1,079	1,488	521	954	1,358	29,290	30,104	80,760	66,935
August	29,836	30,446	24.0	26.7	323	339	507	1,025	2,564	626	1,600	1,158	30,122	30,600	82,268	67,613
September	28,118	30,402	23.1	26.8	394	354	1,758	1,617	4,327	476	1,282	756	31,831	30,442	83,752	69,264
October	30,871	31,239	24.3	26.9	394	427	1,086	1,068	2,469	1,838	1,213	1,133	32,399	33,830	84,960	68,873
November	29,666	31,311	24.4	27.9	452	391	982	1,116	3,952	1,230	1,368	881	34,914	35,376	83,730	66,664
December	31,127	31,890	24.9	28.1	417	348	910	966	5,548	1,212	924	1,518	37,613	37,779	83,195	61,783
Total United States	342,367	358,901	24.3	26.9	4,095	4,625	8,874	14,658	37,369	17,645	14,114	13,532	383,422	403,473	{ 83,195 [3] 82,959	61,783
By districts:																
East Coast	50,113	45,653	23.1	28.3											9,805	3,613
Appalachian	7,709	9,498	14.4	16.5											578	579
Indiana, Illinois, Kentucky, etc	46,761	55,545	18.6	21.0	739	689									4,152	2,446
Oklahoma, Kansas, and Missouri	22,408	24,788	17.6	19.2	283	278									2,046	1,332
Texas Inland	14,280	16,586	21.4	24.3	429	602									1,349	761
Texas Gulf Coast	84,806	74,778	23.3	24.4	747	1,174			[4]	[4]	[4]	[4]	[4]	[4]	8,710	6,275
Louisiana Gulf Coast	13,070	11,772	24.1	22.1	945	897									2,217	1,714
Arkansas and Louisiana Inland	7,180	6,734	24.5	23.5	622	720									368	183
Rocky Mountain	7,629	9,292	22.7	27.0	330	265									535	649
California	88,411	104,255	41.5	45.3			8,874	14,658							53,199	44,231
Total United States	342,367	358,901	24.3	26.9	4,095	4,625	8,874	14,658	37,369	17,645	14,114	13,532	383,422	403,473	[3] 82,959	61,783

[1] Represents quantities used on leases and for general industrial purposes.
[2] Subject to revision.
[3] New basis to compare with 1941.
[4] Figures not available.

close of 1941, compared with 81 percent of the 1942 quantity. Distillates at bulk terminals constituted 26 percent of the 1941 inventory and 27 percent in 1942, while residual grades carried at such terminals accounted for 17 percent of the heavy fuel-oil storage in 1941 and 19 percent in 1942.

Statistics for fuel-oil stocks show major declines in 1942 for both distillate and residual grades in the East Coast refinery district and also considerable loss for residuals in the California refinery area. Oil d stributors along the Atlantic seaboard, being unable to obtain adequate supplies of fuel oil in 1942 from the Gulf coast and inland areas by tanker, rail, or pipe line, were forced to make an unusual draft on locally held stocks. Over half of the distillate inventory (18,035,000 barrels at the end of 1941 dropped to 8,415,000 during 1942) and two-thirds of the residual supply (9,805,000 barrels in 1941 and 3,613,000 n 1942) were liquidated in 1942. The largest share of residual fuel oils held nationally is stored in California, and there the quantities declined from 53,199,000 barrels at the close of 1941 to 44,231,000 in 1942, a 17-percent shrinkage. The 10-percent drop in distillate stocks in 1942 was a net loss, as outside of the major liquidation in the East Coast and slight declines in the Louisiana Gulf and California refinery districts all other areas showed gains in inventory for the year—a reflection of the lack of normal movement of supplies to markets to the north and east. The principal stock increase for distillates in 1942 was realized in the Texas Gulf district, where the volume rose from 7,801,000 barrels in 1941 to 12,336,000 at the end of 1942, or by 58 percent. Here the tanker shortage prevented an uninterrupted flow of light fuels to the East coast. The decline in heavy fuel-oil stocks most serious in the East coast and California areas, was general for all refinery districts of the country in 1942, except for static supplies in the Appalachian section and a 21-percent gain in the Rocky Mountain States; both regions are unimportant storage areas. Declines in inventory for residual fuel oil in 1942 ranged from a 23-percent reduction in the Louisiana Gulf to a 50-percent drop in the Arkansas and Louisiana inland district.

Tanker shipments of fuel oils from California to the East coast have dwindled sharply under war conditions, and although 203,000 barrels of distillates were shipped in 1941, no movements of fuel oils over this route were reported in 1942. The California refinery district (California, Oregon, Washington, Arizona, and Nevada) makes some overland rail and truck shipments of fuel oils to adjoining States. Distillates in this movement increased from 382,000 barrels in 1941 to 423,000 in 1942, while the volume of residuals handled continued the downward trend of recent years from 130,000 barrels in 1941 to 49,000 in 1942.

Sinkings and diversions of boats for military use in 1942 greatly disrupted the normal flow of fuel oils by tankers from the Gulf coast refinery districts to East Coast markets. The seriousness of this situation is evident when it is noted that the tanker movement (118,543,000 barrels of fuel oil in 1941) dropped to 43,660,000 barrels in 1942—a loss of 63 percent. Gulf tanker shipments of both light and heavy fuel oils to the Atlantic seaboard were down sharply in 1942, movements of distillates declining by 52 percent from 42,620,000 barrels in 1941 to 20,305,000 in 1942, and the traffic in residual grades

slumped from 75,923,000 barrels in 1941 to 23,355,000 in 1942—a loss of 69 percent.

With the usual tanker movement of fuel oil from the Gulf coast to Eastern States at a low ebb in 1942, every effort was made to ship needed supplies into the Atlantic area by other means, such as tank cars, barges, and pipe lines. The railroads carried most of this rerouted traffic, hauling 8,329,000 barrels of distillate and 14,740,000 of residual from District 2 to District 1 and 18,951,000 barrels of distillate and 23,058,000 of residual fuel oil from District 3 to District 1 in 1942. Fuel oil moved by barge from the Gulf coast to Mississippi River points, totaling 1,811,000 barrels of light fuel oil and 937,000 of residual grades; possibly some of this oil plus quantities originating in District 2 reached Northern States in District 1 through the Ohio River system for a total of 192,000 barrels of distillate and 230,000 of residual fuel. Tankers and barges operating on the Great Lakes carried 2,344,000 barrels of light grades and 2,233,000 of heavy fuel oils to Eastern States in 1942. Barges following the Gulf coast supplement the fuel-oil supply in the Florida west coast by 655,000 barrels of distillate and 339,000 of residual grades in 1942. Pipe-line deliveries of fuel oil into District 1 appeared in 1942, the quantity being reported as 443,000 barrels of light oils.

Tanker rates on light and heavy fuel oil on the Gulf coast—North Atlantic (not east of New York) route were much higher in 1942 than in 1941, owing to surcharges permitted first by the Maritime Commission and later by the War Shipping Administration "to cover wartime operating expenses." The freight rate on No. 2 fuel oil—57 cents a barrel for November 1941—was dropped to 42 cents a barrel on January 19, 1942. This basic rate held throughout 1942; however, on February 23 the Maritime Commission allowed a surcharge of 37½ percent a barrel to be added to the established rate. The War Shipping Administration advanced the surcharge to 200 percent on April 6, and this charge held for the balance of the year. The Gulf coast—North Atlantic tanker rate for crude and heavy fuel oil (10°–19.9° gravity)—57 cents a barrel for November 1941—was dropped to 48 cents a barrel on January 19, 1942. The surcharges of 37½ percent and 200 percent allowed, respectively, by the Maritime Commission and War Shipping Administration for light fuel oil were likewise granted to tankers for carrying heavy fuel oil on this route.

Representative fuel-oil prices did not change greatly in 1942 compared with 1941, except where higher tanker rates had to be absorbed. The quotation for No. 2 straw fuel oil at refineries in Oklahoma averaged 3.82 cents a gallon in 1942 compared with 3.69 cents in 1941, and important mark-ups were seen in oils for ships' bunkers at New York where tanker rates were involved, Bunker C advancing from an average of $1.34 a barrel in 1941 to $1.61 in 1942 and Diesel grade going from $1.99 a barrel to $2.57. Bunker C at Gulf ports at 89 cents a barrel in 1942 varied little from the 1941 average quotation of 87 cents a barrel; however, Diesel oil for bunkers in this area rose by 8 cents in 1942 to $1.64 average per barrel. An active market for heavy fuel oils in California in 1942 was shown in a 5-cent increase to an average of 85 cents a barrel for Bunker C, but the price of Diesel fuel at $1.41 a barrel was only 1 cent above the 1940 average.

An average price for No. 2 straw fuel oil at refineries in Oklahoma—3.88 cents a gallon for November 1941—prevailed through January

1942. There was a transitional price of 3.87 cents a gallon in February 1942, and this settled to 3.86 by March, which average quotation held until late in August. A lower average price of 3.74 cents a gallon was quoted for September and October, followed by a slight rise to 3.75 cents in November and a slump to 3.65 cents a gallon for the final month of 1942.

Monthly average prices of kerosine and fuel oils in the United States, 1941–42 [1]

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1941													
41°–43° gravity w. w. kerosine at refineries, Oklahoma cents per gallon	4.12	4.13	4.13	4.24	4.42	4.56	4.56	4.56	4.56	4.56	4.56	4.56	4.41
Kerosine, tank-wagon at Chicago cents per gallon	10.00	10.00	10.00	10.00	10.50	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.20
No. 2 straw fuel oil at refineries, Oklahoma cents per gallon	3.68	3.57	3.50	3.50	3.53	3.63	3.63	3.81	3.81	3.87	3.88	3.88	3.69
Bunker C for ships:													
New York dollars per barrel	1.25	1.25	1.25	1.28	1.30	1.34	1.38	1.39	1.43	1.43	1.43	1.41	1.34
Gulf coast do	.83	.83	.83	.86	.88	.88	.90	.90	.90	.90	.90	.90	.87
California do	.63	.66	.69	.69	.82	.88	.88	.88	.88	.88	.88	.88	.80
Diesel oil for ships:													
New York dollars per barrel	1.96	1.76	1.67	1.86	1.99	2.00	2.00	2.07	2.15	2.15	2.15	2.15	1.99
Gulf coast do	1.60	1.56	1.43	1.46	1.48	1.52	1.55	1.55	1.55	1.62	1.73	1.73	1.56
California do	1.40	1.40	1.40	1.40	1.41	1.41	1.40	1.40	1.40	1.40	1.40	1.40	1.40
1942													
41°–43° gravity w. w. kerosine refiners, Oklahoma cents per gallon	4.56	4.56	4.45	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.46
Kerosine, tank-wagon at Chicago cents per gallon	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30
No. 2 straw fuel oil at refineries, Oklahoma cents per gallon	3.88	3.87	3.86	3.86	3.86	3.86	3.86	3.86	3.74	3.74	3.75	3.65	3.82
Bunker C for ships:													
New York dollars per barrel	1.37	1.35	1.38	1.56	1.80	1.80	1.80	1.66	1.65	1.65	1.65	1.61	
Gulf coast do	.90	.90	.90	.90	.90	.90	.90	.89	.88	.88	.86	.85	.89
California do	.88	.88	.88	.88	.88	.84	.84	.84	.84	.84	.84	.84	.85
Diesel oil for ships:													
New York dollars per barrel	2.15	2.15	2.18	2.32	2.40	2.48	3.24	2.82	2.78	2.78	2.78	2.78	2.57
Gulf coast do	1.73	1.73	1.64	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.65	1.64
California do	1.40	1.40	1.40	1.40	1.40	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.41

[1] Platt's Oil Price Handbook.

The average price of Bunker C at New York dropped from $1.41 a barrel in December 1941 to $1.37 in January and $1.35 in February 1942, indicating lower tanker rates on the Gulf Coast—North Atlantic route. Advancing tanker rates caused the Bunker C average price at New York to rise gradually to $1.80 a barrel in May; this "high" held through July, after which the quotation for heavy bunkers settled to $1.66 a barrel in August and to $1.65 from September to the end of 1942. The average quotation for Bunker C at Gulf ports—90 cents a barrel for July 1941—remained through July 1942, when there was a gradual reduction to 89 cents in August, 88 cents in September and October, 86 cents in November, and finally 85 cents a barrel in December 1942. Bunker C in California sold for 88 cents a barrel average from June 1941 through May 1942, then dropped to 84 cents a barrel for the remaining months of the year.

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The cost of Diesel fuel for bunkers at New York was responsive to rising Gulf-to-New York tanker rates. An average quotation of $2.15 a barrel, starting in September 1941, prevailed through February 1942, when advancing tanker costs gradually pushed up the price to a "high" of $3.24 a barrel in July 1942. August brought a drop to $2.82 and then to $2.78 for the final months of the year. The price of Diesel for bunkers at Gulf ports—$1.73 a barrel in November 1941—was maintained through February 1942, when there was a drop to $1.64 in March and to $1.62 in April; this average quotation remained in force until December 1942, when the price rose to $1.65 a barrel. Ships paid $1.40 a barrel for Diesel fuel in California from July 1941 through May 1942, when there was an advance to $1.43 a barrel; this higher quotation was maintained for the balance of the year.

The Bureau of Labor Statistics, United States Department of Labor, releases monthly data covering the retail prices of various fuels in many cities of the country. These publications show that the retail price of representative No. 2 domestic heating oil at Chicago—7.65 cents a gallon, effective in October 1941—was maintained at the same level throughout 1943. The consumer's price for No. 2 fuel oil at New York—7.27 cents a gallon ruling in November 1941—remained unchanged through March 1942. After this date rapidly rising freight costs for tanker and rail shipments pushed up the retail quotation of No. 2 to 9.99 cents a gallon in July. Price reductions on gasoline and fuel oils along the Atlantic coast, effective August 5, 1942, as ordered by the Office of Price Administration made possible by subsidies to dealers from the Defense Supplies Corporation to cover mounting transportation and other costs, forced down the retail cost of No. 2 fuel oil to 8.79 cents a gallon for the remaining months of the year.

LUBRICATING OIL

The fewer miles traveled by motor vehicles in 1942 because of tire and gasoline rationing and the restriction of speed to 35 miles per hour were shown by a decline in the domestic consumption of lubricants to 29,018,000 barrels compared with 30,255,000 used in 1941. Production decreased to 38,626,000 barrels from 39,539,000 in 1941, and exports were 8,311,000 barrels compared with 9,924,000 in 1941. Stocks increased to 9,424,000 barrels at the end of 1942 compared with 8,127,000 at the end of 1941.

Automotive use of lubricants dropped from 11,679,000 barrels in 1941 to 8,704,000 in 1942. This, principally, was attributable to the reduction in mileage traveled by passenger cars, but lower consumption of oil because of slower speeds was also a factor. A tendency contributing slightly in the opposite direction was the older average age of vehicles.

Consumption of lubricants for industrial uses rose to 20,314,000 barrels compared with 18,576,000 in 1941 and 13,760,000 in 1940. This gain indicates not only the rise in industrial activity and military requirements but also new uses for lubricating oils.

Comparative analyses of statistics for lubricating oil in the United States, 1941–42, by months and districts

	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands barrels)		Stocks (thousands of barrels)	
	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]
By months:								
January	2,943	3,497	2.7	2.9	2,367	2,680	8,809	8,266
February	2,522	3,174	2.5	3.0	1,797	2,453	8,790	8,429
March	2,813	3,533	2.5	3.2	2,263	2,615	8,637	8,470
April	3,213	3,438	2.9	3.3	2,712	2,781	8,363	8,470
May	3,322	3,439	2.8	3.2	2,889	2,525	7,835	8,768
June	3,520	3,231	3.0	3.1	3,171	2,665	7,353	8,756
July	3,563	3,133	2.9	2.8	3,055	1,962	7,107	8,945
August	3,561	3,141	2.9	2.7	2,562	2,128	7,206	9,301
September	3,427	2,951	2.8	2.6	2,636	2,267	7,415	9,278
October	3,494	3,057	2.8	2.6	2,656	2,112	7,487	9,421
November	3,607	2,983	3.0	2.7	2,496	2,598	7,752	9,336
December	3,554	3,049	2.8	2.7	1,651	2,232	8,127	9,424
Total United States	39,539	38,626	2.8	2.9	30,255	29,018	8,127	9,424
By districts:								
East Coast	8,608	7,798	4.0	4.8			2,406	2,579
Appalachian	6,414	6,417	12.0	11.2			745	912
Indiana, Illinois, Kentucky, etc.	4,307	4,326	1.7	1.6			747	822
Oklahoma, Kansas, and Missouri	3,976	4,277	3.1	3.3			749	1,007
Texas Inland	358	260	.5	.4	[2]	[2]	126	70
Texas Gulf Coast	9,677	9,356	2.7	3.0			1,588	2,123
Louisiana Gulf Coast	2,093	2,066	3.9	3.9			255	302
Arkansas and Louisiana Inland	679	1,220	2.3	4.3			49	112
Rocky Mountain	187	234	.5	.7			103	120
California	3,240	2,672	1.5	1.2			1,359	1,377
Total United States	39,539	38,626	2.8	2.9	30,255	29,018	8,127	9,424

[1] Subject to revision. [2] Figures not available.

The Texas Gulf Coast district maintained the lead in production of lubricating oil, its 9,356,000 barrels being 24.2 percent of the total. The relative standing of the East Coast district continued its downward trend, declining to 20.2 percent from 21.8 in 1941. California dropped to 6.9 percent compared with 8.2 in 1941 and 9.1 in 1940, the year of its highest relative production. The Inland Louisiana-Arkansas district had the greatest increase in production—from 1.7 percent of the total in 1941 to 3.2 in 1942. The Oklahoma, Kansas, Missouri district followed, with an increase from 10.1 percent to 11.1.

Lubricating-oil stocks of 9,424,000 barrels at the end of 1942 were the highest for any year end since 1931. They increased in all of the districts except Texas Inland, the gain of 34 percent in the Texas Gulf Coast district being the largest.

Domestic demand for lubricating oil, 1938–42

[Thousands of barrels]

Year	Automotive				Industrial	Total demand
	Passenger cars	Trucks	Busses	Total		
1938	8,195	2,185	199	10,579	10,654	21,233
1939	8,245	2,298	205	10,748	12,965	23,713
1940	8,390	2,327	213	10,930	13,760	24,690
1941	9,056	2,398	225	11,679	18,576	30,255
1942 [1]	6,162	2,304	238	8,704	20,314	29,018

[1] Subject to revision.

Automotive consumption of lubricants in the United States, 1941–42 [1]

[Thousands of barrels]

Use	Passenger cars		Trucks		Busses	
	1941	1942	1941	1942	1941	1942
Crankcase oil	8,392	5,650	2,170	2,084	190	200
Transmission oils	664	512	228	220	35	38
Total lubricating oils	9,056	6,162	2,398	2,304	225	238
Chassis greases	598	461	114	110	10	11
Total lubricants	9,654	6,623	2,512	2,414	235	249

[1] Subject to revision.

Military necessities have brought radical changes in the manufacture of lubricating oils. The attempt to restrict lubricants used for military purposes to as few grades as possible requires that all those lubricants be of high grade. Not only must they meet the ordinary and heavy-duty needs of tanks, trucks, light automotive equipment, and airplanes, but they must function within the wide range of conditions under which military vehicles operate. Airplane oils must withstand temperatures which, within moments, may change from the warmth of the tropics to the cold of the stratosphere; trucks and tanks serve both in the sand and heat of the desert and in the ice and cold of the Arctic. The two principal qualities needed for such lubricants are high viscosity index and low pour point.

Vital to production of the superoils required for such service is solvent dewaxing, a method developed principally since 1937. Before the use of this process only Pennsylvania-Grade oils could serve for heavy-duty purposes, but by using solvents to dissolve the wax and asphalt, a high-viscosity-index lubricant can be produced from western and Gulf coast crudes.

But even our best mineral oils are not sufficient in themselves for the severe conditions they sometimes meet. Qualities must be built into them to permit them to lubricate properly at extreme temperatures. This is done by adding agents—"additives"—that have special qualities, such as oiliness, antioxidation qualities, detergent or cleansing qualities, and fluidity at low temperatures, besides inhibitors to counteract certain detrimental effects of the additives.

Scarcity of chemicals necessitated a restricted use of many additives in oils for nonmilitary vehicles. Chlorine was eliminated wherever possible, and cresol, detergent, and detergent-disperser type additives and extreme-pressure lubricants were designated "not for passenger cars." Use for nonmilitary services of pour-point depressants and oxidation inhibitor-type additives was reduced as much as possible.

Prices of lubricating oils, in general, clung close to their maximums permitted by the Office of Price Administration. Pennsylvania neutrals, however, were an exception. The lowered mileage of passenger automobiles, as well as the slower speeds traveled, has reduced considerably the demand for neutrals from which these lighter oils are made. At the same time, military officials have been demanding all the Pennsylvania-Grade heavy-duty oil that can be made; in consequence, the production of bright stock, from which these heavy-duty oils are compounded, has caused accumulation of the neutrals

necessarily produced along with the bright stocks. Stocks of neutrals from Pennsylvania-Grade crude totaled 526,000 barrels on December 31, 1942, compared with 140,000 barrels on the same date in 1941.

Average monthly refinery prices of five selected grades of lubricating oil in the United States, 1941–42, in cents per gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1941													
Oklahoma:													
200 viscosity, No. 3 color, neutral	9.75	9.75	9.75	9.95	10.45	11.21	12.26	13.38	14.56	15.23	15.25	15.25	12.23
150–160 viscosity at 210°, bright stock, 10–25 pour test	13.84	14.25	14.25	14.68	15.83	18.21	20.13	21.08	22.17	22.75	22.75	22.75	18.56
Pennsylvania:													
200 viscosity, No. 3 color, neutrial, 420–425 flash, 25 pour test	21.50	21.50	22.26	24.20	27.95	32.07	35.52	35.07	33.98	33.00	33.00	33.00	29.42
600 steam-refined, cylinder stock, filterable	8.05	8.96	9.40	10.09	11.04	12.42	13.60	14.71	15.33	16.00	15.50	15.50	12.55
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	8.50	8.50	8.50	8.50	8.94	9.00	9.63	10.00	10.00	10.00	10.00	10.00	9.30
1942													
Oklahoma:													
200 viscosity, No. 3 color, neutral	15.25	15.25	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.04
150–160 viscosity at 210°, bright stock, 10–25 pour test	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	33.00	33.00	33.00	33.00	33.00	33.00	33.00	32.14	30.67	27.27	25.58	24.59	30.94
600 steam-refined, cylinder stock, filterable	15.50	15.18	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.06
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	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

[1] National Petroleum News.

The maximum price for the Pennsylvania neutral quoted in the accompanying table was set at 33 cents a gallon on August 4, 1941, by the Office of Price Administration and Civilian Supplies. This constituted a reduction, as the oil had sold as high as 40 cents, and no sales thereafter were for less than the ceiling until the middle of August 1942. After that the price declined throughout the balance of the year, reaching a low of 23 cents in December.

It should be kept in mind that the trend of automobile lubricants has been toward a lighter oil and that with the resumption of peace and normal automobile travel, conditions existing just before the war when neutrals were more popular probably will return. Plans should be made to store excess high-grade neutrals in preparation for that time.

A new Federal excise tax on lubricating oils raised the tax from 4½ cents per gallon to 6 cents, effective November 1, 1942, and the Office of Price Administration provided that the 1½-cent additional tax might be passed to the consumer by adding 1 cent to each sale of 5 quarts or less or the full tax to any sale of more than that quantity.

OTHER PRODUCTS

Wax.—Domestic demand for paraffin wax reached a new peak of 546,313,000 pounds in 1942, compared with 523,965,000 in 1941. Exports, however, dropped to 153,410,000 pounds, from 213,075,000

in 1941, making total demand somewhat less than in 1941. Imports dropped to 9,749,000 pounds from 16,542,000, and stocks at the end of the year were 85,400,000 pounds compared with 74,814,000 at the end of 1941.

Production—700,560,000 pounds—was 30,520,000 pounds higher than the 1941 output of 670,040,000 pounds. A gain of 140 percent in the production in Inland Texas was the largest relative increase, but it still left that district with less than 0.5 percent of the total. The only districts where decreases occurred were the East Coast and Louisiana Gulf Coast.

Prices remained throughout the year at the maximum permitted by the Office of Price Administration, effective December 1, 1941. These ranged from 4.25 cents per pound of 122°–124° melting point to 5.50 cents for crude scale wax of 132° and higher and from 5.0 cents for 120°–122° to 10.5 cents for 149°–151° fully refined wax. A change, however, was made in the method of calculating the amount paid. The above prices originally were f. o. b. seller's shipping point, with the freight equalized from certain basing points. An amendment, in force January 30, 1942, made the effective prices those above plus actual shipping costs.

Comparative analyses of statistics for wax in the United States, 1941–42, by months and districts

[Thousands of pounds]

Month and district	Production		Domestic demand		Exports		Stocks	
	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]
By months:								
January	38,640	55,160	30,836	43,035	13,229	17,605	120,027	72,800
February	38,920	52,920	31,613	38,368	10,174	12,630	119,150	75,600
March	51,240	61,600	34,804	53,517	13,766	13,896	121,887	75,040
April	56,280	52,080	52,151	45,349	11,779	12,203	116,096	69,720
May	57,400	51,800	40,340	43,707	14,700	8,653	118,456	69,160
June	54,600	57,960	46,975	45,768	15,605	11,632	110,481	69,720
July	55,440	50,680	47,803	42,612	16,740	9,748	101,434	68,040
August	54,320	61,040	54,027	44,700	16,716	7,380	85,824	77,000
September	66,360	57,120	53,828	44,031	20,104	12,249	79,458	77,840
October	67,760	75,320	45,727	55,494	30,422	11,426	75,467	86,240
November	68,880	59,920	51,086	41,263	20,396	18,377	76,413	86,520
December	60,200	64,960	34,775	48,469	29,444	17,611	74,814	85,400
Total United States	670,040	700,560	523,965	546,313	213,075	153,410	74,814	85,400
By districts:								
East Coast	233,520	213,640					19,126	23,520
Appalachian	112,000	119,280					13,180	15,960
Indiana, Illinois, Kentucky, etc.	49,280	57,960					21,495	23,240
Oklahoma, Kansas, and Missouri	44,800	57,960	(2)	(2)	(2)	(2)	4,799	3,360
Texas Inland	1,400	3,360						280
Texas Gulf Coast	122,640	140,560					9,244	10,920
Louisiana Gulf Coast	89,320	85,400					3,427	560
Rocky Mountain	17,080	22,400					3,543	7,560
Total United States	670,040	700,560	523,965	546,313	213,075	153,410	74,814	85,400

[1] Subject to revision.
[2] Figures not available.

Average monthly refinery price of 122°–124° white crude scale wax at Pennsylvania refineries, 1938–42, in cents per pound [1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
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
1941	2.73	2.63	2.86	3.28	3.85	4.96	5.13	5.26	5.96	6.25	6.21	4.25	4.45
1942	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25

[1] National Petroleum News.

Coke.—Coke output came under close supervision of the Petroleum Administration for War in 1942. The tendency to neglect coke production in favor of fuel oil, when prices for the latter increased, led to a request by the Administrator that certain refineries raise their output. Use of coke was restricted to essential war requirements, principally for the manufacture of electrodes needed for the production of aluminum and other vital commodities.

Comparative analyses of statistics for petroleum coke in the United States, 1941–42, by months and districts

	Production (thousands of short tons)		Yield (percent)		Domestic demand (thousands of short tons)		Stocks (thousands of short tons)	
	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]	1941	1942 [1]
By months:								
January	125.8	139.8	0.6	0.6	195.5	115.0	406.0	245.8
February	102.6	121.2	.5	.6	118.6	97.3	375.0	258.8
March	125.0	108.4	.6	.5	114.5	102.9	375.0	252.4
April	128.2	91.4	.6	.4	86.2	112.9	400.0	201.0
May	140.0	83.4	.6	.4	119.5	74.8	385.0	191.2
June	144.4	87.6	.6	.4	116.0	78.7	382.0	181.8
July	134.2	101.0	.6	.5	126.7	74.8	367.0	175.0
August	137.0	110.8	.5	.5	102.7	76.6	372.0	179.0
September	157.8	108.0	.7	.5	147.4	81.7	370.0	172.8
October	153.6	123.0	.6	.5	126.9	82.2	362.0	183.6
November	149.4	122.0	.6	.5	88.9	57.4	390.0	197.6
December	150.8	141.8	.6	.6	285.8	50.1	228.0	233.8
Total United States	1,648.8	1,338.4	.6	.5	1,628.7	1,004.4	228.0	233.8
By districts:								
East Coast	4.4	2.4	(2)	(2)			2.0	1.8
Appalachian	26.6	25.2	.2	.2			9.0	2.6
Indiana, Illinois, Kentucky, etc	894.0	847.2	1.8	1.6			64.0	81.6
Oklahoma, Kansas, and Missouri	181.4	144.0	.7	.6	(3)	(3)	17.0	29.2
Texas Inland	119.4	75.0	.9	.5			51.0	48.6
Texas Gulf Coast	185.0	141.6	.3	.2			40.0	26.6
Louisiana Gulf Coast	-------	16.2	-------	.1			1.0	1.2
Rocky Mountain	49.4	37.6	.7	.5			35.0	20.0
California	189.2	49.2	.4	.1			9.0	22.2
Total United States	1,648.8	1,338.4	.6	.5	1,628.7	1,004.4	228.0	233.8

[1] Subject to revision. [2] Less than 0.1 percent. [3] Figures not available.

Output of coke in 1942 amounted to 1,338,400 tons compared with 1,648,800 in 1941. Production declined in all districts except Gulf Coast Louisiana, where the output amounted to 16,200 tons—the first material production since 1938. The Indiana, Illinois, Kentucky, etc., district supplied 63 percent of the output.

Domestic demand, restricted to essential war needs, amounted to 1,004,400 tons compared with 1,628,700 in 1941. Exports were 328,200 tons compared with 279,100 in 1941. The 233,800 tons of stocks were 5,800 above the record year-end low of 1941.

Asphalt and road oil.—Domestic demand for asphalt was 6,460,200 short tons compared with 6,451,800 in 1941. Production was 6,296,500 tons compared with 6,557,600 in 1941; imports declined from 158,300 tons to 142,500 and exports from 274,100 tons to 171,800. Stocks were 411,000 tons at the end of 1942 compared with 604,000 at the end of 1941.

Domestic demand for road oil declined from 8,980,000 barrels in 1941 to 8,484,000 in 1941. Production dropped from 9,149,000 barrels to 8,039,000 and stocks from 793,000 barrels to 348,000.

Detailed statistics on asphalt and road oil appear in the chapter on Asphalt and Related Bitumens.

Still gas.—Production of still gas in 1942 totaled 275,054 million cubic feet (equivalent, 76,404,000 barrels) compared with 300,074 million cubic feet in 1941. Of the latter, 283,021 million cubic feet (94 percent) were used as refinery fuel, which, in terms of British thermal units, constituted more than half of all the heat used at refineries.

The Texas Gulf Coast district continued to lead in the production of still gas in 1942, with the Indiana, Illinois, Kentucky, etc., and East Coast districts following in order.

Production of still gas in the United States, 1940–42, by districts

District	1940		1941		1942 [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	38,804	10,779	42,192	11,720	37,531	10,425
Appalachian	10,080	2,800	10,065	2,796	9,961	2,767
Indiana, Illinois, Kentucky, etc.	56,110	15,586	56,336	15,649	56,398	15,666
Oklahoma, Kansas, and Missouri	22,698	6,305	27,727	7,702	21,608	6,002
Texas Inland	15,181	4,217	16,913	4,698	15,148	4,208
Texas Gulf Coast	87,156	24,210	95,404	26,501	85,337	23,705
Louisiana Gulf Coast	9,616	2,671	8,485	2,357	10,104	2,807
Arkansas and Louisiana Inland	3,067	852	4,406	1,224	3,613	1,004
Rocky Mountain	5,663	1,573	5,872	1,631	5,556	1,543
California	25,045	6,957	32,674	9,076	29,798	8,277
Total United States	273,420	75,950	300,074	83,354	275,054	76,404

[1] Subject to revision.

Miscellaneous oils.—Domestic demand for miscellaneous oils amounted to 14,225,000 barrels in 1942 compared with 11,862,000 in 1941.

Production totaled 7,795,000 barrels compared with 6,266,000 in 1941. Of the production in 1941, 4,739,000 barrels were liquefied petroleum gas, and an additional 6,281,000 barrels of this product were transferred from natural gasoline. Detailed analysis of production is not available for 1942, but transfers from natural gasoline in that year amounted to 7,195,000 barrels. Gains in the production of petrolatum, absorption oil, medicinal oil, and specialities in 1941 over 1940 ranged from 7 percent to 40 percent.

Production of miscellaneous oils in the United States, 1940–41, by districts and classes[1]

[Thousands of barrels]

District	Petrolatum	Absorption oil	Medicinal oil	Specialties	Liquefied petroleum gas	Other	Total
1940							
East Coast	94		148		837	117	1,196
Appalachian	230	8		4		52	294
Indiana, Illinois, Kentucky, etc	39			43	725	43	850
Oklahoma, Kansas, and Missouri	35	43			40	15	133
Texas Inland		51			29	60	140
Texas Gulf Coast	11			65	36	171	283
Louisiana Gulf Coast	20				29	51	100
Rocky Mountain	1				23	4	28
California		28	37	62		51	178
Total United States	430	130	185	174	1,719	564	3,202
1941							
East Coast	79	6	211	8	1,163	107	1,574
Appalachian	239	10		15		31	295
Indiana, Illinois, Kentucky, etc	47			46	1,025	95	1,213
Oklahoma, Kansas, and Missouri	51	42			71	12	176
Texas Inland		31			89	26	146
Texas Gulf Coast	10			70	−17	63	126
Louisiana Gulf Coast	36				90	32	158
Arkansas and Louisiana Inland					14	19	33
Rocky Mountain	−1	14			24	19	56
California		58	47	57	2,280	47	2,489
Total United States	461	161	258	196	4,739	451	6,266

[1] Detailed figures for 1942 not yet available.

WORLD PRODUCTION [2]

War damages and dislocation of ocean shipping resulted in a 7-percent decrease in the world production of crude petroleum, if numerous unofficial statistics and estimates can be considered reliable. The outstanding decreases were in Venezuela, the Netherlands East Indies, and the U. S. S. R. The United States, largest producer in the world, showed only a 1-percent decline from 1941 to 1942.

The Western Hemisphere supplied 80 percent of the world output in 1941 and 81 percent in 1942. Lack of shipping caused American and British-Netherlands corporations operating in Venezuela and Colombia to reduce their output. In Peru and Ecuador, however, the foreign companies were able to increase their production. In Argentina the Government enterprise (Y. P. F.) accounted principally for an 8-percent increase from 1941 to 1942.

A decline in exports from 15.8 million barrels in 1941 to 6 3 million barrels in 1942 caused Mexican production to decrease 17 percent, in spite of increased domestic consumption of mineral oils. Export sales were confined to the Western Hemisphere in 1942; and shipping difficulties did not permit the United States and Cuba, the principal purchasers, to take their normal amounts of Mexican oil in 1942.

Canada maintained its 1941 level of production in 1942; and Trinidad apparently increased its output.

[2] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Crude petroleum produced in principal countries of the world, 1938–42, in thousands of barrels

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940 [1]	1941 [1]	1942 [1]
North America:					
Canada	6,966	7,838	8,591	10,134	10,363
Mexico	38,506	42,898	44,036	42,196	35,152
Trinidad	17,737	19,270	20,219	21,211	25,700
United States	1,214,355	1,264,962	1,353,214	1,402,228	1,385,479
Other North America	78	112	142	150	150
Total North America	1,277,642	1,335,080	1,426,202	1,475,919	1,456,844
South America:					
Argentina	17,076	18,613	20,609	21,873	23,544
Bolivia	226	215	288	235	308
Brazil			2	3	31
Colombia	21,582	23,857	25,593	24,553	10,593
Ecuador	2,246	2,313	2,349	1,557	2,278
Peru	15,839	13,508	12,126	11,935	13,629
Venezuela	188,174	206,470	185,570	223,784	147,740
Total South America	245,143	264,976	246,537	283,940	198,123
Europe:					
Albania	752	934	1,497	1,381	2,002
Czechoslovakia	130	120	119	109	100
France	513	500	496	479	500
Germany	3,861	4,487	4,544	4,438	4,500
Austria	383	693	719	692	900
Hungary	288	1,103	1,755	2,474	4,000
Italy	101	91	57	77	77
Poland	3,763	3,898	3,891	3,319	3,400
Rumania	48,487	45,483	42,182	38,147	38,881
U. S. S. R. [2]	204,956	216,866	218,600	238,150	210,000
Other Europe	9	10	10	10	10
Total Europe [2]	263,243	274,185	273,870	289,276	264,370
Asia:					
Bahrein Island	8,298	7,589	7,074	6,794	7,800
Burma	7,538	7,873	7,731	7,762	2,500
China [4]				10	86
India, British	2,488	2,327	2,250	3,571	2,500
Iran (Persia)	78,372	78,151	66,221	50,722	73,350
Iraq	32,643	30,791	24,225	12,650	14,700
Japan (including Taiwan)	2,511	2,654	2,639	2,659	3,000
Netherland sIndies	57,318	62,087	62,011	53,704	9,000
Sakhalin	[3] 3,821	[3] 4,000	4,000	4,000	4,000
Sarawak and Brunei	6,913	7,097	7,047	6,864	3,000
Saudi Arabia	495	3,934	5,365	5,871	6,000
Total Asia [5]	200,397	206,503	188,563	154,607	125,936
Africa:					
Egypt	1,581	4,666	6,505	8,546	9,000
Other Africa	27	27	27	27	27
Total Africa	1,608	4,693	6,532	8,573	9,027
Australia and New Zealand	4	3	3	3	3
Undistributed	4	4	14	14	15
Grand total	1,988,041	2,085,444	2,141,721	2,212,332	2,054,318

[1] Approximate production. Data derived in part from World Petroleum, vol. 12, No. 2, February 1941, pp. 20–21, and vol. 13, No. 3, March 1942, p. 88.
[2] Includes U. S. S. R. fields in Asia, other than Sakhalin.
[3] Approximate production.
[4] Unoccupied China.
[5] Exclusive of U. S. S. R. fields in Asia, other than Sakhalin, which are included with U. S. S. R. in Europe.

Reliable information on petroleum production in Europe is extremely meager. Rumania maintained its level of output from 1941 to 1942. The U. S. S. R. apparently experienced a 12-percent loss owing to military operations on the north side of the Caucasus Mountains. Hungary presumably increased its petroleum production.

Increased military activity in Egypt and Libya and improvement in the supply of tankers enabled Iran, Bahrein Island, and Iraq to enlarge their output of petroleum from 1941 to 1942. On the other hand, deliberate sabotage by retreating Allied armies apparently reduced petroleum production in the Netherlands East Indies, Sarawak and Brunei, and Burma beyond the possibility of full rehabilitation by the invading Japanese.

FOREIGN TRADE [3]

IMPORTS

Imports of mineral oils, crude and refined, into continental United States decreased 64 percent from 1941 to 1942. They constituted 2 percent of the total new supply in continental United States in 1942, compared with 6 percent in 1941.

Mineral oils, crude and refined, imported into continental United States, 1941–42, by months [1]

[Thousands of barrels]

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1941													
Crude petroleum	2,793	3,371	3,821	3,831	3,866	4,332	5,331	4,327	4,662	4,705	4,733	4,834	50,606
Refined products:													
Gasoline, finished	------	------	1	------	------	------	------	156	105	73	------	------	335
Kerosine	------	------	43	------	------	------	------	81	------	------	------	67	191
Distillate fuel oil	421	483	277	195	300	211	626	463	814	656	340	288	5,074
Residual fuel oil	2,279	2,651	4,191	2,968	2,474	2,458	1,488	2,564	4,327	2,469	3,952	5,548	37,369
Paraffin wax	1	7	------	7	------	------	------	3	5	15	12	9	59
Asphalt	2	54	70	23	13	42	102	80	57	63	273	92	871
Unfinished oils, other	275	226	376	258	355	384	184	107	123	100	124	125	2,637
	5,771	6,792	8,779	7,282	7,008	7,427	7,731	7,781	10,093	8,081	9,434	10,963	97,142
1942 [2]													
Crude petroleum	3,554	3,068	2,058	1,109	849	540	135	315	236	111	74	248	12,297
Refined products:													
Gasoline, finished	14	85	------	------	------	------	------	------	------	------	------	------	99
Kerosine	------	121	32	261	------	------	------	------	------	------	------	4	418
Distillate fuel oil	403	369	407	92	195	54	40	142	125	421	647	533	3,428
Residual fuel oil	3,357	3,297	2,724	1,483	539	342	521	626	476	1,838	1,230	1,212	17,645
Paraffin wax	13	3	19	1	------	------	------	------	------	------	------	------	36
Asphalt	83	13	253	57	5	41	76	61	------	102	55	39	785
Unfinished oils, other	63	121	61	------	------	------	------	------	------	89	32	------	366
	7,487	7,077	5,554	3,003	1,588	977	772	1,144	837	2,561	2,038	2,036	35,074

[1] Imports of crude as reported to Bureau of Mines; imports of refined products compiled from data of Department of Commerce; figures may differ slightly from those used throughout other sections of this report.
[2] Subject to revision.

Crude petroleum, residual fuel oil, and distillate fuel oil made up 96 percent of the total imports in 1941 and 95 percent in 1942. Venezuela supplied 74 percent of the crude petroleum imported in 1941 and 55 percent in 1942; Mexico 19 percent in 1941 and 27 percent in 1942; and Colombia 6 percent in 1941 and 18 percent in 1942. Of the residual fuel oil imported in 1941, the Netherlands West Indies furnished 74 percent, Venezuela 22 percent, and Mexico 32 percent. In 1942 the Netherlands West Indies shipped 90 percent

[3] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

and Venezuela 5 percent of the imported fuel oil. Of the distillate fuel oil imported the Netherlands West Indies sent 33 percent in 1941 and 53 percent in 1942; Venezuela 24 percent in 1941 and 25 percent in 1942; and Mexico 41 percent in 1941 and 18 percent in 1942.

Receipts of foreign crude petroleum were 76 percent lower in 1942 than in 1941. Imports of residual fuel oil declined 53 percent from 1941 to 1942 and of distillate fuel oil 32 percent.

EXPORTS

Continental United States increased its net exports of mineral oils from 11,688,000 barrels in 1941 to 86,055,000 barrels in 1942. This was due principally to a shift from net imports of crude petroleum amounting to 17,368,000 barrels in 1941 to net exports of 21,537,000 barrels in 1942; and to a decrease in net imports of residual fuel oil from 23,255,000 barrels in 1941 to 4,113,000 barrels in 1942. Net exports of motor fuel and of distillate fuel oil were greater in 1942 than in 1941.

In absolute amounts, exports and Territorial shipments of mineral oils, both crude and refined, were 11 percent larger in 1942 than in 1941. The principal gains were in outward shipments of motor fuel and of distillate fuel oil. On the other hand, less kerosine, residual fuel oil, and lubricating oil were exported and shipped to noncontiguous Territories in 1942 than in 1941. Outward shipments of crude petroleum were virtually unchanged from 1941 to 1942.

Mineral oils, crude and refined, shipped from continental United States and including shipments to noncontiguous Territories, 1941–42, by classes and months [1]

[Thousands of barrels]

Class	January	February	March	April	May	June	July	August	September	October	November	December	Total
1941													
Crude petroleum	1,632	1,256	2,058	2,628	4,428	3,894	3,651	3,275	2,900	2,840	2,738	1,938	33,238
Refined products:													
Motor fuel: [2]													
Aviation [3]	440	362	497	63	372	386	239	775	481	1,143	921	1,835	7,514
Other	1,601	891	1,241	1,465	1,216	876	1,349	1,925	1,994	2,357	2,229	2,425	19,569
Total motor fuel	2,041	1,253	1,738	1,528	1,588	1,262	1,588	2,700	2,475	3,500	3,150	4,260	27,083
Kerosine	92	82	165	180	171	112	110	400	302	828	190	589	3,221
Distillate fuel oil	1,595	791	1,028	876	1,156	1,380	1,161	2,300	1,283	1,703	1,445	2,207	16,925
Residual fuel oil	1,002	975	1,170	1,378	981	1,267	954	1,600	1,282	1,213	1,368	924	14,114
Lubricating oil	534	744	703	775	961	831	754	900	582	766	846	1,528	9,924
Paraffin wax	47	36	49	42	53	56	60	60	72	108	73	105	761
Coke	57	75	52	85	178	157	113	146	62	174	162	135	1,396
Asphalt	120	74	105	128	142	103	103	128	183	72	78	272	1,508
Miscellaneous oils	37	44	52	67	50	46	47	59	41	56	46	115	660
Total refined	5,525	4,074	5,062	5,059	5,280	5,214	4,890	8,293	6,282	8,420	7,358	10,135	75,592
Total crude and refined	7,157	5,330	7,120	7,687	9,708	9,108	8,541	11,568	9,182	11,260	10,096	12,073	108,830
1942 [4]													
Crude petroleum	1,522	1,336	1,887	2,973	3,709	3,591	3,370	4,073	3,240	3,264	2,826	2,043	33,834
Refined products:													
Motor fuel [2]													
Aviation [3]	1,235	664	1,461	1,668	1,406	2,594	2,278	1,980	1,113	2,949	2,611	2,716	22,675
Other	1,896	1,514	1,592	1,098	1,161	780	1,148	956	907	1,009	867	611	13,539
Total motor fuel	3,131	2,178	3,053	2,766	2,567	3,374	3,426	2,936	2,020	3,958	3,478	3,327	36,214
Kerosine	392	247	261	368	95	212	432	58	222	258	90	94	2,729
Distillate fuel oil	1,080	1,160	1,797	1,925	1,151	2,052	4,180	1,569	1,705	2,572	1,516	2,009	22,716
Residual fuel oil	1,264	786	917	1,080	1,370	1,311	1,358	1,158	756	1,133	881	1,518	13,532
Lubricating oil	678	558	877	657	616	578	982	657	707	802	470	729	8,311
Paraffin wax	63	45	50	44	31	42	35	26	44	41	66	63	550
Coke	35	55	59	150	92	91	165	151	163	150	253	277	1,641
Asphalt	65	146	67	95	132	64	156	62	31	64	15	48	945
Miscellaneous oils	53	63	58	54	43	51	46	63	54	48	49	75	657
Total refined	6,761	5,238	7,139	7,139	6,097	7,775	10,780	6,680	5,702	9,026	6,818	8,140	87,295
Total crude and refined	8,283	6,574	9,026	10,112	9,806	11,366	14,150	10,753	8,942	12,290	9,644	10,183	121,129

[1] Compiled from the records of the Department of Commerce; figures may differ slightly from those used throughout other sections of this report.
[2] Includes benzol, natural gasoline, and antiknock compounds. [3] Includes antiknock compounds. [4] Subject to revision.

INTERCOASTAL SHIPMENTS [4]

Submarine attacks on shipping and diversion of tankers to wartime routes reduced shipments of mineral oils from Gulf coast ports to the East coast by 71 percent. Crude petroleum underwent the greatest decrease—79 percent. Intercoastal shipments of gasoline declined 75 percent; kerosene 65 percent; distillate fuel oil 52 percent; and residual fuel oil 69 percent.

Gasoline was the largest single item in these intercoastal shipments in 1942, constituting 26 percent of the whole. Crude petroleum was 25 percent, residual fuel oil 19 percent, and distillate fuel oil 16 percent.

Mineral oils, crude and refined, shipped from Gulf coast to East coast ports of the United States, 1941–42, by classes

[Thousands of barrels]

Class	1942 [1]						
	Jan.	Feb.	Mar.	Apr.	May	June	July
Crude petroleum	11,581	6,179	4,379	1,892	1,242	1,228	901
Gasoline	7,848	3,890	3,633	3,779	1,585	2,468	1,890
Kerosine	2,593	1,881	1,476	556	213	305	370
Distillate fuel oil	3,883	3,212	3,353	1,185	1,037	879	1,148
Residual fuel oil	5,218	4,158	5,530	2,064	1,582	660	1,035
Lubricating oil	674	509	430	142	102	130	151
Miscellaneous oils	930	680	777	350	230	608	716
	32,727	20,509	19,578	9,968	5,991	6,269	6,211

Class	1942 [1]						1941 [2] (total)
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Crude petroleum	1,166	729	679	442	580	30,998	147,288
Gasoline	1,676	1,197	1,200	1,376	1,881	32,423	130,534
Kerosine	92	285	254	354	491	8,870	25,300
Distillate fuel oil	1,042	1,490	794	1,049	1,283	20,346	42,620
Residual fuel oil	502	234	532	878	987	23,380	75,923
Lubricating oil	6	14	1			2,159	8,148
Miscellaneous oils	697	559	96	39	35	5,717	956
	5,181	4,508	3,556	4,138	5,257	123,893	430,769

[1] Office of the Petroleum Coordinator and the Petroleum Administration for War.
[2] Petroleum Conservation Division, U. S. Department of the Interior.

[4] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

NATURAL GAS

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

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SUMMARY

The natural-gas industry attained new peaks in 1942 as it responded to heavy demands from war industries and to expanding civilian requirements. Final figures for the year are not yet available, hence the following summary is largely estimated.

Marketed production of natural gas in 1942 totaled 3,055 billion cubic feet—9 percent above the peak of 2,813 billion reported in 1941 (see fig. 1). All the major classes of consumption increased except field use, which declined 1 percent, and gas used in carbon-black manufacture, which fell 8 percent. Increased field use for gas-lift operations in a few States did not quite counterbalance a recession in drilling operations in the country as a whole, and the slump in the rubber industry which furnishes the principal market for carbon black slowed production of that commodity. The largest percentage increase over 1941 was in fuel used at petroleum refineries, which was 25 percent above the 1941 figure; substitution of natural gas for fuel in place of fuel oil and possibly still gas is the probable cause of this increase. Gas used at portland-cement plants gained 19 percent and gas used for miscellaneous industrial purposes 15 percent. Both classes contributed heavily to war requirements. Natural gas is especially adapted for furnishing controlled heat for the manufacture of precision parts for guns, planes, tanks, and ships. An estimated 25 percent of total deliveries is reported to have been used by war industries in 1942.

Salient statistics of natural gas in the United States, 1938–42

	1938	1939	1940	1941	1942 [1]
Marketed production:					
California ---- million of cubic feet	315,168	348,361	351,950	374,905	414,000
Louisiana ---- do	283,899	294,370	343,191	403,855	459,000
Oklahoma ---- do	263,164	250,875	257,626	234,054	277,000
Texas ---- do	882,473	979,427	1,063,538	1,086,312	1,156,000
West Virginia ---- do	134,342	159,226	188,751	207,681	220,000
Other States ---- do	416,516	444,497	455,166	505,851	529,000
Total production ---- do	2,295,562	2,476,756	2,660,222	2,812,658	3,055,000
Exports:					
To Canada ---- do	94	76	90	121	130
To Mexico ---- do	1,743	3,046	5,473	7,345	8,670
Imports from Canada ---- do	372	131			
Consumption:					
Domestic ---- do	367,772	391,153	443,646	442,067	501,000
Commercial ---- do	114,296	118,334	134,644	144,844	170,000
Industrial:					
Field ---- do	659,203	680,884	711,861	686,158	680,000
Carbon-black plants ---- do	324,950	347,270	368,802	365,377	335,533
Petroleum refineries ---- do	109,741	97,685	128,007	148,127	185,000
Electric public-utility power plants [2] ---- million of cubic feet	169,988	191,131	183,156	205,156	234,113
Portland-cement plants [3] ---- do	37,336	40,233	41,949	54,208	64,540
Other industrial ---- do	510,811	607,075	642,594	759,255	876,014
Total consumption ---- do	2,294,097	2,473,765	2,654,659	2,805,192	3,046,200
Domestic ---- percent of total	16	16	17	16	16
Commercial ---- do	5	5	5	5	6
Industrial ---- do	79	79	78	79	78
Number of consumers:					
Domestic ---- thousands	8,570	8,888	9,245	9,730	10,010
Commercial ---- do	695	715	741	767	810
Industrial [4] ---- do	39	40	41	43	45
Number of producing gas wells	53,770	53,530	53,880	54,880	55,500
Value (at wells) of gas produced:					
Total ---- thousands of dollars	113,571	120,243	120,493	138,508	156,000
Average per M cubic feet ---- cents	4.9	4.9	4.5	4.9	5.1
Value (at points of consumption) of gas consumed:					
Domestic ---- thousands of dollars	273,070	287,600	315,515	318,093	356,000
Commercial ---- do	56,247	58,494	64,399	68,398	79,000
Industrial ---- do	171,233	187,627	197,090	233,547	275,338
Total value ---- do	500,550	533,721	577,004	620,038	710,338
Average per M cubic feet:					
Domestic ---- cents	74.2	73.5	71.1	72.0	71.1
Commercial ---- do	49.2	49.4	47.8	47.2	46.5
Industrial ---- do	9.4	9.6	9.5	10.5	11.6
Domestic and commercial ---- do	68.3	67.9	65.7	65.9	64.8
Domestic, commercial, and industrial ---- cents	21.8	21.6	21.7	22.1	23.3
Treated for natural gasoline:					
Quantity ---- millions of cubic feet	2,035,562	2,150,000	2,471,400	2,763,300	3,000,000
Ratio to total consumption	89	87	93	99	98

[1] Subject to revision.
[2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook.
[4] Exclusive of oil- and gas-field operators.

The average value of natural gas at the wells in 1942 was 5.1 cents a thousand cubic feet, compared with 4.9 cents in 1941. Increased production in the eastern fields where higher prices prevail and a strengthening of the price in Texas, which produced over a third of the total output in the United States, contributed to the 0.2-cent gain.

The average value at points of consumption was 23.3 cents in 1942 compared with 22.1 cents in 1941. A gain of 1.1 cents in the average price of industrial gas and an increase in the relative proportion of the higher-priced domestic-commercial gas outweighed declines in the average prices of domestic and commercial gas. The total value of natural gas consumed in the United States in 1942 was $710,338,000—15 percent over the peak of $620,038,000 reported in 1941.

Gas treated for natural gasoline approximated 3,000 billion cubic feet in 1942, compared with 2,763 billion in 1941. The proportion of total consumption was 98 percent in 1942 and 99 percent in 1941.

Exports to Mexico were 8,670 million cubic feet in 1942—18 percent over the 1941 figure. Mixed gas exported to Canada contained

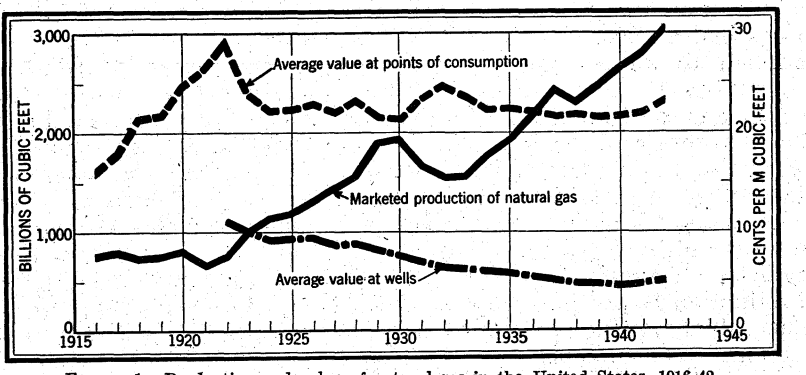

FIGURE 1.—Production and value of natural gas in the United States, 1916-42.

130 million cubic feet of natural gas compared with 121 million in 1941.

Consumers using natural gas in the United States in 1942 totaled 10,865,000—3 percent more than in 1941.

LEGISLATIVE AND LEGAL REVIEW

Conservation continued to be a paramount consideration in 1942, not only as regards the long-term program of producing more efficiently and with less waste, but the conservation of manpower and equipment as well.

The Federal Power Commission was given a wider scope of authority early in the year, and a number of orders were issued regulating the activities of gas companies. Existing pipe-line companies were ordered to file applications with the Commission by May 8, 1942, to obtain certificates of necessity to remain in business and were required to obtain authority before building new lines or changing old ones. In general, the policy was to cut down competition between companies and to avoid extending lines into territory already supplied with gas or to districts where other fuels are readily available.

The Office of Petroleum Administration for War issued a number of orders with regard to drilling. Order M–68 permitting only one well drilled to each 640 acres was modified on February 12 to allow more drilling in New York, Pennsylvania, West Virginia, Ohio, and Kentucky. This order was revised further on June 20 to permit drilling gas wells on 40-acre tracts in Missouri and parts of Oklahoma and Texas. Drilling in the Hugoton field in Kansas and Oklahoma was suspended by Order M–68–6 issued on September 3. More than 20 wells in the field were reported to have no pipe-line connections, and it was decided that no more drilling was necessary until the available production was utilized.

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In September the War Production Board ordered that the line of the Panhandle Eastern Pipe Line Co. be connected to that of the Ohio Fuel Gas Co. in Ohio, to assure a supply of Texas gas to supplement that from the eastern fields, preventing a possible shortage in the area supplied by the latter company. Effective November 30, deliveries to nonresidential consumers were suspended unless such distribution was specifically authorized by the Board. Such restrictions had already been in effect in a few States, but the new ruling applied to all States. Sales of heating equipment to residential consumers were curtailed and prohibited in places where delivery of the gas to residential, commercial, or industrial consumers had not been authorized. When shortages were imminent, gas companies were also required to curtail deliveries to domestic consumers. On December 12, gas deliveries were ordered suspended in some parts of Kansas, Oklahoma, and Missouri to plants which were equipped with stand-by facilities for using coal, and to all refineries with any type of alternative fuel facilities. Early in January 1943 the War Production Board was empowered to cut off either manufactured- or natural-gas consumers that could convert to other fuels without undue expense or inconvenience.

The Office of Price Administration placed a price ceiling on both wet and dry natural gas, effective October 7, 1942, except for rates charged by public utilities or others specifically excluded from the order. The price could be retroactive to May 11.

GROSS PRODUCTION

In the absence of final figures on marketed output, gross production of natural gas in 1942 has not been estimated. The 1941 figure is estimated at 4,103,500 million cubic feet or 11 percent more than the 1940 total. Production from gas wells increased 9 percent to 2,279,590 million cubic feet and from oil wells 14 percent to 1,823,910 million. There were sharp decreases in New York and Mississippi, where gas fields are becoming depleted and oil fields are small. Most of the other States made gains in output from both gas and oil wells. Decreased production from oil wells was noted in Illinois, Michigan, Oklahoma, Pennsylvania, and West Virginia.

Repressuring operations are gaining rapidly in importance; 644,379 million cubic feet of gas were returned to formations in 1941 compared with 362,916 million in 1940. Notable gains were made in Louisiana and Texas, where the cycle process is being extensively used in condensate fields; for example, repressuring in Texas rose from 294,000 million cubic feet in 1940 to 527,159 million in 1941 and in Louisiana from 21,000 million to 56,008 million. Repressuring was reported in Michigan for the first time in 1941. Arkansas, Kansas, and Oklahoma were the only States that reported declines from the 1940 volumes.

Gross production and disposition of natural gas in the United States, 1940–41, 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 waste [2]
1940							
Arkansas	8,500	32,500	41,000	14,379	860		25,761
California	25,200	404,800	430,000	351,950	12,145	6,287	59,618
Colorado	2,500	400	2,900	2,533			367
Illinois	1,100	129,900	131,000	8,359	749		121,892
Indiana	1,200	2,000	3,200	1,137			2,063
Kansas	75,000	40,000	115,000	90,003	2,817	[3] 1,162	21,916
Kentucky	54,000	5,000	59,000	53,056	210	[4] 483	4,711
Louisiana	285,000	150,000	435,000	343,191	21,000		70,809
Michigan	10,000	4,000	14,000	12,648			1,352
Mississippi	6,500	300	6,800	6,365			435
Missouri	390	10	400	310			90
Montana	25,900	1,300	27,200	26,231			969
New Mexico	32,000	94,000	126,000	63,990	31		61,979
New York	15,100	100	15,200	12,187	12	[5] 414	2,696
Ohio	46,400	3,600	50,000	40,639	5,050	[6] 3,706	5,218
Oklahoma	90,000	220,000	310,000	257,626	14,463	794	36,744
Pennsylvania	96,000	6,000	102,000	90,725	826	[7] 1,723	9,212
Texas	1,100,000	475,000	1,575,000	1,063,538	294,000		216,937
West Virginia	193,000	12,000	205,000	188,751	3,583	[8] 426	9,572
Wyoming	22,000	18,000	40,000	27,346	9,170		3,484
Other States [9]	5,390	10	5,400	5,258			142
	2,095,180	1,598,920	3,694,100	2,660,222	362,916	14,995	655,967
1941 [10]							
Arkansas	10,200	34,800	45,000	19,148	781		25,071
California	36,500	423,500	460,000	374,905	21,000	6,000	58,095
Colorado	3,100	200	3,300	3,256			44
Illinois	900	101,500	102,400	10,053	1,958	539	89,850
Indiana	1,400	2,100	3,500	1,522			1,978
Kansas	77,000	46,000	123,000	111,121	2,345	597	8,937
Kentucky	71,000	5,200	76,200	69,067	480	[11] 440	5,371
Louisiana	375,100	199,700	574,800	403,855	56,008		114,937
Michigan	11,900	3,200	15,100	13,916	741	72	371
Mississippi	4,450	590	5,040	4,268			772
Missouri	200	10	210	196			14
Montana	27,000	1,500	28,500	28,499			1
New Mexico	34,100	98,600	132,700	64,655	557		67,488
New York	12,400	100	12,500	10,456	14	[12] 340	1,696
Ohio	47,500	3,700	51,200	41,858	3,213	[13] 3,166	5,167
Oklahoma	99,100	176,300	275,400	234,054	11,420	1,677	28,249
Pennsylvania	99,300	5,700	105,000	92,819	921	[14] 2,841	9,961
Texas	1,126,000	691,000	1,817,000	1,086,312	527,159		203,529
West Virginia	212,100	11,200	223,300	207,681	4,772	[15] 579	7,358
Wyoming	24,600	19,000	43,600	29,284	13,010		1,306
Other States [9]	5,740	10	5,750	5,733			17
	2,279,590	1,823,910	4,103,500	2,812,658	644,379	16,251	630,212

[1] Marketed production plus quantities used in repressuring, stored in ground, lost and wasted (see footnote 2).

[2] Includes gas (mostly residue gas) blown to the air and transportation losses but does not include direct waste on producing properties, except where data are available.

[3] Produced approximately as follows: 373 million cubic feet in Oklahoma, 525 million in Texas, and 264 million in Kansas.

[4] Produced approximately as follows: 183 million cubic feet in West Virginia and 300 million in Kentucky.

[5] Produced approximately as follows: 109 million cubic feet in Pennsylvania and 305 million in New York.

[6] Produced approximately as follows: 397 million cubic feet in Kentucky, 2,216 million in West Virginia, and 1,093 million in Ohio.

[7] Produced approximately as follows: 178 million cubic feet in Kentucky, 424 million in West Virginia, and 1,121 million in Pennsylvania.

[8] Produced approximately as follows: 148 million cubic feet in Kentucky, 7 million in Pennsylvania, and 271 million in West Virginia.

[9] North Dakota, South Dakota, Tennessee, Utah, Virginia, and Washington.

[10] Subject to revision.

[11] Produced approximately as follows: 267 million cubic feet in Kentucky, and 173 million in West Virginia.

[12] Produced approximately as follows: 334 million cubic feet in New York, and 6 million in Pennsylvania.

[13] Produced approximately as follows: 1,865 million cubic feet in West Virginia, 962 million in Ohio, 320 million in Kentucky, and 19 million in Pennsylvania.

[14] Produced approximately as follows: 1,251 million cubic feet in Pennsylvania, 1,110 million in West Virginia, and 480 million in Kentucky.

[15] Produced approximately as follows: 341 million cubic feet in West Virginia, 215 million in Kentucky, and 23 million in Pennsylvania.

Gas storage in depleted fields has been successful in a number of States, and that method of building up a reserve to be drawn upon in times of peak demand is gaining importance. In 1941, 16,251 million cubic feet of natural gas were reported stored in 10 States compared with 14,995 million stored in 8 States in 1940 and 8,032 million stored in 6 States in 1939.

Reported losses and waste of natural gas totaled 630,212 million cubic feet in 1941—a 4-percent decline from 1940 and 7 percent below 1939. This record is creditable but leaves room for improvement, even though much of the total waste is unavoidable.

MARKETED PRODUCTION

The marketed production of natural gas in 1941 was 2,812,658 million cubic feet—a 6-percent gain over the 1940 record of 2,660,222 million cubic feet. Decreases were reported in Mississippi, Missouri, New York, and Oklahoma. All other States important in gas output made increases. The major producing States having the largest were: Kansas, 23 percent; Louisiana, 18; West Virginia, 10; California, 7; and Texas, 2. Texas retained first place in amount produced, and Louisiana displaced California in second place.

West Virginia produced 57 percent, Louisiana 45 percent, and Texas 19 percent over State requirements; the surplus was piped to other States and some Texas gas went to Mexico.

The value of natural gas at the wells turned upward in 1941 after dropping steadily for many years. The average was 4.9 cents a thousand cubic feet compared with 4.5 cents in 1940. The average value at points of consumption was 22.1 cents in 1941 compared with 21.7 cents in 1940.

Natural gas produced in the United States and delivered to consumers, 1937–41, by States, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
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
1940	14,379	351,950	2,533	8,359	1,137	90,003	53,056	343,191	12,648	6,365	26,231	63,990
1941	19,148	374,905	3,256	10,053	1,522	111,121	69,067	403,855	13,916	4,268	28,499	64,655

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Other States	Total	Value at points of consumption	
										Total (thousands of dollars)	Average per M cubic feet (cents)
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
1940	12,187	40,639	257,626	90,725	1,063,538	188,751	27,346	5,568	2,660,222	577,939	21.7
1941	10,456	41,858	234,054	92,819	1,086,312	207,681	29,284	5,929	2,812,658	621,333	22.1

Natural gas produced and consumed in the United States in 1941, 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.							32,023,000	1.1	$7,359,000	23.0
Ariz.							18,213,000	.6	5,711,000	31.4
Ark.	19,148,000	0.7	$764,000	4.0	$2,988,000	15.6	46,933,000	1.7	7,793,000	16.6
Calif.	374,905,000	13.3	22,457,000	6.0	96,673,000	25.8	374,905,000	13.4	96,673,000	25.8
Colo.	3,256,000	.1	121,000	3.7	714,000	21.9	26,574,000	.9	8,983,000	33.8
D. C.							5,124,000	.2	3,552,000	69.3
Fla.							2,378,000	.1	599,000	25.2
Ga.							23,975,000	.8	8,713,000	36.3
Ill.	10,053,000	.4	186,000	1.9	1,668,000	16.6	98,634,000	3.5	43,238,000	43.8
Ind.	1,522,000	.1	179,000	11.8	906,000	59.5	29,989,000	1.1	11,614,500	38.7
Iowa.							24,589,000	.9	8,826,000	35.9
Kans.	111,121,000	3.9	4,512,000	4.1	36,552,000	32.9	109,059,000	3.9	22,550,000	20.7
Ky.	69,067,000	2.5	9,041,000	13.1	28,769,000	41.7	20,170,000	.7	8,708,000	43.2
La.	403,855,000	14.4	13,085,000	3.2	71,089,000	17.6	222,025,000	7.9	25,190,000	11.3
Md.							6,587,000	.2	2,436,000	37.0
Mich.	13,916,000	.5	1,787,000	12.8	8,722,000	62.7	37,290,000	1.3	29,484,000	79.1
Minn.							22,672,000	.8	9,291,000	41.0
Miss.	4,268,000	.1	170,000	4.0	1,084,000	25.4	20,813,000	.7	5,642,000	27.1
Mo.	196,000	(1)	16,400	8.4	100,000	51.0	58,138,000	2.1	22,044,000	37.9
Mont.	28,499,000	1.0	1,305,000	4.6	7,597,000	26.7	24,751,000	.9	6,078,000	24.6
Nebr.							19,205,000	.7	7,109,000	37.0
N. Mex.	[2] 64,655,000	2.3	1,067,000	1.7	11,339,000	17.5	39,138,000	1.4	4,674,000	11.9
N. Y.	[3] 10,456,000	.4	2,053,000	19.6	7,853,000	75.1	25,384,000	.9	19,588,000	77.2
N. Dak.	47,000	(1)	1,000	2.1	16,000	34.0	1,741,000	.1	676,000	38.8
Ohio.	41,858,000	1.5	6,835,000	16.3	21,232,000	50.7	136,251,000	4.9	69,179,000	50.8
Okla.	234,054,000	8.3	6,483,000	2.8	29,821,000	12.7	209,395,000	7.5	21,340,500	10.2
Pa.	[4] 92,819,000	3.3	19,910,000	21.5	42,974,000	46.3	139,492,000	5.0	56,828,000	40.7
S. Dak.	7,000	(1)	400	5.7	2,000	28.6	6,580,000	.2	2,226,000	33.8
Tenn.	10,000	(1)	1,000	10.0	5,000	50.0	22,495,000	.8	6,379,000	28.4
Tex.	[5] 1,086,312,000	38.6	22,269,000	2.0	162,344,000	14.9	875,620,000	31.2	68,101,000	7.8
Utah.	5,562,000	.2	191,000	3.4	1,145,000	20.6	16,667,000	.6	3,458,000	20.7
Va.	106,000	(1)	1,100	10.4	94,000	88.7	1,166,000	(1)	1,068,000	91.6
Wash.	1,000	(1)	100	10.0	2,000	200.0	1,000	(1)	2,000	200.0
W. Va.	207,681,000	7.4	25,171,000	12.1	81,957,000	39.5	88,597,000	3.2	21,782,000	24.6
Wyo.	29,284,000	1.0	902,000	3.1	5,687,000	19.4	18,618,000	.7	3,143,000	16.9
Total:										
1941	2,812,658,000	100.0	138,508,000	4.9	621,333,000	22.1	2,805,192,000	100.0	620,038,000	22.1
1940	2,660,222,000	100.0	120,493,000	4.5	577,939,000	21.7	2,654,659,000	100.0	577,004,000	21.7

[1] Less than 0.05 percent.
[2] Includes 1,154,000 M cubic feet piped to Mexico.
[3] Includes 27,000 M cubic feet piped to Canada.
[4] Includes 94,000 M cubic feet piped to Canada.
[5] Includes 6,191,000 M cubic feet piped to Mexico.

WELLS

Producing gas wells, as of December 31, 1941, numbered 55,500—3 percent more than the 53,880 reported at the end of 1940. As 2,911 wells were drilled during the year, it would appear that 1,291 were abandoned. Actually abandonments probably were fewer, for some of the productive wells reported are old ones that have been reconditioned or deepened.

During 1942 2,597 wells were drilled—11 percent less than the number of completions in 1941. An increased demand for production usually results in greater drilling activity; but difficulty in obtaining materials, Government restrictions, and shortages of manpower retarded operations during the year.

Gas wells in the United States, 1940–42, by States

State	Producing Dec. 31, 1940	Drilled during 1941 [1]	Producing Dec. 31, 1941	Drilled during 1942 [1]
Arkansas	190	20	200	7
California	90	23	110	25
Colorado	20	4	20	1
Illinois	90	13	90	14
Indiana	970	56	950	21
Kansas	2,100	102	2,090	88
Kentucky	[2] 2,400	255	[2] 2,570	210
Louisiana	1,530	111	1,640	88
Michigan	350	97	450	74
Mississippi	30	4	20	1
Missouri	120	18	130	7
Montana	410	59	450	69
New Mexico	100	19	110	15
New York	2,030	18	2,030	26
Ohio	6,300	701	6,700	471
Oklahoma	2,430	159	2,400	102
Pennsylvania	18,130	386	18,300	595
Tennessee	[2]		[2]	
Texas	3,150	294	3,400	238
West Virginia	13,300	558	13,700	536
Wyoming	110	8	110	6
Other States [3]	30	6	30	3
	53,880	2,911	55,500	2,597

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.
[3] North Dakota, South Dakota, Utah, and Virginia.

TECHNOLOGIC DEVELOPMENTS

When the shortage of materials became serious because of the war, renewed efforts were made to find substitutes and additional sources of various commodities. New experiments were made with natural gas and methods found by which its various hydrocarbons could be separated.

The components of natural gas have been found to be valuable in the manufacture of a wide range of war products, from nylon, ammonia, and synthetic rubber to an anaesthetic that is being used increasingly because of its harmless effects.

The necessity for conserving cargo space has brought dehydrated foods to the fore. Natural gas has been found an ideal source of heat to be used in drying fruits, vegetables, and even shrimp. Several California firms are producing dehydrated foods by the ton, and the industry is becoming important in the State. Some food experts believe that the general public will use dehydrated products increasingly in the near future.

REVIEW OF FIELD DEVELOPMENTS, BY STATES

Arkansas.—Joe W. Kimzey, State geologist, has submitted information taken from the records of the Arkansas State Department of Revenues regarding developments in Arkansas.

All the gas-well drilling reported was in the northwest gas fields. One well was drilled in Crawford County to a depth of 5,104 feet, two in Franklin County to 5,755 and 2,900 feet, respectively, and one in Logan County to 2,690 feet. All were dry holes and abandoned. In Pope County a well was drilled to a total depth of 2,830 feet in sec. 22, T. 10 N., R. 21 W. Gas was found in the second sand with an initial production of 17,263,000 cubic feet and in the third sand with initial production of 9,562,000 cubic feet.

Arkansas produced 29,560 million cubic feet of gas during 1942—a 20-percent increase over the 24,617 million cubic feet reported in 1941. The dry-gas fields in the northwestern area produced 5,367 million cubic feet—16 percent less than the 1941 output. In the southern area production increased 33 percent over the 1941 total to 24,193 million cubic feet. Union County ranked first in output with 10,085 million cubic feet, Columbia was second with 9,080 million, and Miller third with 4,440 million. Johnson, with 2,439 million, was the only county in the northwest field that produced over a million cubic feet of gas.

California.—Demands for low-gravity oils to meet war requirements centered activity in California during 1942 in the relatively shallow heavy-oil zones in the South Joaquin Valley area. Such drilling contributed virtually nothing to natural-gas reserves. Information on gas developments in the State during the year is taken from a report from E. F. McNaughton, California Railroad Commission.

Steady drilling in the proved area of the Wilmington field of the Los Angeles Basin resulted incidentally in the formation of secondary gas caps and a correspondingly higher gas : oil ratio in the field as a whole, so that more gas was available.

The Bowerbank gas field was discovered in the South Joaquin Valley area when an existing well was redrilled. Other wells drilled in the vicinity were failures. The Roberts Island dry-gas field, which apparently was not very large, was the only important discovery during the year. The proved area of the Riverdale gas field was extended 2½ miles northeast, resulting in increased activity in that area. The northern boundary of the Raisin City gas field was determined by an unsuccessful completion.

One of the main gas lines from the San Joaquin Valley to the San Francisco area was converted into an oil line in May 1942. To replace this, a 22-inch line was built to connect the metropolitan area with the Rio Vista gas field. The new line, with rearranged facilities of other lines, made available 140 to 150 million cubic feet of gas over the 180 million formerly transported daily by the converted line. Sharp gains in consumption, caused by war production and additional requirements by civilian and military users, made this additional supply necessary. Only about 100 million cubic feet were brought daily from the oil fields, which formerly furnished most of the total supply. Another line was built to connect the Rio Vista field with other areas formerly served with casinghead gas.

Dry gas from the Buttonwillow and Trico fields was run through a line that formerly carried casinghead gas. Because dry gas has a lower heating value than casinghead gas, the California Railroad Commission established an automatic heating-value clause to adjust consumer rates according to the quality of gas served. This provision is in general effect, except for interruptible surplus service.

The nearly depleted Playa del Rey field was tested for underground storage in 1942, and at the end of the year construction was progressing on permanent compressor facilities. It is estimated that 3 billion cubic feet of gas can be stored in the field. Between 15 and 20 million cubic feet probably will be withdrawn daily. The field lies near the heart of the Los Angeles area where peak demand occurs and will furnish an easily accessible auxiliary supply.

Another supply of gas will be stored in a water-seal gas holder with a capacity of 10 million cubic feet, which was completed and placed in service late in 1942 in Los Angeles.

The commission made a survey during the year to determine the daily peak demand for and availability of gas to assure war industries and essential civilian services an uninterrupted supply. It was concluded that demands, though greatly augmented, could be met with existing facilities. Available reserves, as of July 1, 1942, were estimated at 11,007 billion cubic feet and unavailable reserves at 1,456 billion. It was thought that the daily peak demand would total 1,635 million cubic feet. Production for the first half of the year was 206,645 million cubic feet, of which 203,410 were utilized and 3,235 blown to the air. Comparable figures for 1941 were 191,858, 184,554, and 7,304 million, respectively. Figures for the latter half of the year are not available. Dry-gas production in 1942 was 104,867 million cubic feet compared with 36,450 in 1941. The sharp gain was due principally to pipe-line connections with gas fields to replace casinghead gas. Another factor was Government restrictions on production in fields having high gas: oil ratios, so that withdrawals could not be varied to meet fluctuating demands, which forced distributors to depend on dry-gas supplies.

Gas sales totaled 264,444 million cubic feet in 1942 compared with 232,751 in 1941—a 14-percent gain.

Colorado.—Little drilling was done in Colorado during 1942. One well was completed in the Powder Wash field with an initial production of 11,660,000 cubic feet, and the field was extended ½ mile northeast. One well was deepened and the deepening of another started. An exploratory well at Douglas Creek found less than 1,000,000 cubic feet of gas in the basal Dakota sand at 4,433–35 feet. Drilling was continued to the Weber quartzite in search for oil, but work was suspended for the winter at a depth of 7,313 feet. Information regarding developments in Colorado was supplied by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo.

Hiawatha field, with a 37-percent increase, and Powder Wash field, with a 136-percent increase, supplied 76 percent of the total output of the State. All of the fields increased production except Berthoud and Garcia. Gross output, by fields, in millions of cubic feet, follows: Hiawatha, 2,727.1; Powder Wash, 1,125.6; Wilson Creek, 303.0; Thornburg, 167.5; Berthoud, 42.4; Garcia, 16.5; and Craig, 4.9.

Marketed production in 1942 totaled 4,029.5 million cubic feet—a gain of about 49 percent over the 2,713.0 million marketed in 1941. Gross production was 4,387.0 million cubic feet—52 percent over the 1941 figure and twice the amount reported in 1940. It is estimated that 53.8 million cubic feet were used in the field and 303.7 million lost. Of the latter amount, 291.2 million were in the Wilson Creek field, which does not yet market gas.

Illinois.—A. H. Bell, geologist, and C. W. Carter, assistant geologist, Illinois Geological Survey, have reported natural-gas developments in Illinois during 1942.

The Russellville gas field had 5 gas completions within proved territory in 1942, making a total of 53 in the district. The average initial production of the new wells was approximately 2 million cubic

feet daily. Three of the new wells produced from the Bridgeport and two from the Buchanan sand. At the end of the year the field had 270 acres proved in the Bridgeport sand and 1,600 in the Buchanan. Marketed production from the district was 1,472 million cubic feet compared with 863 million in 1941.

The Ayers field, covering 335 acres, had one gas completion in 1942, making a total of eight wells in the area. Gas comes from the Bethel sandstone at a depth of about 950 feet. Production was virtually the same as in 1941.

Daily average production of casinghead gas from the Louden oil field in 1942 was estimated at 8.4 billion cubic feet, with an average daily output at the end of the year approximating 20 million cubic feet. Comparable figures for 1941 were 13.7 billion and 36 million. The greater portion of the gas was treated for natural gasoline, and 6 million cubic feet of the residue gas were injected into the producing sands daily. A pipe-line company was furnished with residue gas to supply St. Elmo, Brownstown, and Vandalia. The same company also received 50 thousand cubic feet daily from a well in the field that produced from the basal Pennsylvanian sandstone.

Gas produced from the Salem oil field was estimated at 23.7 billion cubic feet in 1942, with an average daily output of 63 million cubic feet compared with 35.4 billion and 82 million, in 1941. Four gasoline plants processed an average of 49.8 million cubic feet a day. One company returned approximately 5 million cubic feet of residue gas daily to the producing sand, and another supplied residue gas to Salem, Centralia, and Mount Vernon; the quantity approximated 800,000 cubic feet daily at the end of the year.

A small amount of residue gas from a gasoline plant near Hoodville in Hamilton County, that began operation in December, was injected into the producing sands through several input wells, marking the beginning of a large-scale pressure-maintenance system in that area.

The New Harmony Consolidated oil field had an estimated production of 8.7 billion cubic feet of casinghead gas in 1942, with daily production approximating 21 million cubic feet at the end of the year. About 1.5 million cubic feet of residue gas from a plant that began operations in the field in July were returned to the producing sands daily during the latter half of the year.

The Albion pool, Edwards County, supplied brick plants at Albion with an estimated 100 million cubic feet of gas until the end of the first quarter of 1942, when the plants closed. The field produced approximately 2 million cubic feet of gas daily.

It is estimated that 84.4 billion cubic feet of gas were produced from oil fields discovered after January 1, 1937, but a large part was burned in flares.

Marketed output of natural gas in Illinois in 1942, exclusive of field uses, totaled 2,573.4 million cubic feet, a 51-percent gain over the 1,699.4 million cubic feet produced in 1941.

Indiana.—Ralph E. Esarey, State geologist, and Dr. George V. Cohee, assistant State geologist, report that no large gas reserves were discovered in Indiana during 1942. Only 21 gas wells were drilled during the year—35 less than in 1941 and all in previously discovered fields. Their total initial production was 11,148,500 cubic feet.

Total marketed production of all fields during 1942 was 1,627.3 million cubic feet, 20 percent over the 1,355 million reported in 1941.

This gain was due largely to a 29-percent increase in the Rockport field, which supplied approximately 37 percent of the total output, and to increased production from the Unionville field. Production from the major fields, in millions of cubic feet, was as follows: Rockport, 594.3; Unionville, 239.9; Greensburg, 210.8; Glendale-Hudsonville, 157.0; North Glendale, 102.4; and Laconio (Harrison), 100.0.

Gas from the Griffin oil field, Posey and Gibson Counties, is being used for repressuring the field, after being treated for natural gasoline at a plant that began operations in August 1942 on the Illinois side of the Wabash River. By March 1943 over 1.5 million cubic feet were being injected into the producing sands daily through 14 input wells. Gas from the same plant is also being used to repressure the Waltersburg sand in the Ribeyre Island portion of the New Harmony field through four input wells.

Kansas.—The State had 88 gas-well completions in 1942 compared with 102 in 1941. Information on gas developments was supplied by Charles P. Kaiser, geologist, Kansas Geological Survey.

The Hugoton field was an outstanding exception to the sharp decline in drilling in most of the major fields in the western part of the State. There were 21 completions in Hugoton in 1942 compared with 11 in 1941. The new wells had a daily potential of 324.4 million cubic feet, and production in the field increased from 36.4 billion cubic feet in 1941 to 41.4 billion in 1942. Much of the drilling was in Grant County near the carbon-black plant at Ryus. In all, 299,919 million cubic feet had been drawn from the Hugoton field by the end of 1942.

McLouth, in Jefferson and Leavenworth Counties, eastern Kansas, was the field of greatest activity in 1942. There were 44 gas-well completions compared with 39 in 1941. A total of 89 gas wells has been drilled in the field since production was begun in 1941. The output was 4,438.9 million cubic feet in 1942 compared with 1,667 million in 1941.

Completions in the Cunningham-Cairo field in Kingman and Pratt Counties dropped from 16 in 1941 (with a total daily potential of 190.5 million cubic feet) to 4 in 1942 (with a total daily potential of 41.4 million).

Other completions in the western area were two in the Peace Creek oil pool in western Reno County and two in the Medicine Lodge pool.

Thirteen wells were drilled in eastern Kansas. Completions were made in Allen, Chautauqua, Douglas, Elk, Franklin, Greenwood, Johnson, and Neosho Counties.

Two discovery wells were completed in western Kansas—one in the Deerhead pool, Barber County, and one in the Belpre pool, Edwards County. The first had an initial potential of 4 million cubic feet from the Viola limestone, the second 25 million from the Lansing-Kansas City group of sands.

Production by the major fields, in billions of cubic feet, was: Hugoton, 41.4; Otis, 11.0; Medicine Lodge, 9.9; McLouth, 4.4; Burrton, 3.9; Thurber, 3.3; and Lyons, 0.6. The output of most of the large fields increased, whereas that in some of the smaller ones declined. Western Kansas supplied the major part of a total daily potential of 615.5 million cubic feet. The total for 1941 was 825.4 million cubic feet.

It is estimated that marketed production in Kansas in 1942 was 103 billion cubic feet compared with 99 billion in 1941.

Kentucky.—During 1942 210 gas wells were drilled in Kentucky, or about 10 percent below the high mark of 1941, according to information supplied by Mrs. Louise B. Freeman, assistant State geologist, Kentucky Department of Mines and Minerals. Completions in the four most active counties were: Pike, 74; Floyd, 51; Knott, 37; and Martin, 25. Of the total output, 65 percent in Pike, 66 in Floyd, 79 in Knott, and 53 in Martin County came from the Devonian-Mississippian black shales.

Clay and Jackson Counties were next in rank, with 8 wells each. In Jackson County 24 wells with an average rock pressure of 140 pounds have been drilled since development started there in 1934. The gas is found at 1,100 to 1,200 feet depth and comes from the Niagara dolomite (Coniferous) sand; output has been greatly increased since it has been found that the wells respond to acidizing. The field has become important, even though the gas is not being marketed.

Five wells were drilled during the year in the Johnson County field, 4 miles west of Paintsville; Knox and Magoffin Counties each had one well.

There was little gas development in western Kentucky during 1942.

Louisiana.—Drilling in Louisiana resulted in 88 gas completions in 1942—a 21-percent decline from 1941. Northern Louisiana had 50 completions, with 373,160 acres proved for gas; Southern Louisiana had 38 completions, with 40,885 proved acres.

Only one-fourth of the 48 wildcat wells drilled in the Gulf Coast area were successful, and of the 12 only 2 were completed as gas wells. Distillate fields led in importance in the area.

A well blew out in Arcadia Parish in October 1942 and was still out of control at the end of the year in spite of all efforts to check it. In December it was flowing 523 barrels of oil and distillate and 49,220,000 cubic feet of gas at a depth of 10,447 feet. A relief well was being drilled and was down to 10,025 feet as the year ended.

One of the most important discoveries of 1942 was a well 3 miles southwest of Krotz Springs in the Branch area of St. Landry Parish, which opened a new distillate pool in December. At 11,398 feet it was the deepest wildcat drilled in that area but was plugged back to 9,327 feet.

Distillate was found in the extreme southern part of Bayou Sale field in St. Mary Parish; it comes from a new sand located at 10,703 feet. The well was drilled to a depth of 12,000 feet.

Development in Northern Louisiana shifted in 1942 from the Wilcox sand, which predominated in 1941, to the deeper Pettit and Smackover limes. The Monroe field was the most active in the State, with 30 completions, followed by the North Lisbon in Claiborne Parish and the Nebo-Hemphill field in LaSalle, with 4 completions each.

The following data were furnished by H. W. Bell, Division of Minerals, Louisiana Department of Conservation. The total natural-gas production in Louisiana in 1942 was 669,136 million cubic feet, of which 463,695 million (69 percent) were from gas wells and 205,441 million (31 percent) from oil wells. Northern Louisiana produced 388,274 million cubic feet of dry gas and 46,131 million of casinghead gas. Southern Louisiana produced 75,421 million cubic feet of dry gas and 159,310 million of casinghead gas. The Monroe field re-

mained the major gas-producing area in Louisiana, with an output of 217,915 million cubic feet, or 47 percent of the total dry-gas production. The field comprises 61 percent of the gas acreage of the State. Parishes having largest output were: Union, 100,084 million cubic feet; Morehouse, 68,425; Webster, 55,890; Ouachita, 49,439; Caddo, 29,912; and Bossier, 28,501. There are 36 parishes in the State having dry-gas production from about 70 gas fields.

Michigan.—The following information on natural-gas developments in Michigan in 1942 was furnished by F. R. Frye, petroleum engineer, Michigan Department of Conservation.

In all, 74 gas wells were completed in 1942 compared with 97 in 1941. Previously discovered gas fields in Clare and Osceola Counties were the main points of interest during the year. Of the 74 wells drilled, 30 were in the Marion field, where about 9,500 acres are proved, and 11 in the Evart field, extending the proved acreage there to about 2,100 acres.

Four wells were drilled in the Riverside pool in Missaukee County, the proved acreage approximating 2,240 acres. Two discovery wells were completed, but no additional drilling was done in their vicinity up to the close of the year. The Don Rayburn-Mee No. 1 well in sec. 4, T. 19 N., R. 3 E., was drilled in Arenac County in search for oil. It was put down to the Dundee sand, which was dry, then plugged back to the Berea sand, where it was finished as a gas well, having 300,000 cubic feet initial production and a pressure of 830 pounds. The new pool was tentatively called the North Adams. In December, the Belvidere Oil Co. completed its State No. 1 well for gas at a depth of 1,489 feet in the Michigan Stray sand in Fork Township, Mecosta County. The initial open flow was 1,010,000 cubic feet and the well-head pressure over 500 pounds a square inch.

A desulfurization plant was built in the Riverside pool and put in operation in December 1942, to bring the sulfur content of the gas within the requirements of the Public Service Commission. This field is the first where it has been found necessary to process gas from the Michigan Stray sand.

A main gas-transmission line, started in 1941 from the Ohio State line to Saginaw and Kalamazoo, was completed in 1942. A request for permission to build a line from the Austin gas pool, which is being used for storage, to the Six Lakes pool was denied by the War Production Board.

Reported production of natural gas reached an all-time high of 17,749 million cubic feet—approximately 17 percent over the 1941 figure of 15,092 million.

Mississippi.—H. M. Morse, supervisor of the Mississippi State Oil and Gas Board, reports that the Jackson field continued to be the main source of natural gas in Mississippi in 1942. The field had 23 gas wells producing during the year. One new well was completed in 1942; none was abandoned.

Production in the field has declined steadily since 1939, when the peak of 15,233 million cubic feet was attained. The output in 1942 was 2,084 million—85 percent less than the peak year and 46 percent less than the 1941 figure.

Large quantities of gas are used for pumping in the Tinsley, Vaughan-Pickens, and Pickens-Sharpsburg oil fields, and a smaller amount was burned in flares.

The gas:oil ratio is so low in the Cary oil field that the gas is not used.

Missouri.—Gas completions in Missouri dropped from 18 in 1941 to 7 in 1942. Wells drilled in 1942 were as follows: Bates County, 2, initial open flow 550,000 cubic feet; Caldwell County, 1, initial open flow 200,000 cubic feet; and Platte County, 4, initial open flow 400,000 cubic feet.

As yet no arrangements have been made to utilize the gas from the Polo field in Caldwell County, discovered in 1940.

The above information was supplied by Frank C. Greene, geologist, Missouri Geological Survey.

Montana.—Wells drilled in Montana totaled 69 in 1942 compared with 59 in 1941. Data on natural-gas developments were taken from a report by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo.

Bowdoin and Cedar Creek fields reported 56 of the gas completions, but all had small initial production. The other 13 were in the Cut Bank, Kevin-Sunburst, and Hardin fields. Total daily initial production of the new wells was 87,265,000 cubic feet. The old fields in Montana need continual drilling to compensate for declines in pressure and volume. Some of the old wells were cleaned, repaired, or deepened to augment production. Two minor discoveries were made, one on the Fred and George Creek nose in T. 37 N., R. 2 E., and one at Conrad Butte in T. 29. N., R. 1 W., but they will not be used unless considerable quantities of gas are developed.

Bowes, Dry Creek, and Kevin-Sunburst were the only fields that did not have increased production in 1942. The Cut Bank field, which produced 45 percent of the total output, made a 21-percent gain over 1941, and Cedar Creek, next in rank, gained 4 percent. The following table shows production in Montana, by fields.

Natural gas produced in Montana in 1942, by fields, in thousands of cubic feet

Field	Marketed gas production	Gas used for repressuring	Estimated field use	Estimated waste
Bowdoin	3,137,543			3,000
Bowes	477,361			500
Box Elder	484,147			500
Cedar Creek	6,890,539			8,000
Cut Bank	13,554,401		400,000	50,000
Devon	389,518			10
Dry Creek	1,017,969			1,000
Hardin	89,518			600
Haystack Butte	91,636			10
Kevin-Sunburst	2,731,448	22,820	600,000	15,000
Whitlash	1,046,139			50
	29,910,219	22,820	1,000,000	78,670

Gross production in the State in 1942 was 31,012 million cubic feet—13 percent over the 27,483 million produced in 1941 and 21 percent over the 1940 total. Marketed production totaled 29,910 million cubic feet—an increase of 2,591 million (9 percent) over that of 1941. The Kevin-Sunburst field was the only area in which repressuring was reported, 23 million cubic feet being used for that purpose in 1942 compared with 7 million in 1941. Field use consumed 1,000

million compared with 21 million the previous year, and losses were cut from 137 million in 1941 to 79 million in 1942. The amount of gas treated for natural gasoline exceeded the 1941 figure by 12 percent. A plant at Cut Bank treated 11,891 million cubic feet to produce 2,684,000 gallons of natural gasoline, 201,000 of propane, and 1,548,000 of butane, and in the Dry Creek field another plant processed 128 million cubic feet to produce 70,000 gallons of natural gasoline.

The Cut Bank and Kevin-Sunburst areas were connected by a 25-mile line built during the year.

New Mexico.—Of the 12 gas wells drilled in New Mexico in 1942, 8 were in the southeastern and 4 in the northwestern part of the State. This compares with 13 in the southeastern and 6 in the northwestern areas in 1941. The new wells had total initial productions of 107,010,000 cubic feet and 35,720,000 cubic feet, respectively. Three San Juan County wells found gas in the Dakota sand on the Barker Creek structure.

According to information supplied by Foster Morrell, acting supervisor, Geological Survey, United States Department of the Interior, Roswell, N. Mex., natural-gasoline plants treated 103,704 million cubic feet of natural gas in 1942—a decrease of over 5 percent from the 1941 throughput. Domestic, commercial, and industrial consumers in Lea County used over 42 percent (44,132 million cubic feet) of the gas after it was treated for natural gasoline. In Eddy County 75 million cubic feet of residue gas were marketed. The total of these two amounts represents a 21-percent gain over the 36,472 million marketed in 1941. Gas used for gas lift and field consumption and vented without treatment for natural gasoline amounted to 47,299 million cubic feet in 1942—approximately 2½ times the 19,289 million similarly accounted for in 1941. Total production in the southeastern area probably increased more than 20 percent over the 1941 output.

In the northwestern area, 4,022 million cubic feet of gas were used by domestic, commercial, and industrial consumers, leaving 125 million for fuel and wastage. Production increased 13 percent over the 1941 figure.

New York.—The total output of wells drilled in New York in 1942 continued the decline that began 5 years ago. C. A. Hartnagel, State geologist, reports that unless new reserves are found the total production of the State will drop to the comparatively low level maintained before gas was discovered in the Oriskany sand. Known reserves are being rapidly depleted, and efforts to find new ones have met little success.

Out of 26 wells (most of them exploratory) drilled to the Oriskany sand in 1942, only 6 were productive, compared with 18 out of 42 in 1941. Tompkins County was the most active district in 1942, but efforts to develop the pool resulted in only 2 small producers. Steuben County had only 4 successful completions in 1942, compared with 14 in 1941. Allegany County had 13 gas completions in 1940, 2 in 1941, and none in 1942. Five dry holes drilled in Allegany County in 1942 were over 4,700 feet deep and in Steuben County 4 were over 5,000 feet. New wells were located as follows: Tompkins County, 11; Steuben County, 9; Allegany County, 6.

No important developments occurred in any of the proved Oriskany pools, and the discovery of new supplies of gas appears discouraging.

Only two or three wells were added in the small Trenton limestone field in Oswego and Oneida Counties, and the output continued to be negligible. A few wells were added to the large number of producers in the old Medina fields of western New York.

North Dakota.—According to Wilson M. Laird, State geologist, no new natural-gas developments took place in North Dakota during 1942. The only well drilled was in Oliver County in search for oil, and it was dry.

The pipe line that supplies gas in eastern Montana and a number of communities in the Dakotas took 121,955,000 cubic feet of gas from eight wells in the Cedar Creek field in the southwestern part of the State. Apparently the gas was used as an auxiliary supply, for none was taken between May and September, when demand for domestic fuel is comparatively light.

Ohio.—The following data were taken from reports by Kenneth Cottingham, chief geologist, Ohio Fuel Gas Co.

Under adverse conditions resulting from the war, the total number of gas wells drilled in Ohio in 1942 was 33 percent less than the record of 1941 and below the number of completions in any year since 1938. The daily average initial production of the new wells was 5 percent less than that of wells drilled in 1941. It is estimated that one-tenth of the State acreage was under lease to oil and gas operators at the beginning of 1942, but many of the leases were said to have been surrendered toward the end of the year.

The Clinton sand remains the chief source of gas in the State, although completions in that formation were 16 percent and the average open-flow capacity 17 percent less than in 1941. No significant new areas were discovered, and no important additions were made to the proved acreage. Little drilling was exploratory. A well drilled in Bearfield Township, Perry County, gave every indication that a small Clinton pool had been discovered. It had an initial daily open flow of 1,390,000 cubic feet, but two wells drilled nearby were dry. In Plain Township, Wayne County, a small pool was opened, and about 500 acres were proved. A discovery well having an initial volume of 4,500,000 cubic feet was completed near the end of the year in the southwestern part of Wellington Township, Lorain County, at a depth of about 2,400 feet. The pool is thought to comprise about 350 acres.

Little was done toward finding new production in the Oriskany sand, though it is thought to have possibilities. One well completed in Liberty Township and four in Wheeling Township, Guernsey County, north of the old Cambridge field, averaged 3,300 feet in depth and 1,456,000 cubic feet initial daily open flow. About 1,500 acres were proved in the Oriskany sand, but it is thought that the field will be small. In Mayfield Township, Cuyahoga County, four wells with an average initial open flow of about 2,327,000 cubic feet were drilled to a depth of 1,890 feet. In Richfield Township, Summit County, a well was developed with an initial volume of 238,000 cubic feet. Two attempts to find gas in the Oriskany sand in Meigsville Township, Morgan County, and in Adams Township, Washington County, resulted in dry holes.

No unusually deep drilling was done during 1942. The deepest gas well was in Fairfield Township, Tuscarawas County; production in this well was found in the Clinton sand at 5,313 feet. The initial

volume was 898,000 cubic feet. Another deep test, probably to the Trenton sand, drilling at 6,850 feet found the Clinton sand 18 feet thick at a depth of 5,398 feet, but it was dry.

The productive sands, number of wells drilled, and average initial production per well, in thousands of cubic feet, were as follows: Clinton, 273 wells with 904 thousand cubic feet average initial volume; Shallow, 90 with 351; Berea, 86 with 168; Oriskany, 10 with 1,682; Ohio shale, 7 with 131; and Newburg, 5 with 783.

A well in York Township, Morgan County, proved to be the most productive of the year. It was 4,261 feet deep and had an initial daily open flow of 11,700,000 cubic feet and an initial rock pressure of 1,030 pounds.

Gas wells were drilled in 30 counties in 1942 compared with 35 in 1941. Morgan County, not included in the 10 most active counties in 1941, ranked first in number of gas completion in 1942; Meigs held second place, with 21 fewer wells drilled; Medina, eighth in rank in 1941, was third, with 10 more wells drilled; Licking, first in 1941, dropped to fourth place, with 78 fewer completions. Counties of greatest activity and number of wells drilled in 1942 were: Morgan, 43; Meigs, 42; Medina, 33; Muskingum, 33; Licking, 24; Washington, 24; Tuscarawas, 23; and Wayne, 23.

Oklahoma.—Gas completions in Oklahoma dropped 42 percent or from about 175 in 1941 to 102 in 1942. Much of the drilling was in old areas of proved production. No notable new fields were discovered. Wildcatting increased 26 percent, but very little new production was found. The wildcat wells completed for gas were located as follows: Hughes County, 2; Pittsburg, 2; and Comanche, LeFlore, McIntosh, Okfuskee, Pottawatomie, Sequoyah, and Texas, 1 each.

Activity in the Hugoton gas field was stopped during the year by order of the Petroleum Administration for War. The Oklahoma part of the field, which covers most of Texas County, is the largest known gas reserve in the State. It is estimated to have a 33-year supply of gas, as measured by the present rate of total production of all fields. The field is as yet virtually untouched, only about 0.3 percent of the estimated original reserve having been produced.

According to information supplied by Dan O. Howard, petroleum engineer, Oklahoma Corporation Commission, natural-gas output gained 6 percent in 1942 compared with 1941. Total production amounted to 276,532 million cubic feet. Oil wells produced 151,064 million (55 percent) and gas wells 125,468 million (45 percent). The daily average production approximated 758 million cubic feet. Ninety-five percent of the homes in the State are built to use only natural gas as fuel, and each household averages 95,000 cubic feet of gas a year.

Exports of natural gas to the north and east of Oklahoma continued the increase that began in 1938, largely because of increased industrial demand. A total of 50 billion cubic feet—30.6 percent of the total amount available in the State for domestic and industrial consumption—was transported to other States during 1942.

Carbon-black plants in Oklahoma utilized approximately 10 billion cubic feet of gas during 1942. One chemical plant is proving that natural gas has growing importance in the manufacture of such by-products as formaldehyde, methanol, and related chemicals obtained by direct oxidation of the gas.

The commission is intensifying its efforts to prevent waste of gas in the oil fields and to regulate production in the gas fields to insure maximum recovery.

Pennsylvania.—Information regarding natural-gas developments in Pennsylvania was supplied by J. G. Montgomery, vice president, United Natural Gas Co. The shallow gas fields were the focal point of gas developments in 1942, as was true in 1941. Some drilling is still being done in the deep fields; but production continues to decline, and the fields appear to be almost exhausted. During the year 738 shallow wells were drilled; 80 percent produced gas.

New developments in the southwestern part of the State have proved approximately 2,200 acres in the Armbrust pool, Hempfield Township, Westmoreland County. Total initial volume of the 75 productive wells in the pool was about 48 million cubic feet a day. Nine wells in the Big Injun sand of western Fayette and eastern Greene Counties had average initial capacities of over 1 million cubic feet a day, and 16 wells in Greene, Allegheny, Indiana, Washington, Armstrong, and Westmoreland Counties approximated the same amount. Jefferson County (with 135 wells drilled), Clarion (with 91), Elk (with 63), and McKean (with 49), were the most active of the central Pennsylvania counties in 1942. Others having developments were Clearfield, Forest, Mercer, Venango, and Warren, where a total of 46 wells was drilled. Highland and Ridgway Townships, Elk County, Jenks Township, Forest County, Oliver and Polk Townships, Jefferson County, and Bell Township, Clearfield County, each had a well with an initial open-flow capacity of over 1 million cubic feet.

Very little new production was found in the deep fields. In the Fayette County field, four wells were completed in the Summit gas pool; their initial open flow capacity was 141,000 cubic feet, 11,875,000 cubic feet, 11,700,000 cubic feet, and 1,500,000 cubic feet. Gas was found in the fractured Onondaga chert and the underlying Oriskany sandstone. The complex faulting of this field makes drilling difficult. In Potter County a well in Bingham Township having an initial open-flow capacity of 185,000 cubic feet a day and one in Wharton Township having a capacity of 600,000 cubic feet a day were completed. The first well in Pennsylvania to produce gas in commercial quantities from the Newburg member of the Lockport dolomite was drilled in Worth Township, Mercer County. It had an initial capacity of 159,000 cubic feet a day.

Unsuccessful deep tests included two each in Potter, Tioga, and Lawrence Counties and one each in Greene, Beaver, and Westermoreland Counties. In Tioga County the Salina series below the Oriskany and Helderberg sands, in Lawrence and Mercer Counties the Lockport dolomite, in Westmoreland County the Helderberg below the Oriskany sand, and in Erie County the Trenton limestone were all found to be unproductive.

The area where no Oriskany sand was encountered was extended further by the two wells drilled in Mercer County.

Much more natural gas was produced in Pennsylvania during 1942 than in previous years. The increase is entirely in the shallow fields, as production from the deep fields continued to decline. The output from the deep fields has dropped steadily, as the following figures show: 2,500 million cubic feet in 1942, 3,750 million in 1941, 6,500

million in 1940, and 30,000 million in 1939—a 92-percent decline between 1939 and 1942. Figures of production from the shallow fields are not available.

South Dakota.—The status of natural gas in South Dakota remained unchanged in 1942, according to E. P. Rothrock, State geologist. Gas from a few artesian wells at Pierre and Fort Pierre and on a few ranches near the Missouri River continued to be used.

A drilling program on large acreages that have been under lease for over a year is promised in the spring of 1943, but there was no activity during 1942.

Tennessee.—According to Kendall E. Born, associate geologist, Tennessee Department of Conservation, production of natural gas in Tennessee comes from the Sunbright oil field in Morgan County and the Jamestown gas field in Fentress County. Gas is found in the Mississippian limestone in the former and the Trenton limestone in the latter county; both formations are fissured and fractured.

No production figures are available for the Sunbright field for 1942; in the Jamestown field 7,378,000 cubic feet of gas were marketed from six wells.

Texas.—In all, 238 gas wells were drilled in Texas in 1942 compared with 294 in 1941—a decline of 19 percent.

The Texas Panhandle and Texas Gulf districts are the only two areas in which the reported number of gas completions gained over those in 1941. Completions in the Panhandle increased 18 percent, or from 49 in 1941 to 58 in 1942. Known gas areas in the Panhandle were enlarged by completions in Hansford and Sherman Counties. The Texas Gulf district had 38 completions in 1942—2 more than were reported for the previous year.

Less than half as many gas wells were drilled in 1942 as in 1941 in the North Central and Southwest districts and less than one-third as many in East Texas. West Texas had only three less in 1942 than in 1941.

Wildcatting was active in North Central Texas, but only 1 of the 105 exploratory wells drilled in the district was reported as a gas well. A discovery well was drilled in the Gulf Coast region in Matagorda County north of the Bay City field and 3 were drilled in West Texas. A new gas field was opened in Victoria County in Southwest Texas on November 1 by a well that had an initial production of 162 million cubic feet. One successful wildcat well was drilled in Jim Wells County and one in Dimmitt County. The new Sarco gas field in Goliad County, Southwest Texas, was opened by a well 9 miles southeast of Goliad. The well had an open flow of 180 million cubic feet of gas and 50 barrels of distillate. As the year closed, a wildcat well was making distillate and gas at a depth of 8,542 feet, on a drill-stem test in Starr County, 1½ miles from production. It is one of the deepest active operations in the Rio Grande Valley.

Data on natural-gas operations have been supplied by Jack K. Baumel, Railroad Commission of Texas. The total production of natural gas in 1942 was 1,917 billion cubic feet—an increase of 5.5 percent over the 1,817 billion produced in 1941. Gas lines already in operation were adequate for transmitting gas to meet sharply increased demands, so that there was no problem of transportation, such as confronted the petroleum industry. Deliveries to pipe lines

increased from 65,973 million cubic feet in January 1942 to 71,768 million in December.

Of the total output, 1,271 billion cubic feet (66 percent) were sweet gas, 238 billion (13 percent) sour gas, and 408 billion (21 percent) casinghead gas. These figures indicate a 13-percent increase over 1941 in the production of sweet gas, whereas sour gas decreased 7 and casinghead gas 6 percent.

Cycling- and repressuring-plant operations increased 2 percent—from 570 billion cubic feet in 1941 to 580 billion in 1942. This was an 82-percent gain over the 1940 figure. Gas processed for natural gasoline totaled 904 billion cubic feet, a 4-percent decline from the 945 billion treated in 1941. Carbon-black plants used 295 billion cubic feet of gas in 1942, 10 percent less than the 329 billion used in 1941. Gas vented to the air decreased 19 percent in 1942 compared with 1941.

Utah.—Gross production of natural gas in Utah was 4,390 million cubic feet in 1942—7 percent less than the 4,724 million reported in 1941 and only 1 percent over the output in 1940. Only 6 million cubic feet of the total output in 1942 were not marketed, 1 million being used in the field and 5 million lost. There were 20 million not marketed in 1941 and 45 million in 1940, according to figures furnished by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo.

A plant near Farnham utilized 149 million cubic feet of carbon dioxide from the Farnham dome in the manufacture of dry ice, compared with 102 million in 1941.

No drilling was done in the State during the year.

Virginia.—A report from William M. McGill, assistant State geologist, Virginia Conservation Commission, gives information regarding natural-gas developments in Virginia. Gas in commercial quantities was discovered in the State in a well completed in June 1931. Five other wells, four of which produced gas, were drilled between that time and February 1940. Gas from the wells was turned into a 4-inch line in March 1938 to supply Bristol, Va., and Bristol, Tenn. A well was completed in 1941 in the Lower Mississippian limestone of Washington County at a depth of 3,910 feet. Another in the northwestern part of Rockingham County was shut down after gas was found at 2,992 feet in the Devonian sand.

A small gas well was completed in January 1942 on the Early Grove anticline in Scott County. It found gas in the Little Valley limestone (Lower Mississippian) at a depth of 3,670 feet. The initial daily production was 139,000 cubic feet and the initial pressure 1,300 pounds. It was stated later that it would yield 125,000 cubic feet daily and that the pressure had built up. A second well is reported to have been drilled in the Ewing district, Lee County. Drilling was stopped when gas was found at 1,100 feet. It is thought that oil might be found if the well were deepened to 1,400 feet.

Washington.—The Northwestern Natural Gas Co., which formerly distributed natural gas to towns in the Yakima Valley region, has reported that the gas wells in the Rattlesnake Hills field (from which its supply was obtained) were completely depleted in 1941, and the company has changed to butane-air gas for distribution to its customers.

West Virginia.—Information on natural-gas developments in West Virginia has been supplied by David B. Reger, consulting geologist, Morgantown, W. Va.

Various wildcats extended the proved area of existing gas pools in West Virginia in 1942 but opened no strictly new ones. Out of 53 wildcats drilled, 27 were completed as gas wells and 6 as oil wells. About 51,000 additional acres were proved for gas in old fields, and the opening of new pools by wells previously drilled was confirmed. It is probable that the new proved gas reserves represent a substantial increase over withdrawals.

The State had 536 gas completions during 1942, with a total daily open flow of 1,228,501,000 cubic feet compared with 558 wells reported drilled in 1941 with a total daily open flow of 949 million cubic feet. These figures indicate a 4-percent decline in number of wells drilled in 1942 but a 29-percent increase in total daily capacity. During the year, 76 old wells were deepened, adding 26,034,000 cubic feet to production, compared with 86 wells and 56 million cubic feet in 1941.

Drilling increased in the deep Oriskany sand in 1942, and 205 out of 242 tests were successful. This compares with 166 commercial completions in 1941. The Oriskany sand furnished 86 percent of the initial production during the year compared with 75 percent in 1941. Most of the Oriskany gas comes from the Charleston field in Jackson, Kanawha, and Putnam Counties. Only 2 of the 15 tests drilled in other areas found Oriskany gas in commercial quantities, and they were small. The Charleston field is well defined to the north and east by a number of dry holes. It might be extended to the south as far as northern Boone County, where 6 small Oriskany wells have been drilled. Ten or twelve wells showing tight or thinned-out sands indicate a limit to its extent to the west. It is estimated that nearly one-half of the available gas has been recovered from the proved area. About 120 billion cubic feet were withdrawn in 1942.

The Trace Fork field in Putnam County was the most active of the shallow fields, with 40 completions in the Big Lime, Berea, and Brown Shale sands. The Spurlockville field in Lincoln County and the Villa Nova in Braxton and Clay Counties were next in rank, with 17 completions each.

The counties of greatest activity and the number of gas completions in each were: Jackson, 150; Kanawha, 59; Putnam, 48; Upshur, 33; Boone, 30; Calhoun, 29; Clay, 28; Gilmer, 26; and Ritchie, 18.

Production was raised in Kanawha and Raleigh Counties and other areas by acidizing lime wells. The practice of storing gas in depleted sands to build up a reserve to meet peak demands is gaining in importance. One company reported six such projects in use in Pennsylvania and West Virginia in 1942 and two others under test.

Marketed production in West Virginia is estimated at 220 million cubic feet in 1942—a 6-percent gain over the 208 million reported in 1941.

Wyoming.—Three gas wells were drilled in old fields in Wyoming during 1942, one each in the Big Sand Draw, North Baxter Basin, and Pilot Butte fields. The total daily initial flow was 38 million cubic feet, compared with 56 million from five wells drilled in the old fields in 1941. The Pilot Butte field has no pipe-line connections, and the gas is used for field operations only.

Three gas wells, with a total initial flow of 14 million cubic feet, were drilled in the new Sherard field. The field was connected with the gas system from the Lost Soldier area to Sinclair, Wyo., by 9 miles of welded line.

L. G. Snow, assistant supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo., reports production from 43 fields in Wyoming in 1942. Big Medicine Bow continued the decline that began several years ago. Salt Creek had 583 million production less than in 1941. Muskrat and several small fields declined, but in general the trend was upward.

Gross production amounted to 46,471 million cubic feet—a 7-percent gain over the 43,409 million produced in 1941. The most productive areas and quantities produced were: Salt Creek, 8,926 million cubic feet; Lance Creek, 7,917; South Baxter Basin, 5,784; Big Sand Draw, 5,652; Elk Basin, 2,241; and Garland, 2,101.

Only 716 million cubic feet of gas were lost in 1942, 1,404 million were used in the field, and 14,322 million were returned to formations, leaving 30,029 million to be marketed. Gas marketed was 6 percent more than the 28,317 million marketed in 1941 and 13 percent over the 1940 record. South Baxter Basin, with 5,774 million, and Big Sand Draw, with 5,652 million, led in volume of gas marketed, supplying over one-third of the total amount. Salt Creek, which ranked first in gross production, stood third in amount of gas marketed, with 2,744 million, and Lance Creek, second in gross production, ranked fourth with 2,141 million.

Repressuring was practiced in eight fields during the year. In Salt Creek 6,182, in Lance Creek 5,775, and in Wertz 1,172 million cubic feet of gas were returned to the sands. Comparatively small amounts were also injected in Rock Creek, Lost Soldier, Elk Basin, La Barge, and Grass Creek fields, bringing the total to 14,322 million—a gain of almost 15 percent over the 1941 figure.

Salt Creek with 8,926, Lance Creek with 7,856, and Big Sand Draw with 5,652 million supplied 96 percent of the 23,254 million cubic feet of gas treated for natural gasoline. Rock Creek, Elk Basin, and Grass Creek supplied the other 4 percent. In 1941, 22,366 million feet were treated.

CONSUMPTION

Consumption of natural gas in 1941 continued the upward trend evidenced since 1938, totaling 2,805,192 million cubic feet. This was a 6-percent gain over the peak of 2,654,659 million cubic feet attained in 1940. Increases over 1940 were made in all but five States. Domestic consumption declined 0.4 percent from 1940, although the number of consumers increased. The over-all gain was in the industrial load, as shown by an 18-percent increase in gas used by miscellaneous industrial consumers in 1941, largely owing to rapidly increasing demands from defense industries. The average value of total consumption increased 0.4 cent over the 1940 average to 22.1 cents a thousand cubic feet.

Ohio produced only 31 percent of the State requirements and ranked first in imports from other States. Texas again ranked first in amount consumed, followed by California, Louisiana, Oklahoma, Pennsylvania, and Ohio in the order named.

Natural gas consumed in the United States, 1937–41

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		
1937	8,348	680	9,028	372	117	489	54.2	67.6
1938	8,570	695	9,265	368	114	482	52.0	68.3
1939	8,888	715	9,603	391	119	510	53.1	67.9
1940	9,245	741	9,986	444	134	578	57.9	65.7
1941	9,730	767	10,497	442	145	587	55.9	65.9

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 [2]	Portland-cement plants [3]	Other industrial	Total industrial			
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
1940	712	369	128	183	42	643	2,077	9.5	2,655	21.7
1941	686	365	148	205	54	760	2,218	10.5	2,805	22.1

[1] Includes consumers served with mixed gas. [2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook.

Natural gas consumed in the United States, 1937–41, by States, in millions of cubic feet

State	1937	1938	1939	1940	1941
Alabama	16,593	14,796	20,093	23,461	32,023
Arizona	12,857	12,660	16,643	18,002	18,213
Arkansas	35,074	34,833	35,673	39,719	46,933
California	329,769	315,168	348,361	351,950	374,905
Colorado	20,816	19,212	21,978	22,111	26,574
District of Columbia	3,458	3,826	4,069	4,686	5,124
Florida	1,389	1,469	1,658	1,481	2,378
Georgia	13,893	14,783	16,296	20,551	23,975
Illinois	78,650	66,500	77,134	88,088	98,634
Indiana	23,551	26,706	30,795	29,214	29,989
Iowa	21,354	20,109	21,732	23,460	24,589
Kansas	96,822	86,105	85,865	96,772	109,059
Kentucky	18,154	15,350	16,563	18,881	20,170
Louisiana	174,153	162,260	164,667	185,089	222,025
Maryland	1,011	1,247	4,907	5,855	6,587
Michigan	24,112	24,697	27,316	32,790	37,290
Minnesota	13,111	14,641	17,262	19,904	22,672
Mississippi	13,327	12,785	14,207	17,657	20,813
Missouri	46,898	42,505	47,157	53,141	58,138
Montana	[1] 21,594	[1] 18,225	[1] 19,765	22,328	24,751
Nebraska	17,263	17,539	19,654	20,087	19,205
New Mexico	28,056	32,890	38,981	40,198	39,138
New York	50,080	47,950	46,877	27,250	25,384
North Dakota	1,641	1,533	1,607	1,725	1,741
Ohio	125,133	108,013	114,720	129,856	136,251
Oklahoma	269,604	244,443	231,005	230,806	209,395
Pennsylvania	119,501	96,285	109,746	121,230	139,492
South Dakota	5,519	5,354	5,712	6,454	6,580
Tennessee	13,353	14,047	[2] 15,558	16,819	22,495
Texas	706,120	729,603	796,561	874,294	875,620
Utah	12,449	11,699	13,172	14,802	16,667
Virginia	550	615	[2] 788	963	1,166
Washington	143	117	63	36	1
West Virginia	65,395	57,478	69,394	77,540	88,597
Wyoming	21,648	18,654	17,786	17,459	18,618
Total United States	2,403,041	2,294,097	2,473,765	2,654,659	2,805,192

[1] Includes natural gas piped from Canada.
[2] Small amount of gas consumed in Tennessee included with Virginia; separate figures not available.

Natural gas treated at natural-gasoline plants in the United States, 1937–41, by States, in millions of cubic feet

State	1937	1938	1939	1940	1941
Arkansas	4,031	21,377	19,171	26,584	19,906
California	381,568	398,187	377,041	375,407	371,350
Colorado	153	145	130	142	134
Illinois	1,027	1,110	2,440	12,716	23,732
Kansas	153,416	144,631	141,945	150,963	176,088
Kentucky	34,981	38,446	36,817	39,662	38,062
Louisiana	144,474	116,331	114,960	145,234	191,194
Michigan	1,381	1,395	1,019	1,414	3,581
Montana	9,062	7,126	8,116	9,528	10,386
New Mexico	61,625	97,830	97,010	101,213	105,161
New York	50	65	65	40	5
Ohio	33,625	28,488	32,703	38,547	37,546
Oklahoma	338,007	265,746	219,755	219,255	200,319
Pennsylvania	31,508	22,600	26,662	40,161	43,704
Texas	754,696	752,784	914,701	1,123,236	1,325,471
West Virginia	140,512	122,301	140,982	168,206	195,093
Wyoming	18,684	17,000	16,483	19,092	21,568
	2,108,800	2,035,562	2,150,000	2,471,400	2,763,300
Ratio to total consumption	88	89	87	93	99

Treated for natural gasoline.—The amount of natural gas processed for natural gasoline increased 12 percent, or from 2,471,400 million cubic feet in 1940 to 2,763,300 million in 1941. The ratio to total consumption was 99 in 1941 compared with 93 in 1940. Gas treated in Louisiana increased 32 percent and in Texas 18 percent over the 1940 volumes, largely because of increases in cycle-plant operations. The amount in Kansas increased 17 percent and in West Virginia 16 percent. In Oklahoma it decreased 9 percent and in California 1 percent.

Domestic and commercial.—Domestic consumers used 442,067 million cubic feet of natural gas in 1941, compared with 443,646 million in 1940. The number of consumers increased by 484,880 and totaled 9,730,110 in 1941. The decrease in consumption in the face of added meters is partly explained by higher average temperatures in 1941 over 1940 and may also represent a more frugal use of fuel following rising living costs. The average consumption per domestic consumer was 45,433 cubic feet in 1941 compared with 47,986 cubic feet in 1940. Commercial consumption increased 8 percent over 1940 to 144,844 million cubic feet.

The average value of domestic gas was 72.0 cents a thousand cubic feet in 1941 compared with 71.1 cents in 1940; the average of commercial gas was 47.2 compared with 47.8.

Domestic and commercial consumption of natural gas in the United States in 1941, 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	38,150	1,962,000	$1,974,000	100.6	4,320	826,000	$423,000	51.2	42,470	2,788,000	$2,397,000	86.0
Arizona	42,000	1,653,000	2,014,000	121.8	4,280	1,039,000	574,000	55.2	46,280	2,692,000	2,588,000	96.1
Arkansas	78,390	6,159,000	3,082,000	50.0	13,180	3,499,000	1,235,000	35.3	91,570	9,658,000	4,317,000	44.7
California	1,799,140	80,929,000	58,791,000	72.6	103,300	24,151,000	10,988,000	45.5	1,902,440	105,080,000	69,779,000	66.4
Colorado	102,480	6,633,000	5,085,000	76.7	10,000	2,032,000	1,160,000	57.1	112,480	8,665,000	6,245,000	72.1
District of Columbia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida	4,740	162,000	205,000	126.5	530	92,000	59,000	64.1	5,270	254,000	264,000	103.9
Georgia	92,990	5,571,000	4,742,000	85.1	7,990	3,850,000	1,341,000	34.8	100,980	9,421,000	6,083,000	64.6
Illinois	1,282,220	19,458,000	24,417,000	125.5	69,230	5,401,000	4,688,000	86.8	1,351,450	24,859,000	29,105,000	117.1
Indiana	196,020	3,800,000	4,536,000	119.4	10,900	962,000	838,000	87.1	206,920	4,762,000	5,374,000	112.9
Iowa	141,480	5,068,000	4,894,000	96.6	11,080	1,507,000	1,009,000	67.0	152,560	6,575,000	5,903,000	89.8
Kansas	223,740	17,563,000	10,364,000	59.0	27,100	8,811,000	3,021,000	34.3	250,840	26,374,000	13,385,000	50.8
Kentucky	179,980	9,201,000	5,365,000	58.3	18,080	2,590,000	1,272,000	49.1	198,060	11,791,000	6,637,000	56.3
Louisiana	206,370	10,488,000	7,371,000	70.3	23,590	7,572,000	2,538,000	33.5	229,960	18,060,000	9,909,000	54.9
Maryland	[3] 244,290	[2] 6,094,000	[2] 4,716,000	[3] 77.4	[3] 11,840	[2] 996,000	[2] 656,000	[3] 65.9	[3] 256,130	[2] 7,090,000	[3] 5,372,000	[3] 75.8
Michigan	604,620	21,716,000	20,989,000	96.7	25,640	3,476,000	3,066,000	88.2	630,260	25,192,000	24,055,000	95.5
Minnesota	174,130	6,151,000	5,481,000	89.1	8,710	2,703,000	1,251,000	46.3	182,840	8,854,000	6,732,000	76.0
Mississippi	56,820	4,008,000	2,652,000	66.2	8,480	3,382,000	1,091,000	32.3	65,300	7,390,000	3,743,000	50.6
Missouri	405,780	13,515,000	12,219,000	90.4	36,030	4,108,000	2,557,000	62.2	441,810	17,623,000	14,776,000	83.8
Montana	47,620	6,543,000	3,080,000	47.1	5,320	3,868,000	1,150,000	29.7	52,940	10,411,000	4,230,000	40.6
Nebraska	121,090	5,528,000	4,173,000	75.5	8,230	1,520,000	863,000	56.8	129,320	7,048,000	5,036,000	71.5
New Mexico	25,200	2,437,000	1,683,000	69.1	2,900	1,550,000	588,000	37.9	28,100	3,987,000	2,271,000	57.0
New York	424,200	15,997,000	13,993,000	87.5	37,890	3,238,000	2,423,000	74.8	462,090	19,235,000	16,416,000	85.3
North Dakota	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	1,257,010	62,271,000	40,667,000	65.3	115,620	12,572,000	7,175,000	57.1	1,372,630	74,843,000	47,842,000	63.9
Oklahoma	263,570	21,405,000	9,897,000	46.2	32,330	8,915,000	2,811,000	31.5	295,900	30,320,000	12,708,000	41.9
Pennsylvania	691,110	37,412,000	23,873,000	63.8	57,880	8,128,000	4,305,000	53.0	748,990	45,540,000	28,178,000	61.9
South Dakota	17,060	1,252,000	966,000	77.2	1,910	1,274,000	521,000	40.9	18,970	2,526,000	1,487,000	58.9
Tennessee	53,690	3,424,000	2,602,000	76.0	6,760	2,667,000	1,027,000	38.5	60,450	6,091,000	3,629,000	59.6
Texas	697,520	39,478,000	27,432,000	69.5	79,090	16,141,000	7,086,000	43.9	776,610	55,619,000	34,518,000	62.1
Utah	[3] 34,110	[3] 2,974,800	[3] 2,020,600	[3] 67.9	[3] 1,470	[3] 1,049,200	[3] 359,400	[3] 34.3	[3] 35,580	[3] 4,024,000	[3] 2,380,000	[3] 59.1
Virginia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Washington	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
West Virginia	201,650	19,984,200	7,302,400	36.5	20,090	5,132,800	1,715,600	33.4	221,740	25,117,000	9,018,000	35.9
Wyoming	22,940	3,230,000	1,507,000	46.7	3,140	1,792,000	607,000	33.9	26,080	5,022,000	2,114,000	42.1
Total: 1941	9,730,110	442,067,000	318,093,000	72.0	766,910	144,844,000	68,398,000	47.2	10,497,020	586,911,000	386,491,000	65.9
1940	9,245,230	443,646,000	315,515,000	71.1	741,020	134,644,000	64,399,000	47.8	9,986,250	578,290,000	379,914,000	65.7

[1] Includes natural gas used with manufactured gas. [2] Maryland includes District of Columbia and Virginia. [3] Utah includes North Dakota and Washington.

Field.—Gas used in the field totaled 686,158 million cubic feet in 1941 compared with 711,861 million in 1940. The apparent decline resulted from the use of a new basis of reporting by a company that has been the largest consumer in Texas. The amount actually consumed in the field in 1941 probably increased several percent over the 1940 total. The estimated value of gas used for field purposes was $29,993,000 compared with $27,158,000 in 1940. These figures indicate a gain of 0.6 cent a thousand cubic feet in 1941.

Carbon-black manufacture.—An increase in the proportion of high-yield carbon blacks manufactured, together with a 3-percent decline in total output, reduced the amount of gas used at carbon-black plants in 1941. The total declined 1 percent to 365,377 million cubic feet from 368,802 million in 1940. A gain of 0.1 cent was recorded in the average value, mainly because of a higher average in Texas. The total value was $4,135,000 in 1941 compared with $3,702,000 in 1940.

Petroleum refineries.—Petroleum refineries consumed 148,127 million cubic feet of natural gas in 1941—a 16-percent gain over the 128,007 million used in 1940. This was 18 percent of the total B. t. u. requirements of the industry in 1941—0.9 percent more than was supplied in 1940. As similar comparisons for fuel oil show a loss of 1.6 percent, it would appear that natural gas was used as a substitute for that fuel at some refineries in 1941.

Electric public-utility power plants.—Requirements from public-utility power plants totaled 205,156 million cubic feet in 1941, a 12-percent gain over 1940. Of the major consuming States, sharp gains were noted in Louisiana, Texas, and Kansas, where gas was cheap. California used 13 percent less gas for this purpose in 1941 than in 1940, probably because of the increased use of water power. Tennessee and Arkansas reported sharp increases and Illinois a sharp decrease.

Portland-cement plants.—Consumption at portland-cement plants increased 29 percent to 54,208 million cubic feet in 1941 compared with 41,949 million in 1940. A very small percentage of the total fuel requirements of the industry is furnished by natural gas. However, as its proportion of the total increased slightly in 1941 and that of fuel oil decreased, it may be supposed that gas has displaced oil in some cases.

Other industrial.—Natural gas used for "other" industrial purposes increased 25 percent between 1939 and 1941. It totaled 759,255 million cubic feet in 1941, 18 percent over the 642,594 million used in 1940. Gas used by this class of consumers was 27 percent of the total consumption in 1941 compared with 24 percent in 1940 and displaced field use for the first time in volume. Field use took 24 percent of the total consumption in 1941 compared with 27 percent in 1940.

Miscellaneous industrial consumption increased in all States but New York, Oklahoma, and South Dakota. California, the largest consumer in both years, gained 15 percent over 1940; Pennsylvania, second in rank, gained 33; and Louisiana, third, gained 10. These three States consumed one-third of the total gas used for miscellaneous industrial purposes in 1941.

Industrial consumption of natural gas in the United States in 1941, 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		
				Value at points of consumption		M cubic feet					Value at points of consumption			Value at points of consumption	
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Portland-cement plants	Other industrial	Total	Total	Average (cents)	M cubic feet	Total	Average (cents)
Alabama							898,000	(1)	[1] 28,337,000	29,235,000	$4,962,000	17.0	29,235,000	$4,962,000	17.0
Arizona							2,293,000		13,228,000	15,521,000	3,123,000	20.1	15,521,000	3,123,000	20.1
Arkansas	10,417,000	$613,000				4,669,000	5,262,000	(1)	[1] 16,927,000	26,858,000	2,863,000	10.7	37,275,000	3,476,000	9.3
California	127,466,000	7,740,000				20,073,000	12,153,000	11,822,000	98,311,000	142,359,000	19,154,000	13.5	269,825,000	26,894,000	10.0
Colorado	200,000	11,000				2,000	749,000	(1)	[1] 16,958,000	17,709,000	2,727,000	15.4	17,909,000	2,738,000	15.3
District of Columbia									(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida									2,124,000	2,124,000	335,000	15.8	2,124,000	335,000	15.8
Georgia							5,746,000		8,808,000	14,554,000	2,630,000	18.1	14,554,000	2,630,000	18.1
Illinois	8,999,000	273,000				241,000	2,485,000		62,050,000	64,776,000	13,860,000	21.4	73,775,000	14,133,000	19.2
Indiana	381,000	19,500					5,341,000		19,505,000	24,846,000	6,221,000	25.0	25,227,000	6,240,500	24.7
Iowa							5,272,000	(1)	[1] 12,742,000	18,014,000	2,923,000	16.2	18,014,000	2,923,000	16.2
Kansas	19,583,000	1,345,000	(2)	(2)	(2)	5,138,000	19,466,000	7,645,000	[3] 30,853,000	[3] 63,102,000	[3] 7,820,000	[3] 12.4	82,685,000	9,165,000	11.1
Kentucky	1,891,000	257,000							6,488,000	6,488,000	1,814,000	28.0	8,379,000	2,071,000	24.7
Louisiana	62,844,000	1,998,000	18,627,000	$576,000	3.1	23,967,000	33,493,000	(1)	[1] 65,034,000	122,494,000	12,707,000	10.4	203,965,000	15,281,000	7.5
Maryland									[2] 5,787,000	[2] 5,787,000	[2] 1,684,000	[2] 29.1	[2] 5,787,000	[2] 1,684,000	[2] 29.1
Michigan	1,534,000	123,000				103,000	17,000		10,444,000	10,564,000	5,306,000	50.2	12,098,000	5,429,000	44.9
Minnesota							2,672,000		11,146,000	13,818,000	2,559,000	18.5	13,818,000	2,559,000	18.5
Mississippi	802,000	37,000					1,754,000		10,867,000	12,621,000	1,862,000	14.8	13,423,000	1,899,000	14.1
Missouri	520,000	83,000					12,271,000	(1)	[1] 27,724,000	39,995,000	7,185,000	18.0	40,515,000	7,268,000	17.9
Montana	1,223,000	69,000				926,000	984,000		11,207,000	13,117,000	1,779,000	13.6	14,340,000	1,848,000	12.9
Nebraska							4,928,000	(1)	[1] 7,229,000	12,157,000	2,073,000	17.1	12,157,000	2,073,000	17.1
New Mexico	20,835,000	421,000				44,000	4,125,000		10,147,000	14,316,000	1,982,000	13.8	35,151,000	2,403,000	6.8
New York	324,000	82,000				92,000	28,000		5,705,000	5,825,000	3,090,000	53.0	6,149,000	3,172,000	51.6
North Dakota							(4)		(4)	(4)	(4)	(4)	(4)	(4)	(4)
Ohio	1,575,000	270,000				1,000	1,735,000		58,097,000	59,833,000	21,067,000	35.2	61,408,000	21,337,000	34.7
Oklahoma	116,858,000	3,554,500	(2)	(2)	(2)	11,034,000	12,945,000	(1)	[1][3] 38,238,000	[3] 62,217,000	[3] 5,078,000	[3] 8.2	179,075,000	8,632,500	4.8
Pennsylvania	6,525,000	1,621,000				944,000	11,000		86,472,000	87,427,000	27,029,000	30.9	93,952,000	28,650,000	30.5
South Dakota							1,353,000	(1)	[1] 2,701,000	4,054,000	739,000	18.2	4,054,000	739,000	18.2
Tennessee							8,137,000		8,267,000	16,404,000	2,750,000	16.8	16,404,000	2,750,000	16.8
Texas	282,011,000	8,693,000	330,351,000	3,263,000	1.0	76,439,000	60,059,000	12,935,000	58,206,000	207,639,000	21,627,000	10.4	820,901,000	33,583,000	4.1
Utah	29,000	1,000				110,000	[4] 256,000	(1)	[4] 13,990,000	14,356,000	[4] 1,755,000	[4] 12.2	[4] 14,385,000	[4] 1,756,000	[4] 12.2

Virginia									[2]	[2]	[2]	[2]	[2]	[2]	[2]
West Virginia	14,649,000	2,503,000				783,000	16,000		48,032,000	48,831,000	10,261,000	21.0	63,480,000	12,764,000	20.1
Wyoming	7,492,000	279,000				3,561,000	707,000		1,836,000	6,104,000	750,000	12.3	13,596,000	1,029,000	7.6
Miscellaneous			[3] 16,399,000	[3] 296,000	[3] 1.8			[1] 21,806,000							
Total: 1941	686,158,000	29,993,000	365,377,000	4,135,000	1.1	148,127,000	205,156,000	54,208,000	759,255,000	1,166,746,000	199,419,000	17.1	2,218,281,000	233,547,000	10.5
1940	711,861,000	27,158,000	368,802,000	3,702,000	1.0	128,007,000	183,156,000	41,949,000	642,594,000	995,706,000	166,230,000	16.7	2,076,369,000	197,090,000	9.5

[1] Gas used in 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.

The average value of the gas consumed at petroleum refineries, electric public-utility power plants, and portland-cement plants, and for "Other" industrial purposes was 17.1 cents in 1941 compared with 16.7 cents in 1940. This 0.4-cent gain may be attributed to large gains in volume in some of the Eastern States, where high prices prevail.

Mixed gas.—The use of natural gas mixed with manufactured gas increased 1 percent in 1941 over 1940. The total volumes were 65,979 million cubic feet in 1941 and 65,102 million in 1940. Illinois, which has been the largest consumer of mixed gas, and New York, next in rank, both decreased about 1 percent in the quantity of natural gas blended. The number of consumers increased in most States. The total number of domestic and commercial consumers was 2,619,100 in 1941 compared with 2,514,910 in 1940. Natural gas used in mixed gas was valued at $56,952,000 compared with $56,202,000 in 1940. The average value remained unchanged at 86.3 cents per 1,000 cubic feet.

Consumption of natural gas used with manufactured gas in the United States in 1941, 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	169,910	4,044,000	8,370	561,000	519,000	5,124,000	$3,552,000
Illinois	1,113,640	15,587,000	57,310	4,465,000	5,633,000	25,685,000	25,397,000
Indiana	59,150	513,000	2,890	154,000	296,000	963,500	878,000
Iowa	56,660	1,358,000	3,860	243,000	96,000	1,697,000	1,693,000
Kentucky	79,910	2,912,000	7,430	1,049,000	1,241,000	5,202,000	2,852,000
Maryland	24,990	689,000	450	25,000	20,000	734,000	612,000
Minnesota	144,970	4,160,000	5,800	646,000	10,000	4,816,000	4,417,000
Missouri	245,480	4,183,000	11,760	729,000	496,000	5,408,000	5,453,000
Nebraska	56,110	1,243,000	330	63,000	153,000	1,459,000	886,000
New York	283,460	8,186,000	22,220	1,240,000	1,823,000	11,249,000	8,739,000
Ohio	163,890	700,000	16,060	245,000	208,000	1,153,000	690,000
Pennsylvania	56,150	1,530,000	2,730	299,000	251,000	2,080,000	1,367,000
Virginia	24,890	349,000	680	44,000	16,000	409,000	416,000
Total: 1941	2,479,210	45,454,000	139,890	9,763,000	10,762,000	65,979,000	56,952,000
1940	2,377,760	45,670,000	137,150	9,610,000	9,822,000	65,102,000	56,202,000

INTERSTATE SHIPMENTS

Interstate shipments totaled 815,672 million cubic feet in 1941—a 10-percent increase over 1940. Gas was transported from 21 States in 1941.

New shipments were reported from Arkansas to Louisiana and Texas. Some Texas gas was turned into the pipe line serving Alabama, Georgia, and Mississippi. The States that transported the largest volumes of interstate gas in 1941 were Texas, Louisiana, and West Virginia in the order named. Sharp decreases were noted in New York and Mississippi. Industries in Pennsylvania that formerly drew their natural-gas supplies from New York are now using West Virginia and Kentucky gas. Texas supplied 32 percent of the total shipments in 1941, Louisiana 24, and West Virginia 17, the same proportions as in 1940. Shipments from Pennsylvania to New York continued the recession started in 1940.

Interstate transportation of natural gas in 1941 [1]

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Arkansas		Louisiana	4,026,000
		Texas	204,000
			4,230,000
Colorado	Wyoming	Utah	2,806,000
		Wyoming	124,000
			2,930,000
Illinois		Indiana	199,000
	Indiana	Kentucky	515,000
			714,000
Indiana		Illinois	53,000
		Kentucky	398,000
		Ohio	1,000
			452,000
Kansas		Colorado	667,000
	Missouri	Illinois	2,760,000
	do	Indiana	5,089,000
	Illinois	Iowa	6,973,000
	Nebraska	do	16,000
	do		
	South Dakota		
	Missouri	Michigan	7,167,000
	Illinois		
	Indiana		
	Ohio		
	Nebraska	Minnesota	8,583,000
	Iowa	Missouri	12,776,000
		Nebraska	8,544,000
	Nebraska	do	4,000
	Iowa		
	Missouri	Ohio	42,000
	Illinois		
	Indiana		
		Oklahoma	617,000
	Nebraska	South Dakota	1,040,000
			54,278,000
Kentucky	West Virginia	District of Columbia	5,124,000
	Virginia		
	Maryland		
		Indiana	106,000
	West Virginia	Maryland	4,682,000
	Virginia		
	West Virginia	do	743,000
	Virginia		
	Maryland		
	District of Columbia		
		Ohio	3,297,000
	West Virginia	do	5,009,000
	do	Pennsylvania	17,187,000
	do	Virginia	688,000
	do	do	409,000
	Virginia		
	Maryland		
	District of Columbia		
		West Virginia	15,691,000
			52,936,000
Louisiana	Mississippi	Alabama	30,692,000
		Arkansas	24,975,000
	Mississippi	Florida	2,157,000
	Alabama		
	Mississippi	Georgia	23,188,000
	Alabama		
	Arkansas	Illinois	21,648,000
	Missouri		
		Mississippi	14,972,000
	Arkansas	do	2,378,000
	do	Missouri	12,173,000
	do	do	6,244,000
	Missouri		
	Illinois		
	Arkansas	Tennessee	22,448,000
	Mississippi		
		Texas	34,570,000
	Arkansas	do	1,335,000
			196,780,000

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1941—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Mississippi		Alabama	425,000
	Alabama	Florida	221,000
		Louisiana	350,000
			996,000
Missouri		Illinois	8,000
	Illinois	Indiana	16,000
	do	Michigan	22,000
	Indiana		
	Ohio		
			46,000
Montana		North Dakota	1,741,000
	North Dakota	South Dakota	3,775,000
			5,516,000
New Mexico	Texas	Arizona	18,213,000
	New Mexico	Colorado	206,000
	Texas	Mexico	1,154,000
	New Mexico		
	Arizona		
		Texas	7,483,000
			27,056,000
New York		Canada	27,000
		Pennsylvania	1,958,000
			1,985,000
North Dakota	Montana	South Dakota	47,000
	North Dakota		
Ohio		Indiana	4,000
		West Virginia	96,000
			100,000
Oklahoma		Arkansas	1,464,000
	Kansas	Illinois	88,000
	Missouri		
	Kansas	Indiana	163,000
	Missouri		
	Illinois		
	Kansas	Iowa	1,568,000
	Nebraska		
	Kansas	do	3,000
	Nebraska		
	South Dakota		
		Kansas	20,663,000
	Kansas	Michigan	228,000
	Missouri		
	Illinois		
	Indiana		
	Ohio		
	Kansas	Minnesota	1,926,000
	Nebraska		
	Iowa		
	Kansas	Missouri	8,180,000
	do	Nebraska	1,451,000
	do	do	1,000
	Nebraska		
	Iowa		
	Kansas	Ohio	1,000
	Missouri		
	Illinois		
	Indiana		
	Kansas	South Dakota	234,000
	Nebraska		
		Texas	3,007,000
			38,977,000
Pennsylvania	New York	Canada	94,000
		New York	16,913,000
		Ohio	69,000
	West Virginia	do	450,000
		West Virginia	3,510,000
			21,036,000

Interstate transportation of natural gas in 1941—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Texas	Louisiana, Mississippi	Alabama	906,000
		Arkansas	769,000
	Louisiana	do	4,807,000
	New Mexico	Colorado	25,358,000
	Louisiana, Mississippi, Alabama	Georgia	787,000
	Oklahoma, Kansas, Missouri	Illinois	6,145,000
	Oklahoma, Kansas, Nebraska, Iowa	do	58,593,000
	Oklahoma, Kansas, Missouri, Illinois	Indiana	11,332,000
	Oklahoma, Kansas, Nebraska, Iowa, Illinois	do	12,010,000
	Oklahoma, Kansas, Nebraska	Iowa	16,006,000
	Oklahoma, Kansas, Nebraska, South Dakota	do	23,000
	Oklahoma	Kansas	31,553,000
		Louisiana	10,574,000
		Mexico	6,191,000
	Oklahoma, Kansas, Missouri, Illinois, Indiana, Ohio	Michigan	15,957,000
	Oklahoma, Kansas, Nebraska, Iowa	Minnesota	12,163,000
	Louisiana	Mississippi	191,000
	Oklahoma, Kansas	Missouri	18,615,000
	Oklahoma, Kansas	Nebraska	7,832,000
	Oklahoma, Kansas, Nebraska, Iowa	do	5,000
		New Mexico	1,539,000
	Oklahoma, Kansas, Missouri, Illinois, Indiana	Ohio	95,000
		Oklahoma	13,701,000
	Oklahoma, Kansas, Nebraska, New Mexico, Colorado	South Dakota	1,477,000
		Wyoming	662,000
			257,291,000
Utah		do	216,000
Virginia		Tennessee	37,000
West Virginia		Kentucky	3,126,000
		Maryland	1,162,000
		Ohio	81,599,000
	Kentucky	do	3,930,000
		Pennsylvania	48,337,000
	Maryland	do	227,000
			138,381,000
Wyoming		Colorado	17,000
		Montana	1,768,000
		Nebraska	1,368,000
		Utah	8,515,000
			11,668,000
			815,672,000

PIPE-LINE DEVELOPMENTS

Because of the steel shortage, the construction of gas lines came under strict supervision of the War Production Board. The relatively more urgent need for pipe-line expansion in crude oil led to the conversion of some gas-line mileage to oil lines as part of the several projects supervised by the Petroleum Administration for War. The net gain in gas-line mileage was therefore small—possibly smaller than for any year since before the boom period, 1928–30.

Permission was granted to remove pipe from the Rodessa loop. After reconditioning, part of the line was to be relaid to meet the increased demand in the Dallas-Fort Worth area. In February a 139-mile line was started from the South Arkansas gas fields near Columbia to supply gas to two plants. The gas is sour, and desulfurization plants were built to make it marketable. The fields in Southern Arkansas were also the starting point for an 18-inch line to Little Rock and other communities in the central part of the State.

The Federal Power Commission granted permission for the Border Pipe Line Co. to build a line from the San Salvador fields in Hidalgo County, Tex. Plans for a 772-mile line from the Louisiana and Texas gas fields to Ohio, Pennsylvania, and West Virginia were considered but were still under advisement at the end of the year. The Lone Star Gas Co. started a line from Groesbeck to connect with the 18-inch main line at Buffalo. The Natural Gas Pipe Line Co. of America duplicated its 800-mile line of 24-inch pipe with 26-inch pipe to transport more gas from the Panhandle. A 12-inch line was laid from the Chickasha and Cement gas fields in Oklahoma to an Army cantonment. A 12-inch line between Manchester and Kalamazoo, Mich., was started in September 1942. A permit was granted for a 275-mile trunk line from Ohio to Kalamazoo. The line from the Lirrette gas field in Louisiana to Mobile was put in operation in February 1942 to supplement the line from Jackson.

NATURAL GASOLINE

AND LIQUEFIED PETROLEUM GASES[1]

By G. R. Hopkins and A. T. Coumbe[2]

SUMMARY OUTLINE

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NATURAL GASOLINE

SUMMARY

The natural-gasoline industry experienced a satisfactory year in 1942 in point of volume. The total output of all the light products—natural gasoline, cycle products, and liquefied petroleum gas—reached the record-breaking total of 3,509,814,000 gallons or 3 percent above 1941. However, this showing was due mainly to expanded cycle operations, as the output of natural gasoline alone was 8 percent below 1941.

Prices of natural gasoline were favored by starting the year well above the corresponding levels of 1941, but owing to price ceilings and transportation difficulties the trend in 1942 was generally downward. The average price for 26–70 grade in 1942 was 3.22 cents per gallon compared with 3.70 cents in 1941.

As with production, the trend in stocks in 1942 depends on the products that are considered. Including liquefied petroleum gas, the trend was upward, but for natural gasoline and cycle products there was a decline. In any event, the pronounced draft on stocks that characterized 1941 was not repeated, which was probably another reason for the price weakening.

Participation in the war program was a primary consideration of the industry in 1942. This participation took many forms, depending on products made, size, and location. Probably the most important roles were as suppliers of materials for aviation gasoline and rubber. Of these, aviation gasoline was by far the larger in volume. The liquefied-gas branch of the industry performed admirably in supplying fractions, mainly isobutane and isopentane, for aviation-gasoline manufacture, in addition to assuming added responsibilities for supplying certain war plants with fuels.

[1] Data for 1942 are preliminary; detailed statistics with final revisions will be released later.
[2] Tables compiled by E. M. Seeley, Petroleum Economics Division, Bureau of Mines.

The shortage of materials prevented much expansion in capacity. Losses in manpower were serious but not crippling. Ordinary research slowed, but much was learned as to the use of the light fractions in aviation gasoline and various chemicals, which should reduce the dependence of the industry on ordinary refinery blending in the post-war period.

Salient statistics of the natural-gasoline industry in the United States, 1938–42, in thousands of gallons

	1938	1939	1940	1941	1942 [1]
Production:					
Natural gasoline, Cycle products	2,156,574	2,169,300	2,339,400	2,208,360 / 480,354	2,042,502 / 665,532
Liquefied petroleum gases:					
Isobutane at natural-gasoline and cycle plants	(2)	(2)	(2)	127,932	118,188
Liquefied petroleum gases at natural-gasoline and cycle plants	(2)	(2)	(2)	579,264	683,592
Liquefied refinery gases at refineries	(2)	(2)	(2)	199,038	192,234
Total	2,156,574	2,169,300	2,339,400	3,594,948	3,702,048
Stocks, end of year:					
Natural gasoline, Cycle products	202,860	185,682	239,568	171,276 / 8,274	157,374 / 13,524
Liquefied petroleum gases:					
Liquefied petroleum gases	(2)	(2)	(2)	6,804	23,646
Liquefied refinery gases	(2)	(2)	(2)	5,376	8,946
Total	202,860	185,682	239,568	[3] 179,550 / 191,730	203,490
Demand:					
Used at refineries	1,678,362	1,663,452	1,660,974	2,008,650	2,391,018
Jobbers, retailers, etc.	177,240	171,066	283,290	837,858	415,800
Sales of liquefied petroleum gases and liquefied refinery gases	165,201	223,580	313,456	462,840	[4] 490,854
Exports and losses	267,948	351,960	341,250	345,618	392,616
Total	2,288,751	2,410,058	2,598,970	3,654,966	3,690,288
Value at plants:					
Natural gasoline, Cycle products, Liquefied petroleum gases—thousands of dollars	87,266	90,050	68,261	88,877 / 16,938 / 13,305	78,800 / 23,200 / 19,000
Average per gallon—cents	4.0	4.2	2.9	3.5	3.4
Natural gas treated—millions of cubic feet	2,035,562	2,150,000	2,471,400	2,763,300	[5] 3,000,000
Average yield of natural gasoline per M cubic feet—gallons	1.06	1.01	0.95	0.97	[5] 0.90
Average yield, all light products—do	(2)	(2)	(2)	1.23	[5] 1.17

[1] Subject to revision.
[2] Not available.
[3] For comparison with 1940.
[4] Preliminary total excluding most of the chemical use. See discussion on Liquefied Petroleum Gases at the end of this chapter.
[5] Estimated.

PRICES AND MARKET CONDITIONS

Although most spot prices for natural gasoline opened 1942 well above those for 1941, the decline beginning in February and reaching its lowest level in March brought prices below the 1941 average. The result was that the average for the 26–70 grade in Oklahoma, used as the market indicator, declined from 3.70 cents per gallon in 1941 to 3.22 cents in 1942. However, as the fluctuation in spot prices invariably is more pronounced than changes in the national average, the decline for the national average is estimated at 3.9 cents per gallon in 1941 to 3.8 cents in 1942. As indicated in figure 1, the downward movement in natural gasoline was contrary to the trend in the representative refinery-gasoline price (Oklahoma) used.

However, the divergence in the trends was not enough to justify the feeling that the general relationship between these two prices has been greatly disturbed. The increase in natural-gasoline stocks at plants (see fig. 1) may have had something to do with the lower quotations; likewise, the decline in finished gasoline stocks may have influenced prices upward in spite of price ceilings.

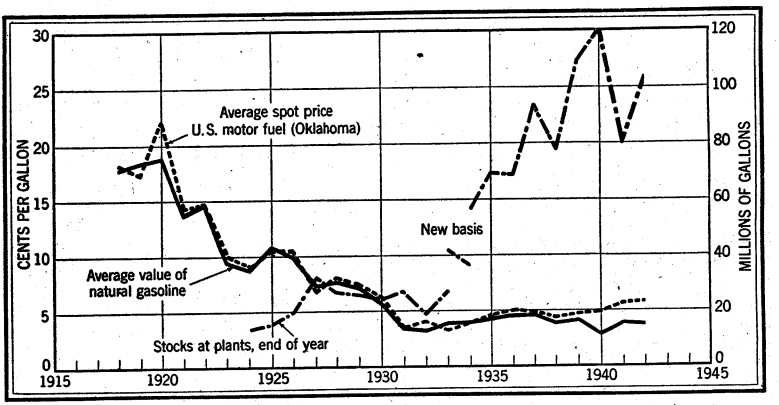

FIGURE 1.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–42.

Prices to blenders of Mid-Continent natural gasoline, grade 26–70, with dates of price changes in 1942 and monthly and yearly average in cents per gallon

[National Petroleum News]

Date	Cents
Jan. 1	5.13
24	4.75–4.88
26	4.75
27	4.50
28	4.25–4.63
29	4.13–4.25
30	4.25
Average	4.94
Feb. 2	4.00–4.50
3	4.00
4	4.00–4.13
5	4.00
7	3.75–4.00
9	3.50–3.63
10	3.50
11	3.38
13	3.25–3.38
14	3 25
16	3.00–3.13
17	2.75–3.13
18	2.75
19	2.25–2.50
20	2.38
21	2.25
24	2.38
25	2.25–2.38
27	2.25
Average	3.09
Mar. 5	2.25–2.38
6	2.25
16	2.25–2.38
17	2.25
23	2.00–2.25
Mar. 24	2.25
25	2.25–2.38
27	2.38
28	2.25–2.38
31	2.25
Average	2.26
Apr. 1	2.38
2	2.25–2.38
3	2.38
6	2.25–2.38
8	2.38
9	2.25–2.38
10	2.38
11	2.25–2.38
13	2.38
15	2.25–2.38
17	2.25
18	2.38
20	2.25–2.38
23	2.38
24	2.25
27	2.25–2.38
29	2.38
Average	2.33
May 4	2.25–2.50
5	2.38
22	2.38–2.50
28	2.38
29	2.38–2.50
Average	2.39
June 1	2.38
June 30	2.50
Average	2.38
July 8	2.50–2.60
9	2.50
10	2.50–2.63
14	2.50
15	2.63
18	2.75
25	2.88
27	2.88–3.00
28	3.00
31	3.13
Average	2.69
Aug. 3	3.13–3.38
4	3.38
6	3.50
13	3.50–3.63
14	3.63
Average	3.54
September: Average	3.63
October: Average	3.63
Nov. 3	3.75
6	3.88
Average	3.85
December: Average	3.88
Average: 1942	3.22
1941	3.70

PRODUCTION

Trends in total output.—The output of natural gasoline and cycle products trended upward in 1942, but crude-oil production decreased (see fig. 2). In relative terms, the gain in natural gasoline and cycle products was 1 percent and the loss in crude oil 1 percent. However, when cycle production, which has no direct relationship to crude-oil operations, is eliminated the curve for natural gasoline alone declines 8 percent. Part of the reason for this large decrease is that an increasing amount of lighter fractions of natural gasoline is being produced as liquefied petroleum gas.

The trend of the total output of light products (natural gasoline, cycle products, and liquefied gas) in 1942 was similar to crude oil in that both were downward from January to April but upward for the next 4 months. From then on the output of light products was upward, but the course for crude oil flattened.

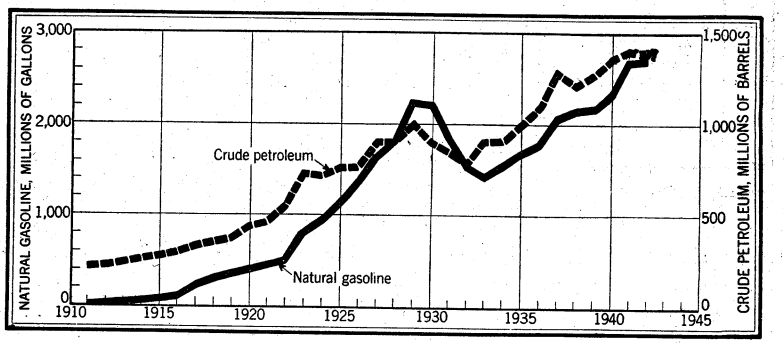

FIGURE 2.—Annual production of natural gasoline and crude petroleum, 1911–42.

Natural gasoline and cycle products produced in the United States, 1938–42, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico
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	32,096	587,476	380	21,499	64,691	9,539	113,741	3,919	2,603	55,713
1941	28,108	577,127	390	54,872	72,876	10,247	201,049	5,670	2,517	69,115
1942 [1]	33,523	545,437	289	66,616	67,834	9,571	247,815	2,312	2,808	71,095

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming [2]	Total		
								Thousands of gallons [3]	Value at plant	
									Thousands of dollars	Average per gallon (cents)
1938	27	7,382	468,499	10,734	685,920	50,398	30,647	2,156,574	87,266	4.0
1939	34	7,445	436,123	11,756	770,047	52,272	31,461	2,169,300	90,050	4.2
1940	17	8,062	399,369	15,371	932,040	58,782	34,102	2,339,400	68,261	2.9
1941	17	8,217	362,247	15,440	1,180,221	65,873	34,728	2,688,714	105,815	3.9
1942 [1]	15	6,311	345,345	15,114	1,188,352	71,922	33,675	2,708,034	[4] 102,000	[4] 3.8

[1] Subject to revision.
[2] Includes Utah in each year.
[3] Includes cycle products as follows—1938: 1,259,000 gallons; 1939: 39,354,000 gallons; 1940: 165,690,000 gallons; 1941: 480,354,000 gallons; 1942: 665,532,000 gallons.
[4] Estimated.

California.—Natural-gasoline production continued to decline in California, as the total of 545,437,000 gallons was 5 percent below 1941. As in 1941, the decline was due to a further drop in the Kettleman Hills field. Output in the old Los Angeles Basin fields continued to hold up exceptionally well, and some of them—like Huntington Beach—made gains.

Monthly production of natural gasoline and allied products in the United States, 1941–42, by fields, in millions of gallons

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1941													
W. New York and W. Pennsylvania	1.6	1.4	1.6	1.3	1.2	0.9	0.9	1.0	1.2	1.4	1.7	1.8	16.0
West Virginia	9.4	8.7	9.2	7.5	7.5	6.9	6.6	6.9	6.9	8.3	9.8	10.3	98.0
Ohio	.8	.7	.8	.7	.6	.5	.5	.5	.7	.9	.7	.8	8.2
Illinois	6.6	6.0	7.0	6.9	7.3	7.3	7.7	8.0	8.0	9.0	9.4	10.0	93.2
Kentucky	3.3	3.1	2.9	2.5	2.7	2.4	2.4	2.7	2.8	3.3	3.5	3.8	35.4
Michigan	.5	.5	.5	.5	.5	.5	.5	.4	.5	.5	.4	.4	5.7
Kansas	8.0	7.7	7.4	6.7	6.5	6.2	6.3	6.4	6.7	7.5	8.0	8.3	85.7
Oklahoma	37.7	34.1	37.5	36.6	37.1	36.4	37.1	38.5	38.8	40.3	39.7	39.6	453.4
Texas:													
Gulf	17.3	16.7	17.8	18.4	19.8	21.2	23.5	24.5	24.8	28.0	28.7	29.7	270.4
East Texas	22.9	21.2	23.3	23.7	25.8	25.1	25.6	26.6	26.1	27.1	26.0	27.0	300.4
Panhandle	35.2	35.1	35.3	35.7	36.5	34.7	35.5	36.5	37.6	39.8	39.8	40.6	442.3
Rest of States	40.1	36.6	40.3	43.3	45.8	44.5	45.7	48.0	48.8	50.1	50.0	52.5	545.7
Total Texas	115.5	109.6	116.7	121.1	127.9	125.5	130.3	135.6	137.3	145.0	144.5	149.8	1,558.8
Arkansas	2.8	2.5	2.8	2.8	2.9	2.8	2.9	2.8	2.8	3.2	3.1	3.0	34.4
Louisiana:													
Gulf	4.1	3.6	4.7	4.7	4.9	4.8	5.5	5.6	5.2	5.9	6.2	6.6	61.8
Inland	8.0	8.1	8.1	7.6	7.0	7.3	17.1	17.4	19.7	20.1	21.9	21.6	163.9
Total Louisiana	12.1	11.7	12.8	12.3	11.9	12.1	22.6	23.0	24.9	26.0	28.1	28.2	225.7
New Mexico	6.1	5.5	6.2	6.6	7.0	7.1	7.3	7.3	7.0	6.8	6.9	7.2	81.0
Montana	.4	.4	.4	.3	.3	.3	.3	.3	.3	.3	.4	.3	4.0
Colorado, Utah, and Wyoming	3.2	2.8	3.0	2.8	3.1	2.8	3.0	3.0	3.0	3.3	3.4	3.3	36.7
California	55.6	50.7	54.1	52.8	55.5	53.9	56.0	56.2	55.5	57.2	55.4	56.8	659.7
Total United States	263.6	245.4	262.9	261.4	272.0	265.6	284.4	292.6	296.4	313.0	315.0	323.6	3,395.9
Daily average	8.5	8.8	8.5	8.7	8.8	8.9	9.2	9.4	9.9	10.1	10.5	10.4	9.3
1942[1]													
W. New York and W. Pennsylvania	1.8	1.7	1.7	1.5	1.0	.8	.7	.8	1.0	1.3	1.5	1.7	15.5
West Virginia	9.6	8.7	8.2	8.6	8.3	6.6	6.6	7.1	7.2	8.5	9.3	10.3	99.0
Ohio	.9	.8	.7	.6	.5	.3	.3	.3	.4	.5	.5	.5	6.3
Illinois	10.9	10.2	11.3	11.1	11.0	11.1	11.6	11.4	11.9	13.4	13.0	13.3	140.2
Kentucky	1.2	1.1	.8	2.8	2.7	2.6	2.5	2.7	2.8	3.2	3.3	3.8	29.5
Michigan	.2	.1	.2	.2	.3	.2	.3	.2	.2	.2	.1	.1	2.3
Kansas	7.6	7.1	7.2	6.0	6.0	5.3	5.6	5.9	6.5	6.8	7.3	7.7	79.0
Oklahoma	37.9	35.1	38.0	34.6	36.5	36.5	36.9	37.8	38.0	39.0	37.6	38.5	446.4
Texas:													
Gulf	35.4	32.8	34.8	25.9	29.2	28.1	29.3	31.4	32.3	33.7	33.9	34.8	381.6
East Texas	26.4	24.1	22.7	16.0	23.1	24.0	23.8	29.9	28.2	28.4	26.1	26.0	298.7
Panhandle	40.3	33.9	36.4	31.7	33.7	33.8	35.3	32.6	33.7	34.5	37.1	40.6	423.6
Rest of Texas	45.8	41.7	43.6	40.7	40.9	38.8	40.2	39.4	38.0	38.5	36.8	38.5	482.9
Total Texas	147.9	132.5	137.5	114.3	126.9	124.7	128.6	133.3	132.2	135.1	133.9	139.9	1,586.8
Arkansas	2.9	2.7	3.5	3.3	3.6	3.6	3.7	3.7	3.7	3.9	3.7	3.6	41.9
Louisiana:													
Gulf	5.5	4.9	5.5	5.2	6.0	5.1	5.9	6.1	6.3	6.6	6.2	7.1	70.4
Inland	22.2	19.6	18.6	14.1	17.3	18.7	18.8	19.6	19.5	20.1	20.0	20.8	229.3
Total Louisiana	27.7	24.5	24.1	19.3	23.3	23.8	24.7	25.7	25.8	26.7	26.2	27.9	299.7
New Mexico	7.1	6.6	7.4	6.7	6.8	6.8	7.6	8.0	7.5	7.5	7.3	7.4	86.7
Montana	.5	.4	.4	.4	.3	.4	.3	.3	.3	.3	.4	.5	4.5
Colorado, Utah, and Wyoming	3.2	2.7	3.1	2.8	2.9	2.7	3.0	3.1	3.0	3.3	3.4	3.4	36.6
California	55.1	50.1	50.7	50.6	52.1	50.0	53.4	54.9	53.4	55.0	53.0	57.1	635.4
Total United States	314.5	284.3	294.8	262.8	282.2	275.4	285.8	295.2	293.9	304.7	300.5	315.7	3,509.8
Daily average	10.1	10.2	9.5	8.8	9.1	9.2	9.2	9.5	9.8	9.8	10.0	10.2	9.6

[1] Subject to revision.

The output of liquefied petroleum gases at natural-gasoline plants in California rose from 82,638,000 gallons in 1941 to 89,973,000 gallons in 1942, a modest gain for this branch of the industry.

Louisiana.—The production of the three light products in Louisiana increased 33 percent in 1942 over 1941. This increase was confined to cycle products (up 87 percent) and liquefied petroleum gases (up 110 percent), as the output of natural gasoline declined 22 percent. Much of the gain was due to the full year's operation of the large cycle plant in the Cotton Valley field.

Oklahoma.—Production in Oklahoma followed the usual trend, that is, with natural gasoline decreasing and liquefied petroleum gases increasing. In this case, however, the gain in gases was less than the loss in natural gasoline; hence the total declined 2 percent. There are no real cycle plants in the State.

Texas.—Production in Texas followed the same trend as in Louisiana, with increases for cycle products, liquefied petroleum gases, and the total but with a decline for natural gasoline. The total set a new record of 1,586,772,000 gallons, or 2 percent more than in 1941. The output of cycle products increased 28 percent and liquefied petroleum gases 5 percent, but natural gasoline declined 13 percent.

Natural gasoline and allied products produced and natural gas treated in the United States in 1941, by States [1]

State	Number of operators [2]	Natural gasoline		Cycle products		Liquefied petroleum gases		Natural gas treated		
		Thousands of gallons	Thousands of dollars	Thousands of gallons	Thousands of dollars	Thousands of gallons	Thousands of dollars	Millions of cu. ft.	Average yield (gallons per M cu. ft.) Natural gasoline (including cycle products)	Average yield (gallons per M cu. ft.) All light products
Arkansas	6	28,108	1,173	--------	--------	6,281	57	19,906	1.41	1.73
California	35	577,127	24,067	--------	--------	82,638	2,082	371,350	1.55	1.78
Colorado	2	390	18	--------	--------	--------	--------	134	2.91	2.91
Illinois	23	54,872	2,693	--------	--------	38,293	1,054	23,732	2.31	3.93
Kansas	9	72,876	2,631	--------	--------	12,815	410	176,088	.41	.49
Kentucky	5	10,247	475	--------	--------	25,124	1,055	38,062	.27	.93
Louisiana	16	117,180	4,025	83,869	2,351	24,675	388	191,194	1.05	1.18
Michigan	2	5,670	261	--------	--------	--------	--------	3,581	1.58	1.58
Montana	1	2,517	177	--------	--------	1,449	81	10,386	.24	.38
New Mexico	6	69,115	2,049	--------	--------	11,885	228	105,161	.66	.77
New York	1	17	1	--------	--------	--------	--------	5	3.40	3.40
Ohio	8	8,217	401	--------	--------	--------	--------	37,546	.22	.22
Oklahoma	47	362,247	16,084	--------	--------	91,136	2,076	200,319	1.81	2.26
Pennsylvania	55	15,440	705	--------	--------	571	42	43,704	.35	.37
Texas	101	783,736	29,479	396,485	14,587	378,598	4,416	1,325,471	.89	1.18
Utah	--------	808	45	--------	--------	--------	--------	--------	--------	--------
West Virginia	20	65,873	2,717	--------	--------	32,171	1,354	195,093	.34	.50
Wyoming	5	33,920	1,876	--------	--------	1,560	62	21,568	1.57	1.65
Total: 1941	284	2,208,360	88,877	480,354	16,938	707,196	13,305	2,763,300	.97	1.23
1940	276	[3] 2,339,400	[3] 68,261	(3)	(3)	(4)	(4)	2,471,400	.95	(4)

[1] Complete figures for 1942 not yet available.
[2] A producer operating in more than one State is counted but once in arriving at total for United States.
[3] Cycle products included under natural gasoline.
[4] Figures not available.

The record of production by the major districts in Texas in 1942 shows the Gulf rapidly forging to the front but East Texas and the Panhandle losing ground, primarily because no cycle plants and little additional fractionating equipment were built outside of the Gulf district and adjoining counties in 1941 and 1942. As a matter of fact, the East Texas field did an outstanding job in holding its 1942 decline to less than 1 percent.

Other States.—Although the majority of this group declined in output in 1942, the total for all increased 9 percent, or from 498,219,000 gallons in 1941 to 541,485,000 gallons in 1942. This gain roughly equaled the rise in output of Illinois, where increased production, particularly of liquefied petroleum gases, continues to expand even though the gross gas output is declining. New Mexico and West Virginia continued to gain, but Kansas showed an unexpected decline.

CONSUMPTION AND MOVEMENTS

The total demand for all light products except liquefied refinery gases increased from 3,455,928,000 gallons in 1941 to 3,501,624,000 gallons in 1942—a rise of 1 to 2 percent. The gain was divided between cycle products and liquefied petroleum gases, as natural gasoline alone declined about 10 percent.

The figures in the distribution table of this chapter indicate a material increase in the refinery utilization of natural gasoline and allied products in 1942; actually, however, there may have been a decline, because the production figures for 1941 were revised upward to include 707,196,000 gallons of liquefied petroleum gas, but the totals for refinery utilization were left unchanged. This threw most of the liquefied petroleum gases in 1941 into "sales to jobbers and retailers." This item consequently declined radically in 1942, when most of the gas was included in the proper category, "used at refineries."

Losses and exports rose from 345,618,000 gallons in 1941 to 392,616,000 gallons in 1942. Although these two figures are not exactly comparable, probably there was an actual increase in this item.

Percentage of natural gasoline and allied products in refinery gasoline in the United States, 1938–42, 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
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	2.0	1.6	4.5	8.0	16.6	4.4	1.7	3.3	4.5	15.7	6.6
1941	2.3	1.9	5.3	6.6	17.6	5.6	3.7	6.1	4.4	16.1	7.1
1942 [1] [2]	1.4	2.1	5.8	6.3	16.0	13.9	15.4	11.6	4.8	16.7	9.7

[1] Subject to revision.
[2] Not comparable with prior years because relatively more liquefied petroleum gas is included.

Distribution of natural gasoline and allied products in the United States, 1941–42, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1941													
Production	263,634	245,406	262,878	261,450	271,950	265,608	284,424	292,572	296,394	312,984	315,042	323,568	3,395,910
Decrease in all stocks	8,988	7,518						8,652	30,996	21,126	13,146	11,844	60,018
	272,622	252,924	262,878	261,450	271,950	265,608	284,424	301,224	327,390	334,110	328,188	335,412	3,455,928
Used at refineries [1]	160,776	139,104	158,508	146,916	142,758	147,756	152,376	173,460	199,542	209,874	189,756	187,824	2,008,650
Sales:													
To jobbers and retailers	72,198	64,134	67,158	58,338	62,286	58,380	69,384	68,418	69,132	75,726	80,472	92,232	837,858
Liquefied petroleum gases for fuel	23,016	20,790	22,176	21,756	20,076	22,092	22,386	20,118	20,622	21,546	23,520	25,704	263,802
Increase in all stocks			840	7,266	14,784	15,918	3,444						
Losses and exports	16,632	28,896	14,196	27,174	32,046	21,462	36,834	39,228	38,094	26,964	34,440	29,652	345,618
	272,622	252,924	262,878	261,450	271,950	265,608	284,424	301,224	327,390	334,110	328,188	335,412	3,455,928
1942 [2]													
Production:													
Natural gasoline	179,928	168,840	173,082	161,490	170,436	162,792	170,478	173,082	173,250	171,276	167,790	170,058	2,042,502
Cycle products	61,362	54,684	59,346	47,754	53,760	52,206	54,600	56,028	54,978	57,078	55,902	57,834	665,532
Liquefied petroleum gases	73,206	60,732	62,412	53,550	57,960	60,438	60,690	66,066	65,688	76,398	76,860	87,780	801,780
Liquefied refinery gases	9,954	10,248	9,660	12,768	21,798	21,042	20,622	18,606	17,010	13,272	17,094	20,160	192,234
Decrease in all stocks						3,570		7,518	13,860	27,762	17,262	14,574	
	324,450	294,504	304,500	275,562	303,954	300,048	306,390	321,300	324,786	345,786	334,908	350,406	3,702,048
Used at refineries [1]	224,742	187,152	185,388	169,932	179,424	185,766	192,234	206,178	214,536	229,110	209,538	207,018	2,391,018
Sales of natural gasoline and cycle condensate to jobbers and retail outlets	14,910	32,382	42,882	37,548	37,842	38,724	35,322	37,716	33,138	31,164	36,540	37,632	415,800
Sales for fuel purposes:													
Liquefied petroleum gases	29,820	24,234	23,352	24,024	20,286	20,916	22,512	21,084	24,318	27,846	28,854	34,944	302,190
Liquefied refinery gases	9,954	9,324	10,038	11,340	19,152	22,470	21,420	18,438	16,212	14,490	16,380	19,446	188,664
Increase in all stocks	15,330	18,018	16,884	19,194	24,696		2,184						11,760
Losses and exports	29,694	23,394	25,956	13,524	22,554	32,172	32,718	37,884	36,582	43,176	43,596	51,366	392,616
	324,450	294,504	304,500	275,562	303,954	300,048	306,390	321,300	324,786	345,786	334,908	350,406	3,702,048

[1] Includes quantities run through pipe lines.
[2] Subject to revision.

Natural gasoline and allied products utilized at refineries in the United States, 1941–42, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1941													
East Coast	8,778	7,518	6,258	5,376	5,418	4,368	5,670	6,090	7,770	7,770	8,568	9,744	83,328
Appalachian	1,428	1,722	1,764	2,142	1,554	1,218	1,596	1,134	1,974	1,848	1,806	2,100	20,286
Indiana, Illinois, Kentucky, etc	24,780	22,680	22,890	24,864	23,184	23,226	25,158	26,208	28,224	30,618	28,350	29,400	309,582
Oklahoma, Kansas, and Missouri	17,976	14,784	15,792	14,070	13,734	12,936	14,154	15,960	20,118	18,606	20,034	19,236	197,400
Texas:													
Gulf Coast	21,924	19,152	25,662	27,174	25,074	29,610	28,812	35,868	46,536	43,932	42,000	46,914	392,658
Inland	32,004	24,990	26,964	23,058	24,234	24,990	24,864	28,056	28,728	32,550	27,090	29,316	326,844
Total Texas	53,928	44,142	52,626	50,232	49,308	54,600	53,676	63,924	75,264	76,482	69,090	76,230	719,502
Louisiana-Arkansas:													
Louisiana Gulf Coast	1,050	798	1,428	1,008	1,344	924	924	3,906	4,284	5,376	5,502	6,174	32,718
Arkansas and Louisiana Inland	2,226	1,890	1,470	1,386	1,134	1,260	1,386	4,578	4,662	5,880	3,696	4,158	33,726
Total Louisiana-Arkansas	3,276	2,688	2,898	2,394	2,478	2,184	2,310	8,484	8,946	11,256	9,198	10,332	66,444
Rocky Mountain	3,780	3,108	2,646	2,184	2,352	2,100	1,638	2,352	2,310	3,150	3,822	3,696	33,138
California	46,830	42,462	53,634	45,654	44,730	47,124	48,174	49,308	54,936	60,144	48,888	37,086	578,970
Total United States	160,776	139,104	158,508	146,916	142,758	147,756	152,376	173,460	199,542	209,874	189,756	187,824	2,008,650
1942 [1]													
East Coast	7,476	5,502	3,360	2,772	1,134	2,100	2,856	3,318	2,856	1,764	2,226	1,218	36,582
Appalachian	2,352	1,764	1,722	1,596	1,554	1,596	2,100	1,344	1,512	1,974	2,268	1,680	21,462
Indiana, Illinois, Kentucky, etc	24,276	22,302	22,344	20,118	23,142	26,754	27,972	31,248	33,264	32,340	27,804	27,006	318,570
Oklahoma, Kansas and Missouri	15,834	15,624	13,818	12,600	12,306	12,642	12,096	12,852	14,952	16,338	17,598	15,372	172,032
Texas:													
Gulf Coast	83,538	54,810	53,298	54,558	56,910	58,422	56,826	67,074	65,688	66,822	63,546	66,066	747,558
Inland	29,022	29,232	21,462	16,296	19,824	18,984	20,706	21,336	21,882	25,536	22,806	18,018	265,104
Total Texas	112,560	84,042	74,760	70,854	76,734	77,406	77,532	88,410	87,570	92,358	86,352	84,084	1,012,662
Louisiana-Arkansas:													
Louisiana Gulf Coast	8,274	8,610	16,002	12,180	9,996	11,760	11,214	8,148	10,668	16,086	13,440	14,700	141,078
Arkansas and Louisiana Inland	4,956	3,150	2,730	2,814	4,116	4,158	6,636	6,090	6,762	6,552	4,956	4,998	57,918
Total Louisiana-Arkansas	13,230	11,760	18,732	14,994	14,112	15,918	17,850	14,238	17,430	22,638	18,396	19,698	198,996
Rocky Mountain	3,948	3,066	2,688	1,764	1,092	1,302	1,680	2,016	2,268	4,200	4,788	4,662	33,474
California	45,066	43,092	47,964	45,234	49,350	48,048	50,148	52,752	54,684	57,498	50,106	53,298	597,240
Total United States	224,742	187,152	185,388	169,932	179,424	185,766	192,234	206,178	214,536	229,110	209,538	207,018	2,391,018

[1] Subject to revision.

Refinery utilization.—The proportion of natural gasoline used at refineries increased from 7.1 percent in 1941 to 9.7 percent in 1942, but here also is a lack of comparability. The figures for most of the districts are comparable; for example, the decline indicated for the East coast and the gain in California undoubtedly occurred.

Direct sales.—Comparable data on "direct sales," or sales to other than refiners, are lacking in 1942. This type of distribution would be expected to increase, as much of the cycle production never reaches a refinery.

STOCKS

Stocks of natural-gasoline and cycle products continued to decline in 1942, although the net change was much less than in 1941. The total, as of December 31, 1942, was 170,898,000 gallons compared with 179,550,000 gallons the first of the year. The decrease of about 9,000,000 gallons comprised a decline of about 14,000,000 gallons in natural gasoline and an increase of about 5,000,000 gallons in cycle products. Stocks of liquefied petroleum gases nearly quadrupled during the year; stocks of liquefied refining gases at refineries increased. Including the two kinds of liquefied gases (petroleum and refinery), stocks increased from 191,730,000 gallons on January 1 to 203,490,000 gallons on December 31.

The downward trend in natural-gasoline stocks in California in 1941 carried over into 1942. As the decline in California exceeded the national total, stocks of natural gasoline east of California increased. Quantitatively most of the increase east of California was at plants in Texas, although several other States had larger relative gains.

Stocks of natural gasoline and allied products in the United States in 1942, by months, in thousands of gallons

Date	Natural gasoline	Cycle products	Liquefied gases		Total
			Petroleum	Refinery	
January 1	171,276	8,274	6,804	5,376	191,730
January 31	179,676	9,408	12,600	5,376	207,060
February 28	193,368	13,062	12,348	6,300	225,078
March 31	206,892	14,826	14,322	5,922	241,962
April 30	228,060	13,020	12,726	7,350	261,156
May 31	245,868	16,128	13,860	9,996	285,852
June 30	244,608	12,474	16,632	8,568	282,282
July 31	246,372	14,868	15,456	7,770	284,466
August 31	235,242	13,692	20,076	7,938	276,948
September 30	216,930	14,826	22,596	8,736	263,088
October 31	192,486	15,036	20,286	7,518	235,326
November 30	173,376	12,390	24,066	8,232	218,064
December 31	157,374	13,524	23,646	8,946	203,490

TECHNOLOGIC DEVELOPMENTS

Cycling plants.—The equipment shortage brought on by the war prevented much expansion of the cycling branch of the industry, but some plants on which construction was started in 1941 were completed and put in operation in 1942. Thus 37 plants were reported as operating in 1942 compared with 30 in 1941 and 24 in 1940. These figures include only bonafide cycling plants and not natural-gasoline plants that repressure.

Cycling plants in Texas processed 425,000,000,000 cubic feet of gas in 1942 and obtained an average yield of 0.92 gallon of liquid per

thousand cubic feet. The plants in Louisiana processed about 42,000,000,000 cubic feet, with a considerably higher yield.

Yields.—The average yield for natural gasoline and cycle products in 1941 was 0.97 gallon per thousand—a slight increase over the 0.95 gallon for 1940. This gain may be attributed principally to an increase in Texas from 0.83 gallon in 1940 to 0.89 gallon in 1941 and in Illinois from 1.69 to 2.31. The gain in yields in Illinois in 1940 and 1941 is typical of the performance of a group of fields that have experienced too rapid withdrawal of crude oil. In nearly all such fields the output of casinghead gas declines rapidly, but its gasoline content increases.

Natural gasoline and allied products produced in the United States in 1941, by States and by methods of manufacture [1]

State	Number of plants operating				Production (thousands of gallons)			
	Compression [2]	Absorption [3] [4]	Charcoal	Cycling [5]	Compression [2]	Absorption [3] [4]	Charcoal	Cycling [5]
Arkansas		9				34,389		
California	2	89			2,225	657,540		
Colorado	1	1			124	266		
Illinois	43	5			1,711	91,454		
Kansas	2	12			1,626	84,065		
Kentucky	3	2	1		1,166	[6] 34,020	185	
Louisiana	3	25		1	2,913	134,356		88,455
Michigan	1	2			1,503	4,167		
Montana		1				3,966		
New Mexico		7				81,000		
New York	1				17			
Ohio	3	8	1		29	6,867	1,321	
Oklahoma	32	81			41,702	411,681		
Pennsylvania	68	11	1		2,036	13,948	27	
Texas	31	118		29	151,909	1,004,301		402,609
Utah						[6] 808		
West Virginia	50	22	3		24,269	70,436	3,339	
Wyoming	3	4			23,920	11,560		
Total: 1941	243	397	6	30	255,150	2,644,824	4,872	491,064
1940	245	407	8	24	[7] 166,482	[7] 2,002,385	4,843	[7] 165,690

[1] Figures for 1942 not yet available.
[2] Includes 22 plants manufacturing liquefied petroleum gases.
[3] Includes combination of absorption process with compression and charcoal processes.
[4] Includes 159 plants manufacturing liquefied petroleum gases.
[5] Includes 8 plants manufacturing liquefied petroleum gases.
[6] Drip gasoline.
[7] Does not include liquefied petroleum gases.

Production by processes.—In previous years cycle plants were classed as compression plants; in consequence, that group increased in relative importance during 1939 and 1940. However, in this year's table on "methods of manufacture" the number of cycle plants and the production are shown separately, by States. The data for 1941 (1942 figures for other than cycle plants are not yet available) indicate that the three old classes (compression, absorption, and charcoal) all declined in number of plants compared with 1940. Compression production probably declined throughout 1942, absorption production probably declined in 1942 after a gain in 1941, and the small output of charcoal plants probably declined in 1942.

Trends in vapor pressures.—During the year the Bureau's monthly questionnaire on natural gasoline was revised, and the queries on vapor pressure of shipments were replaced by items covering a breakdown of production by vapor pressures. Data on the new basis for

east of California for 1942 show an average vapor pressure of 20.5 pounds. This compares with an average of 19.7 pounds for total shipments east of California in 1941.

Technical trends.—Because of the shortage of materials, little in the way of new equipment and methods was introduced in the natural-gasoline industry in 1942. The primary consideration continued to be the maximum use of isobutane, isopentane, and other fractions in the aviation-gasoline program. It has been reported that participation of the industry in aviation-gasoline production will approach 70,000 barrels daily by the end of 1943. The extent to which the rubber and other war programs depend on natural gasoline and allied products for raw materials is probably increasing, but relatively the quantities involved are small.

LIQUEFIED PETROLEUM GASES

Sales of liquefied petroleum gases continued to expand strongly in 1942, as in recent years; however, difficulties connected with the war probably prevented full supplying of the potential market. Distributors of liquefied petroleum gases reported sales of 585,440,000 gallons in 1942—a 27-percent gain over 1941 deliveries of 462,852,000 gallons. The increase in 1942 compares with a 48-percent growth in demand in 1941 and a 40-percent gain in 1940, and it is surprising that dealers troubled by the shifting of supplies to raw material uses, inadequate transportation, lack of sufficient equipment, and other handicaps made the showing reported. The fact that the general public is rapidly learning to appreciate the many advantages and diversified uses of liquefied petroleum gases is evident in the rapidly growing market demand, which has approximately doubled since 1940.

Sales of liquefied petroleum gases in the United States, 1936–42, in thousands of gallons

Year	Butane	Propane	Butane-propane mixtures	Pentane	Total	
					Quantity	Percent of increase over preceding year
1936	40,200	36,502	27,375	2,575	106,652	38.8
1937	45,399	46,474	46,694	2,833	141,400	32.6
1938	52,768	54,130	56,050	2,253	165,201	16.8
1939	71,351	79,323	69,020	3,886	223,580	35.3
1940	77,056	109,216	123,348	3,836	313,456	40.2
1941	112,244	126,969	219,252	4,387	462,852	47.7
1942[1]	128,560	150,511	301,917	4,452	585,440	26.5

[1] Subject to revision.

All principal uses of liquefied petroleum gases made important gains in 1942 over 1941. The quantity (299,559,000 gallons) reported for domestic or household consumption in 1942 was 36 percent above the 1941 total (220,722,000 gallons)—a percentage increase somewhat below those made in 1941 (65 percent) and 1940 (53 percent); however, it must be realized that normal distribution to increasing numbers of consumers was impossible under conditions prevailing in 1942. Gas-manufacturing companies purchased 24 percent more liquefied petroleum gases in 1942 (31,366,000 gallons) than in 1941 (25,255,000 gal-

lons), about the same gain in requirements as was made in 1941 over 1940. A 41-percent expansion in the sales of liquefied petroleum gases for industrial fuel reported in 1941 (98,728,000 gallons) was not reached in 1942 (114,132,000 gallons), as the increase over 1941 was only 16 percent. Difficulty in obtaining the more desirable butane for use as an industrial fuel was probably one of the reasons for the smaller relative growth in this particular use in 1942. Manufacturers of chemicals required 53,038,000 gallons of liquefied petroleum gases in 1942 or 20 percent more than the 1941 total of 44,206,000 gallons—a gain compared with a 28-percent increase in 1941 over 1940. Deliveries of 82,456,000 gallons of liquefied petroleum gases for internal-combustion-engine fuel in 1942 were 23 percent above the 1941 total of 66,871,000 gallons or about the same increment (24 percent) as reported in 1941.

About one-fifth (22 percent) of total liquefied petroleum gas sales in 1942 was reported as butane compared with one-fourth (24 percent) in 1941 deliveries. This drop in the butane proportion in the 1942 total followed a downward trend of recent years and a change that probably will continue as more butane is diverted for the manufacture of motor fuel, rubber, and other products. The propane share in the marketed production of liquefied petroleum gases also continued to decrease (27 percent in 1941 and 26 percent in 1942), while the proportion of butane-propane mixtures in total deliveries accounted for a larger percentage. Butane-propane mixtures replacing butane for many uses constituted about 52 percent of total sales of liquified petroleum gases in 1942 compared with a 47-percent share in 1941. Pentane, which is relatively unimportant in volume, made up less than 1 percent of total requirements both in 1941 and 1942.

Sales of butane increased from 112,244,000 gallons in 1941 to 128,560,000 gallons in 1942—a 15-percent gain. The rate of increase in 1942 was well below the 46-percent expansion for butane deliveries in 1941. The gains for the principal uses of butane were smaller than those reported for 1941, except for the chemical-manufacturing industry, which purchased 5,256,000 gallons of butane in 1942 compared with negligible amounts in previous years. Butane as well as propane is evidently replacing butane-propane mixtures as raw material at chemical plants, as "mixtures" showed a small decline in 1942. Butane delivered for internal-combustion-engine fuel, which increased 67 percent in 1941 over 1940, dropped from 18,799,000 gallons in 1941 to 14,870,000 in 1942, a loss of 21 percent, evidently because of the diversion of butane to war industries.

The marketed production of propane was reported as 150,511,000 gallons in 1942 compared with 126,969,000 gallons in 1941, an increase of 19 percent and a rate slightly above the 16-percent gain realized in 1941. The quantity of propane delivered for domestic use—113,249,000 gallons in 1942—was 16 percent (42-percent gain in 1941 over 1940) above the 1941 total of 98,048,000 gallons. The much lower rate of expansion in 1942 reflects the inability of distributors to fully supply the potential domestic market under disturbed conditions prevailing during the year. Gas-manufacturing companies bought 26 percent less propane (4,957,000 gallons in 1942 and 6,678,000 in 1941) in 1942 but increased their purchases of butane (by 2 percent over 1941) and butane-propane mixtures (119 percent over 1941).

Propane delivered to manufacturing plants rose by 23 percent, from 16,730,000 gallons in 1941 to 20,601,000 in 1942. Industrialists turned to propane for fuel and other uses in 1942 as more of the butane supply was diverted to other channels. This is a change from 1941, when less propane (by 50 percent) was used by manufacturers than in 1940. The requirements for propane by chemical plants increased from 1,528,000 gallons in 1941 to 5,850,000 in 1942, paralleling a similar gain in butane sales to manufacturing chemical firms. The quantity of propane reported as internal-combustion-engine fuel nearly doubled in 1942 (3,112,000 gallons in 1942 compared with 1,631,000 in 1941), replacing butane used as motor fuel, which showed a drop in 1942.

The marketed production of butane-propane mixtures rose from 219,252,000 gallons in 1941 to 301,917,000 gallons in 1942. The 38-percent gain for 1942 was far below the 78 percent expansion in deliveries reported for 1941; however, the percentage increase for butane-propane mixtures in 1942 was still well above the rates reported for the other liquefied gases, as it was in 1941. All principal demands for butane-propane mixtures showed substantial gains in 1942 over 1941, except for a minor decline (2 percent below 1941) in the quantity credited to chemical manufacturers. The domestic use of butane-propane mixtures increased from 87,673,000 gallons in 1941 to 140,516,000 in 1942 or by 60 percent compared with over a 100-percent gain in 1941. Incidentally, the quantity of butane-propane mixtures reported for domestic use in 1942 exceeded for the first time the propane delivered for the same purpose. Sales of butane-propane mixtures to gas-manufacturing companies more than doubled in 1942 (13,961,000 gallons in 1942 compared with 6,368,000 in 1941) contrasted with a minor increase (2 percent over 1941) in butane requirements and a sharp decline (26 percent below 1941) in purchases of propane. The quantity of butane-propane mixtures used as industrial fuel in 1942—43,011,000 gallons—was 22 percent above the 1941 total—35,287,000 gallons. Butane-propane mixtures are important as raw material for the manufacture of chemicals; however, requirements dropped slightly from 39,243,000 gallons in 1941 to 38,325,000 in 1942, in contrast with larger purchases of butane and propane by chemical plants. The demand for butane-propane mixtures for motor fuel—64,470,000 gallons in 1942—was 39 percent above 1941 requirements—46,441,000 gallons. The indications are that butane (21-percent decrease in 1942) for this purpose is being replaced mostly by butane-propane mixtures and less extensively by propane.

Deliveries of pentane increased slightly from 4,387,000 gallons in 1941 to 4,452,000 in 1942. The larger share of this gas is used in the manufacture of chemicals, the quantity increasing from 3,146,000 gallons in 1941 to 3,607,000 in 1942. The sales of pentane for domestic consumption, which rose from 656,000 gallons in 1940 to 1,128,000 in 1941, declined to 766,000 in 1942.

The changing proportions of the various liquefied gases sold to satisfy the principal uses are of special interest. Butane delivered for domestic consumption has remained at about 15 percent of total requirements in recent years, whereas the proportion of propane so used has declined from about 51 percent in 1940 to 38 percent in 1942, and the butane-propane mixtures have gained in about the reversed ratio. Liquefied petroleum gases sold to gas-manufacturing companies in

1940 were over half butane and about a quarter propane; but in 1942 butane-propane mixtures represented the larger share (45 percent), with corresponding losses in the butane and propane percentage totals.

Sales of liquefied petroleum gases in the United States, 1941–42, by uses, methods of transportation, and regional distribution, in thousands of gallons

	Butane	Propane	Butane-propane mixtures	Pentane	Total	
					Quantity	Percent
1941						
By uses:						
Domestic	33,873	98,048	87,673	1,128	220,722	47.7
Gas manufacturing	12,152	6,678	6,368	57	25,255	5.5
Industrial fuel	46,677	16,730	35,287	34	98,728	21.3
Chemical manufacturing	289	1,528	39,243	3,146	44,206	9.6
Internal-combustion-engine fuel	18,799	1,631	46,441	----------	66,871	14.4
All other uses	454	2,354	4,240	22	7,070	1.5
	112,244	126,969	219,252	4,387	462,852	100.0
Percent of total	24.3	27.4	47.4	0.9	100.0	----------
By methods of transportation:						
Bulk [1]	111,896	73,511	216,320	4,171	405,898	87.7
Cylinders [1]	348	53,458	2,932	216	56,954	12.3
	112,244	126,969	219,252	4,387	462,852	100.0
Regional distribution:						
Pacific Coast area	26,628	14,006	62,251	----------	102,885	22.2
All other areas	85,616	112,963	157,001	4,387	359,967	77.8
	112,244	126,969	219,252	4,387	462,852	100.0
1942 [2]						
By uses:						
Domestic	45,028	113,249	140,516	766	299,559	51.2
Gas manufacturing	12,419	4,957	13,961	29	31,366	5.3
Industrial fuel	50,495	20,601	43,011	25	114,132	19.5
Chemical manufacturing	5,256	5,850	38,325	3,607	53,038	9.1
Internal-combustion-engine fuel	14,870	3,112	64,470	4	82,456	14.1
All other uses	492	2,742	1,634	21	4,889	.8
	128,560	150,511	301,917	4,452	585,440	100.0
Percent of total	21.9	25.7	51.6	0.8	100.0	----------
By methods of transportation:						
Bulk	127,492	88,340	297,511	4,161	517,504	88.4
Cylinders and drums	1,068	62,171	4,406	291	67,936	11.6
	128,560	150,511	301,917	4,452	585,440	100.0
Regional distribution:						
Pacific Coast area	10,044	17,803	99,058	----------	126,905	21.7
All other areas	118,516	132,708	202,859	4,452	458,535	78.3
	128,560	150,511	301,917	4,452	585,440	100.0

[1] Revised figures.
[2] Subject to revision.

Industrial fuel was approximately 48 percent butane in 1940 and 1941, but the proportion dropped to 44 percent in 1942, as butane was diverted for raw material. Propane, which comprised 47 percent of the industrial fuel total in 1940, dropped to 17 percent in 1941 and 18 percent in 1942. Butane-propane mixtures rose from 5 percent of the industrial fuel total in 1940 to 36 percent in 1941 and 38 percent in 1942. "Mixtures" used for raw materials in the manufacture of chemicals constituting about 88 percent of the total demand in 1940 and 1941 declined to 72 percent in 1942, and the butane and propane proportions each rose to about 10 percent of the total. Pentane delivered to chemical manufacturers has declined from 9 percent of

total requirements in 1940 to 7 percent in 1942. Butane used for motor fuel increased from 21 percent of the total in 1940 to 28 percent in 1941 but then declined to 18 percent in 1942. Butane-propane mixtures made up 70 percent of the internal-combustion-engine fuel total in 1941 and 78 percent in 1942.

The American Gas Association has furnished the following data concerning the distribution of liquefied petroleum gas by manufactured-gas companies in 1942:

At the end of 1942, liquefied petroleum gas was being delivered through mains to consumers in 208 communities in 31 States by 92 companies supplying 69,140 consumers.

Butane-air gas with heating value ranging from 520 to 1,300 B. t. u. per cu. ft. was supplied to 153 communities in 30 States. A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B. t. u. per cu. ft. was supplied to 15 communities in Arizona, California, and Nevada. Undiluted propane gas with a heating value of 2,550 B. t. u. per cu. ft. was supplied to 40 communities in Maryland, Minnesota, New Jersey, North Dakota, Virginia, and Wisconsin.

Bulk shipments of liquefied petroleum gases increased from 405,898,000 gallons in 1941 to 517,504,000 in 1942, and quantities handled in cylinders were 56,954,000 gallons in 1941 and 67,936,000 in 1942. The trend toward bulk shipments of liquefied petroleum gases, which was rather pronounced in 1941, was also evident in 1942, and over 88 percent of total deliveries were handled in bulk, either in tank cars or trucks. Shortage of material for making containers and the greater ease of handling bulk shipments under present transportation conditions probably will force an even larger proportion of bulk deliveries in the future.

Deliveries of liquefied petroleum gases in the Pacific Coast area (California, Oregon, Washington, Arizona, and Nevada) increased from 102,885,000 gallons in 1941 to 126,905,000 in 1942, a gain of 23 percent. The demand for liquefied petroleum gases on the Pacific coast represented 22 percent of the national total in both 1941 and 1942. The marketed production of liquefied petroleum gases in all other areas expanded by 27 percent—from 359,967,000 gallons in 1941 to 458,535,000 in 1942.

CARBON BLACK

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

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SUMMARY

A number of factors combined to bring about adverse conditions in the carbon-black industry during 1942. Anticipating a rise in price, which occurred in January, consumers replenished their supplies at the end of 1941. Reductions in exports because of the war, as well as in rubber manufacture, contributed to a decrease in demand that was not offset by increased sales for military purposes. Production declined 3 percent from the 1941 total, whereas sales declined 30 percent, resulting in a large accumulation of stocks held by producers at the end of the year. (See fig. 1.)

In spite of the decline in rubber manufacture in 1942, about 89 percent of domestic sales went to the rubber trade. Toward the end of the year demands from the synthetic-rubber industry were taking up part of the slack. All the major classes of consumption decreased

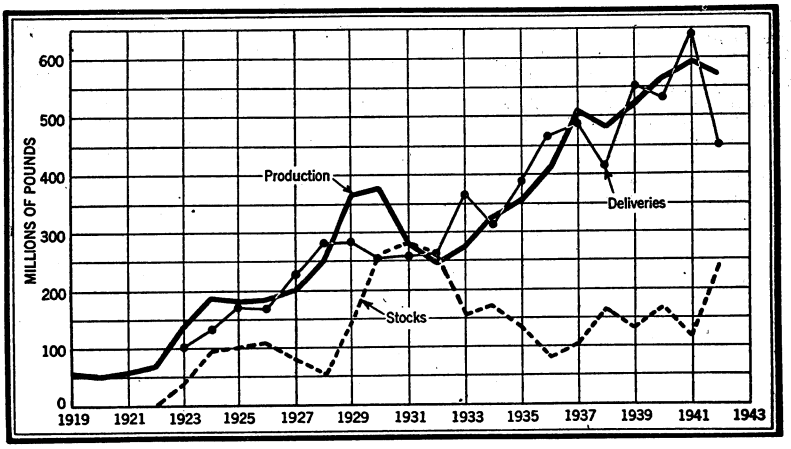

Figure 1.—Production, stocks, and deliveries of carbon black, 1919–42.

quantitatively, but their ratio to total demand remained virtually unchanged.

The Office of Price Administration allowed a rise of 0.2 cent a pound for both compressed and uncompressed grades of carbon black the first week in January. Prices were unchanged during the remainder of the year.

Salient statistics of carbon black produced from natural gas in the United States, 1938–42

	1938	1939	1940	1941	1942
Number of producers reporting	24	22	22	21	21
Number of plants	55	49	51	49	50
Quantity produced:					
By States and districts:					
Louisiana—pounds	39,534,000	51,734,000	55,610,000	78,050,000	90,353,000
Texas:					
Panhandle district—do	382,369,000	410,130,000	423,908,000	415,001,000	380,536,000
Rest of State—do	34,735,000	43,044,000	55,987,000	65,211,000	54,353,000
Total Texas—do	417,104,000	453,174,000	479,895,000	480,212,000	434,889,000
Other States—do	20,401,000	20,258,000	33,287,000	35,803,000	48,764,000
Total United States—do	477,039,000	525,166,000	568,792,000	594,065,000	574,006,000
By processes:					
Contact processes [1]—do	446,241,000	469,150,000	497,026,000	492,857,000	428,665,000
Furnace processes [2]—do	30,798,000	56,016,000	71,766,000	101,208,000	145,341,000
Stocks held by producers Dec. 31—pounds	166,159,000	130,792,000	169,587,000	118,847,000	242,755,000
Losses—do	[3] 65,000	----------	223,000	61,000	167,000
Quantity sold:					
Domestic deliveries—					
To rubber companies—do	217,231,000	316,621,000	310,179,000	439,502,000	295,947,000
To ink companies—do	14,131,000	21,929,000	24,159,000	28,198,000	19,233,000
To paint companies—do	4,229,000	6,382,000	6,806,000	5,840,000	3,616,000
For miscellaneous purposes—pounds	7,883,000	11,773,000	11,012,000	23,039,000	15,500,000
Total domestic deliveries—pounds	243,474,000	356,705,000	352,156,000	496,579,000	334,296,000
Export—do	167,968,000	203,828,000	177,618,000	148,165,000	115,635,000
Total sold—do	411,442,000	560,533,000	529,774,000	644,744,000	449,931,000
Value (at plants) of carbon black produced:					
Total	$11,486,000	$12,857,000	$16,510,000	$19,341,000	$19,547,000
Average per pound—cents	2.41	2.45	2.90	3.26	3.41
Estimated quantity of natural gas used—M cubic feet	324,950,000	347,270,000	368,802,000	365,377,000	335,533,000
Average yield of carbon black per M cubic feet—pounds	1.47	1.51	1.54	1.63	1.71
Average value of natural gas used per M cubic feet—cents	.89	.94	1.00	1.13	1.29

[1] Principally channel.
[2] Includes furnace, thermatomic, and Lewis.
[3] Gain.

Summary of statistics for carbon black produced from natural gas in the United States, 1919–42

Year	Production (thousands of pounds)	Value (thousands of dollars)	Stocks at end of year (thousands of pounds)	Sales (thousands of pounds)		Average yield (pounds per M cubic feet of gas)
				Domestic	Export	
1919	52,057	3,816	(1)	(1)	(2)	1.04
1920	51,322	4,032	(1)	(1)	(2)	1.26
1921	59,766	5,446	(1)	(1)	(2)	1.18
1922	67,795	5,820	2,435	(1)	(2)	1.26
1923	138,263	11,692	38,321	[2] 102,210	(2)	1.27
1924	186,872	11,565	95,671	[2] 128,861	(2)	1.19
1925	177,417	9,640	96,023	132,449	43,183	1.26
1926	180,576	9,939	108,378	128,294	39,211	1.39
1927	198,429	10,955	82,831	168,999	54,431	1.38
1928	248,790	13,782	50,240	202,676	77,903	1.42
1929	366,442	18,720	132,203	191,977	91,829	1.40
1930	379,942	14,852	259,245	167,279	84,260	1.43
1931	280,907	8,621	280,010 [3] 281,667	161,712	96,714	1.44
1932	242,700	6,664	257,998	161,483	100,072	1.44
1933	273,125	7,602	155,969	222,182	152,286	1.44
1934	328,828	11,654	171,799	191,992	120,620	1.43
1935	352,749	13,755	136,086	245,351	142,185	1.46
1936	411,345	16,110	79,582	313,018	154,718	1.45
1937	510,606	17,389	100,497	305,362	184,253	1.50
1938	477,039	11,486	166,159	243,474	167,968	1.47
1939	525,166	12,857	130,792	356,705	203,828	1.51
1940	568,792	16,510	169,587	352,156	177,618	1.54
1941	594,065	19,341	118,847	496,579	148,165	1.63
1942	574,006	19,547	242,755	334,296	115,635	1.71

[1] Figures not available.
[2] Exports not separately reported by the Department of Commerce before 1925.
[3] For comparison with 1932.

PRODUCTION

By States.—Texas produced 76 percent of the United States total output in 1942 compared with 81 percent in 1941 and 84 percent in 1940. Its output was 434,889,000 pounds, a 9-percent decline from the 1941 record. Although the Panhandle district produced 8 percent less carbon black than in 1941, it contributed 87.5 percent of the State total in 1942 compared with 86.4 percent in 1941.

Louisiana gained 16 percent over 1941, owing principally to increased output of furnace blacks. Production was 90,353,000 pounds in 1942 compared with 78,050,000 pounds in 1941.

Oklahoma and Kansas both had less production than in 1941. New Mexico and California were added to the list of producing States during the year.

Methods and yields.—Because of the growing importance of furnace blacks, it has been decided to divide the figures according to contact processes and furnace or retort processes instead of channel and "Other processes" as has been done in former years.

Carbon black produced from natural gas in the United States in 1942, by States and by major producing districts

State and district	Producers reporting [1]	Number of plants	Production			Natural gas used			
			Pounds	Value at plant		M cubic feet	Average yield per M cubic feet (pounds)	Value	
				Total	Average (cents)			Total	Average per M cubic feet (cents)
California	1	1	24,446,000	$512,000	2.09	8,225,000	2.97	$368,000	4.47
Kansas	2	2							
New Mexico	1	1							
Louisiana: Monroe-Richland district (Morehouse and Ouachita Parishes)	6	6	90,353,000	3,258,000	3.61	18,040,000	5.01	504,000	2.79
Oklahoma	4	4	24,318,000	809,000	3.33	9,789,000	2.48	163,000	1.67
Texas:									
Panhandle district (Carson, Gray, Hutchinson, Moore, and Wheeler Counties)	16	29	380,536,000	13,152,000	3.46	269,136,000	1.41	3,073,000	1.14
Rest of State (Aransas, Nueces, Stephens, Ward, and Winkler Counties)	5	7	54,353,000	1,816,000	3.34	30,343,000	1.79	230,000	.76
Total Texas	16	36	434,889,000	14,968,000	3.44	299,479,000	1.45	3,303,000	1.10
Total United States	21	50	574,006,000	19,547,000	3.41	335,533,000	1.71	4,338,000	1.29

[1] In counting the total number of producers reporting, a producer operating in more than 1 State, district, or county is counted but once.

Twenty-five percent of the total output in 1942 was produced by furnace processes, 17 in 1941, 13 in 1940, and 11 in 1939. In October 1942 the War Production Board placed furnace blacks under strict allocation control.

Increased production of these high-yield blacks raised the average yield for the United States to a new peak of 1.71 pounds per thousand cubic feet of gas, compared with 1.63 in 1941 and 1.54 in 1940.

Number and capacity of plants.—One plant was shut down in Stephens County, Tex., in 1942, and one new plant was operated in Lea County, N. Mex., and one in Contra Costa County, Calif.—making a total of 50, compared with 49 in 1941.

The total daily capacity of all plants was 1,808,756 pounds compared with 1,716,395 in 1941, a 5-percent gain. It is estimated that plants operated at 87 percent of capacity compared with 95 percent in 1941.

Producers.—The Shell Chemical Co., with a plant in Contra Costa County, Calif., was added to the list of carbon-black producers during the year; otherwise the list remains unchanged from 1941.

Carbon-black producers of the United States, as of December 31, 1942

State and company	County or parish	Nearest town	Process
California: Shell Chemical Co	Contra Costa	Pittsburg	Furnace.
Kansas:			
Peerless Carbon Black Co	Grant	Ulysses	"Special."
United Carbon Co., Inc	do	Ryus	Roller.
Louisiana:			
Imperial Oil & Gas Products Co	Ouachita	Sterlington	Channel.
Charles Eneu Johnson & Co	Morehouse	Bastrop	Do.
Peerless Carbon Black Co	Ouachita	Bourland	"Special."
Southern Carbon Co	do	Hancock	Lewis.
Thermatomic Carbon Co	do	Sterlington	Thermatomic.
United Carbon Co	do	Swartz	Channel.
New Mexico: Columbian Carbon Co	Lea	Eunice	Do.
Oklahoma:			
Cabot Carbon Co	Seminole	Wewoka	Do.
General Atlas Carbon Division of General Properties Co., Inc.	Texas	Guymon	Furnace.
Charles Eneu Johnson & Co	Pontotoc	Stonewall	Channel.
United Carbon Co	Beckham	Sayre	Do.
Texas:			
Cabot Carbon Co	Carson	Skellytown	Roller and channel.
	Gray	Pampa	Channel.
	Hutchinson	Stinnett	Do.
	Ward	Monahans	Do.
	Winkler	Kermit	Do.
Carbon Blacks, Inc	Gray	Pampa	Roller.
Coltexo Corporation	do	Lefors	Channel.
Columbian Carbon Co	Carson [1]	(1)	(1).
	Gray	Kings Mill	Channel.
	do	Lefors	Do.
	Hutchinson	Borger (2 plants [1])	Do.
	Moore	Sunray	Do.
	Nueces	Corpus Christi	Do.
	Wheeler	Lela	Do.
Columbian-Phillips Co	Moore	Sunray	Do.
Combined Carbon Co	Hutchinson	Sanford	Do.
Continental Carbon Co	Moore	Sunray	Do.
Crescent Carbon Co	Hutchinson	Borger	Do.
Crown Carbon Co	Moore	Sunray	Do.
General Atlas Carbon Division of General Properties Co., Inc.	Gray	Pampa	Furnace.
J. M. Huber Corporation	Hutchinson	Borger	Channel.
Moore County Carbon Co	Moore	Sunray	Do.
Panhandle Carbon Co	Hutchinson	Borger	Do.
Peerless Carbon Black Co	Gray	Pampa	"Special."
Texas Elf Carbon Co	do	do	Channel.
	Stephens	Eliasville	Do.
United Carbon Co	Aransas	Aransas Pass	Do.
	do	do	Furnace.
	Hutchinson	Borger (3 plants)	Channel.
	do	Sanford (2 plants)	Do.
	do	Stinnett	Do.
	Moore	Sunray (2 plants)	Do.

[1] Plant, located in both Carson and Hutchinson Counties, counted in Hutchinson County.

DEMAND

Total deliveries.—Carbon-black deliveries reported by producers were 449,931,000 pounds during 1942 compared with 644,744,000 pounds in 1941. There was a sharp decline both in exports and in all major classes of domestic sales. (See fig. 2.)

Domestic consumption.—Domestic deliveries totaled 334,296,000 pounds in 1942 compared with 496,579,000 pounds in 1941, a 33-percent decline. Sales to the major classes of consumers were: Rubber companies, 295,947,000 pounds (88 percent); ink companies, 19,233,000 pounds (6 percent); paint companies, 3,616,000 pounds (1 percent); and miscellaneous, 15,500,000 pounds (5 percent). These quantities are in virtually the same ratio to total sales as in 1941.

The curtailment in the rubber industry caused a 33-percent decline in movements to rubber companies. Trade was light up to the middle of the year, when there was a slight improvement. Toward the end of the year deliveries to synthetic rubber manufacturers strengthened the market.

Before the war, when supplies of natural rubber were ample, channel blacks dominated the rubber markets at the expense of furnace blacks. The finer-grained, harder channel blacks were superior in abrasive resistance, which gave them a decided advantage in the manufacture of the average automobile tire, which, in normal times, constitutes the most

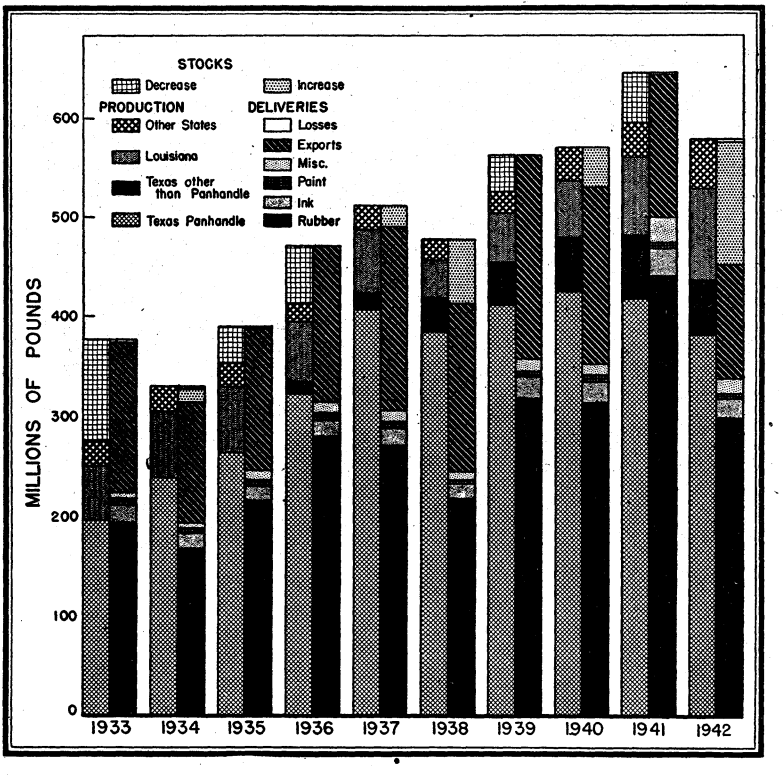

FIGURE 2.—Production and consumption of carbon black, 1933-42. Production in "Texas other than Panhandle" included in "Other States," 1933-35.

important part of the carbon-black market. The only reason furnace blacks survived this competition was their relatively high yield.

When most of the sources of natural rubber were cut off and the synthetic rubber program was projected, the picture changed radically. Most grades of synthetic rubber have higher heat generation and lower tensile strength than natural rubber. Both of these general characteristics call for the use of large amounts of the softer, coarser-grained blacks, which explains why the present trend in construction is toward furnace-type blacks and away from channel blacks.

Sales to ink companies amounted to 19,233,000 pounds in 1942 compared with 28,198,000 in 1941. As the quantity of newsprint available for consumption in 1942 was only 3 or 4 percent below 1941, it is apparent from the sales figures that the ink companies did considerable stocking in 1941.

The paint trade was affected by the curtailment in automobile manufacture and the consequent declines in the use of black paints and enamels. Paint companies purchased 3,616,000 pounds of carbon black in 1942, a 38-percent decline from the 1941 figure (5,840,000 pounds).

Deliveries for miscellaneous purposes totaled 15,500,000 pounds in 1942, a 33-percent decline from the 1941 record of 23,039,000 pounds.

Exports and imports.[1]—Exports of carbon black in 1942 continued the decline started in 1940, when the war began to impair foreign trade. A total of 115,635,000 pounds was purchased by foreign countries during the year, a 22-percent decrease from the 148,165,000 pounds purchased in 1941 and a 43-percent decrease from the peak of 203,828,000 pounds recorded in 1939. The total value was $5,229,000 in 1942 and $6,686,000 in 1941, an average of 4.52 and 4.51 cents per pound, respectively. The average for the year 1940 was 4.40 cents.

The United Kingdom continued to be the leading customer, purchasing 58,223,000 pounds (39 percent of the total) in 1941 and 53,297,000 pounds (46 percent of the total) in 1942. Canada ranked second, with 32,760,000 pounds purchased in 1941 and 29,651,000 in 1942.

September was the month of heaviest shipments in 1941 and June in 1942. Galveston, which has been the main shipping point for a number of years, dropped from 115,042,000 pounds exported in 1940 to 61,132,000 in 1941 and to 22,914,000 in 1942. Michigan took first place in 1942 with 29,085,000 pounds shipped out.

Carbon black exported from the United States, 1941–42, by months and customs districts

Month	1941		1942		Customs district	1941		1942	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
Jan.	9,800,208	$454,687	14,843,817	$696,441	Buffalo	145,057	$12,280	241,126	$10,872
Feb.	9,092,813	384,618	13,440,092	618,850	Dakota	28,217	1,557	248,360	9,123
Mar.	12,183,017	538,411	6,172,113	255,541	El Paso	2,077,820	80,550	1,885,776	79,243
Apr.	11,038,325	508,468	8,179,205	391,223	Galveston	61,131,615	2,982,173	22,913,733	1,081,536
May	15,028,478	683,493	4,998,974	224,609	Los Angeles	362,540	14,261	2,725,617	38,798
June	7,100,275	298,292	15,789,105	767,683	Michigan	32,286,372	1,091,563	29,084,820	1,045,644
July	14,863,785	670,866	5,144,342	215,649	New Orleans	28,625,209	1,386,931	14,742,059	786,987
Aug.	11,157,609	503,884	11,252,102	537,347	New York	3,001,380	170,394	16,849,264	863,151
Sept.	22,470,331	1,061,790	9,598,078	436,866	Sabine	11,100	616	----------	----------
Oct.	12,119,912	545,162	4,919,614	212,930	San Francisco	3,886,600	166,578	5,341,767	268,930
Nov.	10,808,292	449,696	12,184,594	463,865	Vermont	124,486	5,031	26,314	2,236
Dec.	12,502,252	586,945	9,113,121	408,140	Other districts	16,484,901	774,378	21,576,321	1,042,624
	148,165,297	6,686,312	115,635,157	5,229,144		148,165,297	6,686,312	115,635,157	5,229,144

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

Carbon black exported from the United States, 1940–42, by countries

Country	1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	3,005,361	$150,558	5,828,519	$287,870	3,215,276	$161,503
Australia	7,264,539	327,434	12,201,171	563,104	7,833,813	405,850
Belgium	1,251,212	66,172				
Brazil	2,181,849	99,911	6,235,139	285,204	2,626,163	131,840
Canada	19,622,401	592,885	32,760,178	1,118,151	29,650,763	1,070,714
China	1,860,072	90,133	486,667	24,126		
France	24,397,155	1,122,773				
India and Dependencies [1]	3,825,436	182,939	6,768,852	305,699	7,648,607	354,672
Italy	4,547,708	204,375				
Japan	17,662,686	785,760	2,274,000	98,447		
Mexico	1,826,648	67,187	2,250,143	93,742	4,841,480	133,163
Netherlands	1,114,599	57,919				
Netherlands Indies	1,463,111	78,327	2,780,458	129,017	756,075	44,458
Norway	538,454	24,138				
Portugal	1,645,097	74,474	140,762	8,767	84,997	5,547
Spain	483,770	22,243	818,500	37,451	565,150	28,047
Sweden	1,281,550	59,882	345,550	17,440	265,275	17,486
Union of South Africa	4,025,531	182,900	7,668,759	345,536	2,618,460	126,396
United Kingdom [2]	77,308,549	3,503,191	58,223,076	2,889,741	53,296,513	2,608,449
Other countries	2,312,139	130,619	9,383,523	482,017	2,232,585	141,019
	177,617,867	7,823,820	148,165,297	6,686,312	115,635,157	5,229,144

[1] British India.
[2] United Kingdom of Great Britain and Northern Ireland.

Imports of "gas black and carbon black" rose from 800 pounds valued at $101 in 1941 to 77,870 pounds valued at $7,307 in 1942. Acetylene black imported from Canada declined from 4,063,000 pounds valued at $430,000 in 1941 to 3,840,000 pounds valued at $381,000 in 1942.

STOCKS

Stocks at the end of the year more than doubled the 118,847,000 pounds reported on hand December 31, 1941. A 3-percent decrease in production and a 30-percent decrease in sales caused supplies to accumulate until they totaled 242,755,000 pounds by the end of 1942. This was the highest year-end total since 1932, when 257,998,000 pounds were reported.

PRICES AND VALUES

The average value of carbon black at the plants in 1942 was 3.41 cents, a gain of 0.15 cent over 1941. Prices remained unchanged during the year, except for a small advance during the first week of January. This rise (0.2 cent) brought the quotation for regular, uncompressed black, in bags at the plants, to 3.625 cents a pound.

ASPHALT AND RELATED BITUMENS

By A. H. Redfield [1]

SUMMARY OUTLINE

	Page		Page
Summary	1185	Manufactured or petroleum asphalt	1186
Native asphalts and bitumens	1185	Production	1186
Bituminous rock	1185	Stocks	1187
Gilsonite and wurtzilite	1185	Sales	1187
Sulfonated bitumen	1185	Foreign trade	1190
Exports	1185	Distribution by rail	1190
		Road oil	1192

SUMMARY

Refinery sales of petroleum asphalt (exclusive of road oil) to domestic consumers in the United States were 10 percent larger in tonnage in 1942 than in 1941; and, because of higher prices, they were 17 percent larger in value. As the refinery output was 4 percent less than in 1941 and imports were 22.5 percent lower, inventories at the refineries were reduced nearly one-third, and more of the other petroleum products were transferred to the asphalt account. Exports in 1942 were only 38 percent as large as those in 1941.

As in 1941, the tonnage of bituminous rock sold increased more proportionally—43 percent—than did the total tonnage of solid and liquid asphalt sold for paving purposes—10 percent. Although the comparatively low valued products of Texas and Oklahoma supplied the greater increases in sales of bituminous rock, the total value of bituminous rock sold increased 46 percent, and the average value per short ton was 2 percent higher.

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—Sales of rock asphalt by producers in the United States increased 43 percent in quantity—from 654,692 short tons in 1941 to 935,295 tons in 1942—and 46 percent in value—from $2,312,227 to $3,367,279. Prices were higher than in 1941, and the average sales value at the mine increased from $3.53 to $3.60 per ton.

Texas and Oklahoma operators increased their sales from 446,432 tons valued at $1,197,319 in 1941 to 699,572 tons valued at $2,018,822 in 1942. Sales were larger also in California and in Missouri. East of the Mississippi River, producers in Kentucky and Alabama enlarged their sales from 193,887 tons valued at $1,047,529 in 1941 to 207,324 tons valued at $1,228,748 in 1942.

Gilsonite and wurtzilite.—Increased demand in the domestic market raised producers' sales of gilsonite in Utah from 36,407 tons valued at $851,623 in 1941 to 40,041 tons valued at $909,311 in 1942. The average sales price per ton at the mine or railhead decreased from $23.39 to $22.71.

Sales of wurtzilite from Utah decreased from 69 tons valued at $5,343 in 1941 to 37 tons valued at $2,852 in 1942.

Sulfonated bitumen.—Sales of natural sulfonated bitumen from Box Elder County, Utah, were considerably larger in 1942 than in 1941.

Exports.—Exports of natural unmanufactured asphalt amounted to 10,865 short tons valued at $328,660 in 1941 and to 8,941 tons valued at $231,772 in 1942. Increased sales to Canada, Australia,

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

and the United Kingdom did not compensate for decreased exports to Brazil and complete cessation of shipments to Japan and to China.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Production of asphalt by petroleum refineries in the United States decreased 4 percent from 1941. In the East Coast district output decreased 62 percent, because wartime difficulties of transport reduced the total runs of crude petroleum by 26 percent, and higher proportions of the reduced runs were made into residual and distillate fuel oil. Slightly less asphalt was made in refineries of the Indiana-Illinois-Kentucky-etc. district also than in 1941. On the other hand, increased production of asphalt in the other refining districts almost offset the sharp decrease in the East Coast district. The most marked increase in asphalt tonnage was in California, where 50 percent more asphalt was made in 1942 than in 1941.

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1942, by districts, in short tons

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, losses, and exports	Sales to domestic consumers
			Dec. 31, 1941	Dec. 31, 1942		
East Coast	817,200	120,500	120,000	50,000	24,900	982,800
Appalachian	339,300	700	13,000	26,400	10,700	315,900
Indiana, Illinois, Kentucky, etc.	1,322,400	158,700	171,000	96,700	347,600	1,207,800
Oklahoma, Kansas, and Missouri	526,700	97,300	94,000	39,600	39,800	638,600
Texas:						
Gulf Coast	497,600		23,000	23,800	85,800	411,000
Inland	388,300		15,000	20,200	20,300	362,800
Total Texas	885,900		38,000	44,000	106,100	773,800
Louisiana-Arkansas:						
Louisiana Gulf Coast	519,800	32,700	47,000	38,000	25,400	536,100
Arkansas and Louisiana Inland	370,100	25,800	22,000	22,000	2,500	393,400
Total Louisiana-Arkansas	889,900	58,500	69,000	60,000	27,900	929,500
Rocky Mountain	178,900	181,000	27,000	18,500	3,500	364,900
California	1,336,200	434,200	72,000	75,800	139,100	1,627,500
Total United States:						
1942	6,296,500	1,050,900	604,000	411,000	699,600	6,840,800
1941	6,557,600	653,100	614,000	604,000	992,000	6,228,700

Sales of asphalt (exclusive of road oil) at petroleum refineries to domestic consumers in the United States, 1941–42, by districts

District	1941		1942	
	Short tons	Value	Short tons	Value
East Coast	2,165,783	$24,799,304	982,821	$13,117,302
Appalachian	249,362	3,071,753	315,883	4,243,253
Indiana, Illinois, Kentucky, etc.	1,026,016	10,506,007	1,207,744	13,334,239
Oklahoma, Kansas, and Missouri	620,166	4,373,066	638,618	5,296,640
Texas:				
Gulf Coast	196,015	1,773,130	411,042	4,455,867
Inland	336,022	2,948,610	362,809	3,531,567
Total Texas	532,037	4,721,740	773,851	7,987,434
Louisiana-Arkansas:				
Louisiana Gulf Coast	363,885	3,496,201	536,107	6,109,670
Arkansas and Louisiana Inland	315,116	2,210,082	393,404	3,202,112
Total Louisiana-Arkansas	679,001	5,706,283	929,511	9,311,782
Rocky Mountain	161,200	1,492,574	364,900	3,589,734
California	795,158	5,842,416	1,627,453	13,934,917
Total United States	6,228,723	60,513,143	6,840,781	70,815,301

Stocks.—The heaviest relative drafts on stocks were at East Coast refineries. Stocks were reduced also during 1942 in the Indiana-Illinois-Kentucky-etc., the Oklahoma-Kansas-Missouri, the Louisiana Gulf Coast, and the Rocky Mountain districts. On the other hand, more asphalt was in storage at the end of 1942 in the Appalachian district in Texas, and in California.

Sales.—Sales of petroleum asphalt by refineries to domestic consumers in the United States increased 10 percent in quantity and 17 percent in value from 1941 to 1942; the average value at the refinery increased from $9.72 per short ton to $10.35.

Of the total sold, 7 percent was manufactured from foreign petroleum (imported chiefly from Venezuela and Mexico) in 1942, compared with 25 percent in 1941. Although runs of foreign crude oil to stills decreased 71 percent, sales of petroleum asphalt from this source decreased only 68 percent. Of the foreign crude processed, 17 percent was converted into asphalt in 1941 and 21 percent in 1942. East Coast refineries sold 88 percent of the total asphalt made from foreign crude in 1942 compared with 97 percent in 1941.

Highway and street construction and airport-runway surfacing used (in the form of paving asphalt, paving flux, cut-back asphalts, and asphalt emulsions) 64 percent of the total asphalt sold to domestic consumers by petroleum refineries in 1942 as in 1941. Street and road contracts exceeding $25,000, compiled by Engineering News-Record, show a decrease of 9 percent in value—from $582.8 million in 1941 to $530.5 million in 1942—and of 14 percent in indicated volume if the values are adjusted by the Engineering News-Record index of construction costs. Contracts awarded in New England and 5 Middle Atlantic States decreased sharply and were considerably lower in 14 States lying west of Mississippi River and east of the Rocky Mountains. On the other hand, more roadway was contracted for in 10 Southeastern States and Louisiana in 1942 than in 1941; and in 7 Far Western States a sharp increase in highway contracts occurred.

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1942, 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:						
Asphalt for—						
Paving	1,969,676	$19,458,316	163,538	$2,114,510	2,133,214	$21,572,826
Roofing	1,176,715	11,917,708	123,453	1,600,525	1,300,168	13,518,233
Waterproofing	85,503	1,078,263	7,922	123,931	93,425	1,202,194
Blending with rubber	14,877	238,376	7,386	120,401	22,263	358,777
Briquetting	97,812	964,383			97,812	964,383
Mastic and mastic cake	6,997	93,317	5,185	72,590	12,182	165,907
Pipe coatings	15,337	233,921	598	9,460	15,935	243,381
Molding compounds	32,949	447,535	3,179	44,453	36,128	491,988
Miscellaneous uses	184,454	2,067,264	29,586	447,573	214,040	2,514,837
	3,584,320	36,499,083	340,847	4,533,443	3,925,167	41,032,526

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1942, by varieties—Continued

[Value f. o. b. refinery]

Variety	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Semisolid and liquid products of more than 200 penetration:						
Flux for—						
Paving	326,705	$2,344,655	17,713	$235,756	344,418	$2,580,411
Roofing	533,443	4,108,916	35,847	451,723	569,290	4,560,639
Waterproofing	21,892	156,914	431	5,603	22,323	162,517
Mastic	4,050	37,229			4,050	37,229
Cut-back asphalts:						
Rapid-curing	689,319	7,639,637	53,593	822,350	742,912	8,461,987
Medium-curing	998,811	11,033,843	47,247	617,486	1,046,058	11,651,329
Emulsified asphalts and fluxes	117,803	1,458,862	842	22,790	118,645	1,481,652
Paints, enamels, japans, and lacquers	35,702	644,768	6,576	112,491	42,278	757,259
Other liquid products	25,625	89,602	15	150	25,640	89,752
	2,753,350	27,514,426	162,264	2,268,349	2,915,614	29,782,775
Total:						
1942	6,337,670	64,013,509	503,111	6,801,792	6,840,781	70,815,301
1941	4,676,218	42,408,215	1,552,505	18,104,928	6,228,723	60,513,143

Paving asphalt sold at petroleum refineries to domestic consumers in the United States, 1941–42, by districts, in short tons

District	1941	1942
East Coast	779,923	292,884
Appalachian	66,940	67,234
Indiana, Illinois, Kentucky, etc.	178,549	254,467
Oklahoma, Kansas, and Missouri	36,526	92,987
Texas:		
Gulf Coast	45,575	118,372
Inland	64,361	144,847
Total Texas	109,936	263,219
Louisiana-Arkansas:		
Louisiana Gulf Coast	145,953	192,041
Arkansas and Louisiana Inland	143,562	163,591
Total Louisiana-Arkansas	289,515	355,632
Rocky Mountain	26,773	112,177
California	276,059	694,614
Total United States	1,764,221	2,133,214

Nevertheless, sales of paving asphalt, used for high-type surfacing, increased 21 percent over 1941. The East Coast district was the only exception to the general increase. Government purchases rather than private contracts apparently caused these increases.

A marked drop in sales of cut-back asphalts by East Coast refineries was the principal factor in the 6-percent decline in total sales of these products. Sales of cut-backs were more than one-third less than in 1941 in the Oklahoma-Kansas-Missouri district also. In other refining districts sales of cut-back asphalts increased markedly, indicating an increase in light highway construction, except on the East coast and in central United States.

Cut-back asphalts sold at petroleum refineries to domestic consumers in the United States, 1941–42, by districts, in short tons

District	1941	1942
East Coast	576,779	118,371
Appalachian	46,526	57,023
Indiana, Illinois, Kentucky, etc	280,437	311,618
Oklahoma, Kansas, and Missouri	323,115	205,506
Texas:		
Gulf Coast	75,305	128,579
Inland	65,753	77,695
Total Texas	141,058	206,274
Louisiana-Arkansas:		
Louisiana Gulf Coast	143,544	172,716
Arkansas and Louisiana Inland	48,507	51,965
Total Louisiana-Arkansas	192,051	224,681
Rocky Mountain	114,739	225,890
California	228,427	439,557
Total United States	1,903,132	1,788,970

More emulsified asphalts were sold in 1942 than in 1941. Petroleum refineries sold 129,006 short tons (30,396,265 gallons) valued at $1,576,840 in 1941 and 118,645 tons (27,955,076 gallons) valued at $1,481,652 in 1942; in addition, 76,830,549 gallons valued at $6,919,102 in 1941 and 86,973,381 gallons valued at $8,996,057 in 1942 were sold by major industrial companies that purchased asphalt from petroleum refineries. Accordingly, total known sales of emulsified asphalts and fluxes increased 7 percent in quantity—from 107,226,814 gallons to 114,928,457 gallons—and 23 percent in value—from $8,495,942 to $10,477,709.

Roofing manufacture made the second-largest demand for asphalt, absorbing 27 percent of the total sales to domestic consumers in both 1941 and 1942. Although shipments of prepared roofing and asphalt siding reported to the Bureau of the Census increased 26 percent—from 44,275,100 squares (revised figure) in 1941 to 55,967,441 squares in 1942—domestic sales of roofing asphalt and roofing flux combined increased only 12 percent—from 1,671,696 to 1,869,458 tons.

Roofing asphalt and flux sold at petroleum refineries to domestic consumers in the United States, 1941–42, by districts, in short tons

District	1941	1942
East Coast	513,927	402,561
Appalachian	120,515	164,003
Indiana, Illinois, Kentucky, etc	430,365	480,430
Oklahoma, Kansas, and Missouri	136,196	217,178
Texas:		
Gulf Coast	35,603	106,210
Inland	79,652	90,183
Total Texas	115,255	196,393
Louisiana-Arkansas:		
Gulf Coast	32,757	62,981
Arkansas and Louisiana Inland	116,142	64,987
Total Louisiana-Arkansas	148,899	127,968
Rocky Mountain	3,789	3,849
California	202,750	277,076
Total United States	1,671,696	1,869,458

FOREIGN TRADE

Imports.—Imports of natural asphalt and bitumen into the United States in 1942 totaled 7,961 short tons valued at $136,054 compared with 13,543 tons valued at $182,723 in 1941. Imports of lake asphalt from Trinidad decreased from 8,593 tons valued at $93,708 in 1941 to 6,122 tons valued at $79,817 in 1942, and imports of grahamite from Cuba decreased from 4,682 tons valued at $83,859 to 1,351 tons valued at $24,741.

Imports of solid petroleum asphalt increased slightly—from 66,352 tons valued at $243,306 in 1941 to 68,638 tons valued at $309,140 in 1942. All the 1941 imports and 66,505 tons (valued at $282,395) of those in 1942 came from Netherlands West Indies.

In addition, 434,839 barrels (79,062 tons) valued at $243,306 of liquid petroleum asphalt, including cut-backs and road oil, were imported in 1941 and 255,934 barrels (46,533 tons) valued at $370,606 in 1942. Mexico supplied all the imports in 1941 and 255,418 barrels (46,439 tons) valued at $369,088 of those in 1942.

Exports.—War blockades and the disruption of normal ocean traffic caused exports of petroleum asphalt from the United States to drop from 224,798 short tons valued at $3,689,502 in 1941 to 85,205 tons valued at $1,645,353 in 1942. The only exceptions to the general decline were in points of special war activity of the United States, such as Panama Canal Zone, Gold Coast, and Nigeria.

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I and class II railroads within the United States decreased from 6,879,488 tons in 1941 to 6,152,459 tons in 1942, according to freight-commodity statistics compiled by the Interstate Commerce Commission. Increased deliveries in the Pacific, Mountain, and West South Central States failed to offset smaller deliveries east of Mississippi River and in the West North Central States.

Asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States, 1941–42, by States, in short tons

State and group	1941	1942
New England	297,920	156,180
Middle Atlantic:		
New York	313,212	164,041
New Jersey	137,882	101,450
Pennsylvania	718,705	397,167
Total Middle Atlantic	1,169,799	662,658
East North Central:		
Ohio	1,235,174	1,105,741
Indiana	358,333	288,242
Illinois	618,655	507,244
Michigan	203,626	128,353
Wisconsin	202,320	138,230
Total East North Central	2,618,108	2,167,810
West North Central:		
Minnesota	117,399	86,507
Iowa	43,921	35,297
Missouri	127,455	88,515
North Dakota	29,276	22,964
South Dakota	33,386	51,363
Nebraska	50,791	45,907
Kansas	71,978	55,652
Total West North Central	474,206	386,205

Asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States, 1941–42, by States, in short tons—Continued

State and group	1941	1942
South Atlantic:		
Delaware	18,739	18,838
Maryland	34,079	26,347
District of Columbia	9,898	6,383
Virginia	136,696	71,888
West Virginia	80,991	57,050
North Carolina	126,818	77,187
South Carolina	57,747	38,059
Georgia	87,806	84,144
Florida	106,235	128,330
Total South Atlantic	659,009	508,226
East South Central:		
Kentucky	95,341	62,520
Tennessee	102,144	85,578
Alabama	70,578	80,326
Mississippi	57,516	68,424
Total East South Central	325,579	296,848
West South Central:		
Arkansas	27,308	52,209
Louisiana	117,236	121,935
Oklahoma	28,983	20,146
Texas	189,128	245,563
Total West South Central	362,655	439,853
Mountain:		
Montana	12,612	71,592
Idaho	29,137	37,459
Wyoming	14,886	23,949
Colorado	65,309	99,362
New Mexico	41,208	61,557
Arizona	54,020	162,675
Utah	22,042	39,887
Nevada	35,096	58,709
Total Mountain	274,310	555,190
Pacific:		
Washington	90,274	122,788
Oregon	73,801	132,220
California	372,364	543,658
Total Pacific	536,439	798,666
Total United States	6,718,025	5,971,636
Canada	4,806	1,300
Total terminated	6,722,831	5,972,936

Source: Interstate Commerce Commission, Freight Commodity Statistics.

ROAD OIL

Refinery sales of road oil to domestic consumers decreased 19 percent in quantity in 1942. Only 31,325 barrels valued at $58,371 were manufactured from foreign crude. Of this total 18,858 barrels valued at $28,406 were sold by refineries of the East Coast district, and nearly all the remainder was sold by refineries of the Rocky Mountain district.

Road oil sold by petroleum refineries to domestic consumers in the United States, 1941–42, by districts

District	1941		1942	
	Thousands of barrels	Thousands of dollars	Thousands of barrels	Thousands of dollars
East Coast	391	1,542	106	192
Appalachian	44	77	31	71
Indiana, Illinois, Kentucky, etc.	2,603	3,683	1,278	1,968
Oklahoma, Kansas, and Missouri	682	1,101	360	529
Texas	237	368	80	127
Louisiana-Arkansas	121	127	17	56
Rocky Mountain	1,458	1,851	1,197	1,729
California	3,295	3,503	4,058	4,931
Total United States	8,831	12,252	7,127	9,603

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of road oil in the United States in 1942, by districts, in thousands of barrels

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, losses, and exports	Sales to domestic consumers
			Dec. 31, 1941	Dec. 31, 1942		
East Coast	–5	74	39	1	1	106
Appalachian	30		1			31
Indiana, Illinois, Kentucky, etc.	1,169	39	168	13	85	1,278
Oklahoma, Kansas, and Missouri	396	217	32	34	251	360
Texas	48	49	35	51	1	80
Louisiana-Arkansas	149	1	15	15	133	17
Rocky Mountain	1,363	263	252	117	564	1,197
California	4,889		251	117	965	4,058
Total: 1942	8,039	643	793	348	2,000	7,127
1941	9,149	514	624	793	663	8,831

CEMENT

By FORREST T. MOYER AND E. V. BALSER

SUMMARY OUTLINE

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SUMMARY

Production of finished hydraulic cements in 1942, the construction year of the war program, advanced to a new record of 185,341,609 barrels—a total that surpassed 1941 output by 11 percent and the former high set in 1928 by 4 percent. The gain over 1941 resulted entirely from the record demand for portland cement as output of natural and other hydraulic cements, which represent only a small percentage of the total, declined slightly. Total shipments from producing mills in 1942 reached a new high volume of 187,809,208 barrels and exceeded production by nearly 2½ million barrels. As a result, stocks of finished cement at mills on December 31, 1942, fell to 17,696,686 barrels, a 12-percent decline from stocks at the end of 1941. Reflecting increased costs of production over 1941, the average mill value of portland cement rose 6 cents to $1.53 per barrel and that for all other hydraulic cements advanced 10 cents to $1.46.

Although private and defense construction had begun to taper off in the latter part of 1941, the mounting volume of construction contracted after the country entered the war in December had almost immediate effect upon the cement industry. Over-all activity, after allowance for seasonal effects, increased rapidly to a peak in the August-October period of 1942. Production of cement advanced from the low monthly volume of the year in February to a peak in October with only minor recessions during June and September. Through November and December output was maintained at a relatively high level in order to replenish the badly depleted stocks. Monthly shipments increased rapidly from February through August and remained at a high level to the end of October. However, in November and December shipments declined at a slightly more than seasonal rate. During January–March stocks of finished cement were built up to a normal level of about 25 million barrels, which was maintained through May. In the June-October period, when ship-

ments greatly exceeded production, stocks declined rapidly to a low on October 31 of slightly less than 11 million barrels, but by the end of December these had been restored approximately halfway to the customary level.

Requirements exceeded supplies in some sections of the country, and cement had to be brought in from relatively distant plants. However, there were few shipments of large quantities for unusually long distances. Shortages developed during 1942 in the Southeastern States, Texas, and Washington. Temporary shortages were apparent in Kansas and Nebraska.

Salient statistics of the cement industry in the United States, 1938–42

	1938 [1]	1939	1940	1941	1942
Production of finished cement:					
Portland—barrels	105, 357, 000	122, 259, 154	130, 216, 511	164, 030, 559	182, 781, 184
Masonry, natural, and puzzolan (slag-lime)—barrels	1, 820, 795	2, 439, 110	2, 534, 566	2, 875, 962	2, 560, 425
Total production—do	107, 177, 795	124, 698, 264	132, 751, 077	166, 906, 521	185, 341, 609
Capacity used at portland-cement mills—percent	41. 2	47. 7	51. 2	66. 3	73. 5
Production of portland-cement clinker [2]—barrels	104, 121, 105	121, 620, 018	130, 140, 932	163, 628, 857	181, 267, 461
Active plants:					
Portland	151	150	152	155	155
Masonry, natural, and puzzolan (slag-lime)	12	12	12	12	11
Shipments from mills:					
Portland—barrels	106, 324, 127	122, 651, 459	130, 349. 786	167, 439, 237	185, 300, 884
Value [3]	$153, 977, 226	$180, 893, 208	$190, 078, 068	$246, 621, 914	$283, 237, 028
Per barrel	$1. 45	$1. 47	$1. 46	$1. 47	$1. 53
Masonry, natural, and puzzolan (slag-lime)—barrels	1, 867, 949	2, 405, 135	2, 514, 597	2, 926, 203	2, 508, 324
Value [3]	$2, 725, 776	$3, 361, 724	$3, 386, 801	$3, 967, 567	$3, 668, 169
Per barrel	$1. 46	$1. 40	$1. 35	$1. 36	$1. 46
Total shipments—barrels	108, 192, 076	125, 056, 594	132, 864, 383	170, 365, 440	187, 809, 208
Value	$156, 703, 002	$184, 254, 962	$193, 464, 869	$250, 589, 481	$286, 905, 197
Stocks at mills, December 31:					
Portland:					
Finished cement—barrels	23, 992, 939	23, 645, 583	23, 364, 657	[4] 19, 964, 918	17, 445, 220
Clinker—do	5, 286, 053	5, 165, 066	4, 885, 941	4, 574, 528	3, 509, 336
Masonry, natural, and puzzolan (slag-lime)—barrels	373, 816	239, 938	259, 868	[4] 199, 365	251, 466
Imports—do	1, 727, 411	1, 913, 853	538, 060	[5] 43, 110	[6]
Exports—do	558, 226	1, 146, 339	1, 667, 595	[5] 1, 757, 172	[6]
Apparent consumption—do	109, 361, 261	125, 824, 108	131, 734, 848	[6]	[6]

[1] Does not include Puerto Rico, where production began in 1939.
[2] Compiled from monthly reports by producers.
[3] Value received f. o. b. mill, excluding cost of containers.
[4] Revised figures.
[5] Figures cover January to September, inclusive.
[6] Figures not available for publication.

The strong demand for cement originated principally in the large volumes of military and industrial construction started in 1942. As measured by Federal Reserve Board indexes (1923–25=100), based upon data of the Dodge Corporation, the value of construction contracts awarded in 1942 reached a new high of 166 compared with 122 in 1941 and 135, the former record, in 1928. The index for residential building declined from 89 in 1941 to 82 in 1942, whereas that for all other construction rose from 149 in 1941 to 235 in 1942. Engineering construction, which requires large quantities of cement, increased 59 percent over 1941, according to values of contracts reported by Engineering News-Record. The area of concrete pavement contracted for in 1942, as recorded by the Portland Cement Association, was 56

percent greater than in 1941 and totaled nearly 132 million square yards. Airport paving was slightly more than treble the 1941 area and represented nearly three-fourths of the total pavement contracted in 1942, compared with slightly more than one-third in 1941. Road, street, and alley paving fell nearly one-third below the 1941 volume.

Distribution of consumption changed sharply in 1942, as indicated by the foregoing data. Direct military construction doubtless consumed most of the supply. In this category, the large volume of airport construction, coupled with the greater thicknesses of runways required to support the heavy planes, probably consumed more cement than any other type of construction. After military uses, the probable order of consumption was in construction of industrial plants and facilities, highways, and residential building. The first year of war also effected a marked change in location of cement consumption in the country (see fig. 2). As indicated by destinations of shipments from mills, consumption increased sharply over 1941 in the Southern and Rocky Mountain States and gained moderately in the Middle and Pacific States but declined in the Northeastern States.

The first direct war control on the cement industry was the General Maximum Price Regulation of the Office of Price Administration, effective May 11. This order froze prices of cement at the highest selling value, f. o. b. plant, obtained during March 1942. Cement prices were removed from the general order by Maximum Price Regulation 188, which was effective August 1 and continued the March prices as maximum. With regard to cement prices, this order was superseded by Maximum Price Regulation 224, which applied only to cement and was effective September 23. Under the last regulation, prices on shipments within ordinary shipping radius of the mill were set at the maximum value obtained during the March 1–15 period, whether on a mill or delivered basis, plus any increase in freight rates since March 17. However, in order to insure adequate supplies in deficient areas, prices on shipments outside the normal shipping area of a mill were placed on an average dollars and cents f. o. b. basis determined for each Bureau of Mines district. For all districts other than California and Oregon and Washington the base was equal to 95 percent of the average net mill realization during 1941. In the two excepted districts the base was set at 95 percent of average net mill realization for the first quarter of 1942. This regulation provided for absorption of the extra and relatively high transportation costs by the consuming Government agencies.

As a means of increasing production and conserving grinding medium and power, similar emergency alternate specifications for three types of portland cement were formulated and approved early in June by the Federal Government and American Society for Testing Materials. War Production Board Limitation Order L–179, effective August 23, restricted manufacture of portland cement to the three types—general-purpose, moderate-heat, and high-early-strength—set forth in the emergency specifications. The order also prohibited assignment of storage bins for the exclusive use of any customer and required that all testing be done by the National Bureau of Standards or a Standards-approved laboratory. Twelve large dams in the Southern and Western States and oil-well cements were exempted from provisions of the orders.

On February 16, 1943, an amendment to this general limitation order removed the ban upon assignment of bin space to customers and no longer required that tests be done by an approved laboratory.

In addition to direct controls, the cement industry was affected by war restrictions on construction. The first of these, War Production Board Conservation Order L–41 of April 9 and its more restrictive revision of September 7, brought a virtual halt to all nonessential public and private construction as a means of assuring adequate labor and material supplies for necessary building. After the middle of 1942, the growing shortage of labor and raw materials forced recognition that construction was out of balance with other phases of the war

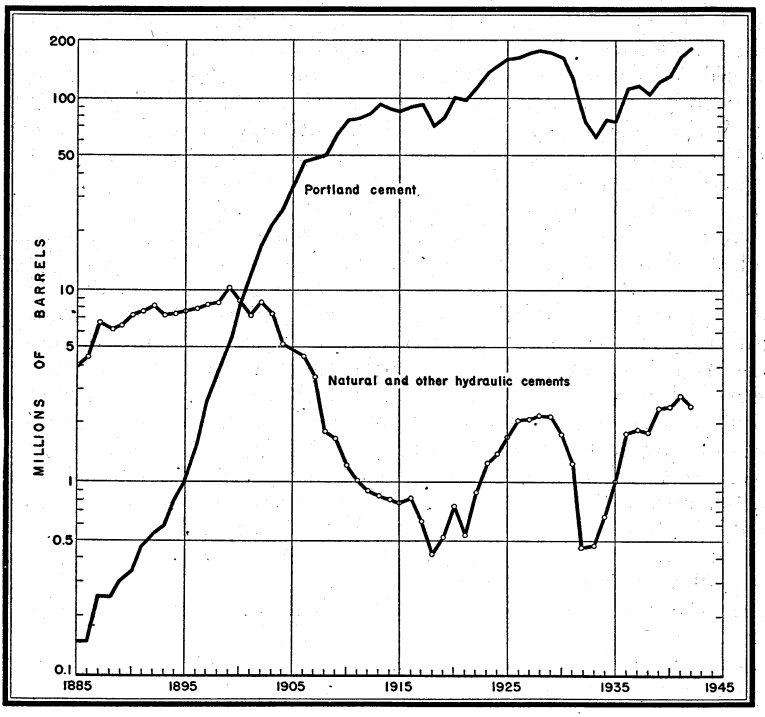

FIGURE 1.—Trends in production of hydraulic cements in the United States, 1885–1942.

program and that the country was being overbuilt. Consequently, the War Production Board on October 22 established the Facility Clearance Board and the Facility Review Committee to review construction already contracted and under way and also to approve all proposed construction for essentiality. By the end of 1942, stop orders had been issued on nearly 1¼ billion dollars of contracts, of which much of the volume was for engineering construction that would have required large quantities of cement.

Since its inception in the early 1870's the portland cement industry has shown a remarkable rate of growth. By 1888 annual production had increased to 250,000 barrels, and from that time output gained

rapidly in each year through 1913, when 92,097,131 barrels was produced. However, as shown in figure 1, the rate of increase flattened appreciably after 1910, and from 1913 through 1918 the industry suffered its first recession. The uptrend was resumed in 1919, and except for a minor setback in 1921 it continued at a substantial rate through 1928. In the depression of the early 1930's production slumped to 63,473,189 barrels (in 1933); and although recovery since then has been irregular, the over-all improvement, to the record output of 1942, has been rapid. Natural cement was first made in the United States near Chittenango, N. Y., in 1818. Combined annual production of it and miscellaneous hydraulic cements other than portland showed a generally rising trend to the record output of 10,203,179 barrels in 1899. Demand for portland exceeded that for other hydraulic cements for the first time in 1901, and as it continued to increase, demand for other cements declined to a low of 432,966 barrels in 1918. Since then, annual production of hydraulic cements other than portland showed moderate recovery through 1928 followed by a sharp decline through 1932 and subsequent recovery to the 1941 output of 2,875,962 barrels.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

As annual production of portland cement represents about 99 percent of the total output of all hydraulic cements, the general conditions affecting and the activity of the portland cement industry during 1942 were the same as those given in the preceding summary.

Location of war construction in 1942 effected marked changes in the quantities of portland cement produced in the various States. The record output of 1942 was obtained from 155 active mills in 35 States and Puerto Rico. Compared with 1941, production increased in 25 States and Puerto Rico, declined in 6 States, and was relatively unchanged in 4. Exceptional gains of more than one-third were recorded for Kansas, Oklahoma, South Dakota, Washington, and Puerto Rico. Ranking States in 1942, in order of output, were Pennsylvania, California, Texas, New York, and Michigan. Manufacture of cement ceased in New Jersey in 1942, and output declined sharply from 1941. Production was higher than in 1941 in all Bureau of Mines districts except New York and Maine, for which a small decline was recorded. The largest proportional gains were in the Western Missouri-Nebraska-Kansas-Oklahoma-Arkansas, Oregon-Washington, and Puerto Rico districts.

Shipments from mills during 1942 exceeded production in all districts except the Eastern Pennsylvania-New Jersey-Maryland, New York-Maine, Michigan, and Puerto Rico. As a result, these were the only districts in which stocks of finished cement at mills on December 31, 1942, were greater than at the end of 1941.

Finished portland cement produced, shipped, and in stock in the United States, 1941–42, by States and districts

State and district	Active plants		Production			Shipments from mills								Stocks at mills (Dec. 31)		
			Barrels			1941			1942					Barrels		
	1941	1942	1941	1942	Percent of change from 1941	Barrels	Value		Barrels	Value		Percent of change from 1941 in—		1941	1942 [1]	Percent of change from 1941
							Total	Average		Total	Average	Barrels	Average value			
STATE																
Alabama	6	6	7,410,499	8,534,324	+15.2	7,610,030	$11,142,649	$1.46	8,598,332	$12,874,701	$1.50	+13.0	+2.7	344,017	280,009	−18.6
California	12	12	19,935,309	23,350,674	+17.1	20,186,028	28,019,494	1.39	23,787,808	36,895,916	1.55	+17.8	+11.5	[2] 1,372,211	935,077	−31.9
Illinois	4	4	5,854,218	7,049,636	+20.4	5,958,376	8,660,104	1.45	7,102,393	10,284,111	1.45	+19.2	------	[2] 629,184	576,427	−8.4
Iowa	5	5	5,064,620	5,062,230	−.05	5,328,398	8,659,014	1.63	5,662,733	9,151,499	1.62	+6.3	−.6	[2] 1,275,363	674,860	−47.1
Kansas	6	6	4,680,636	7,254,906	+55.0	4,734,129	7,136,933	1.51	7,726,291	11,415,377	1.48	+63.2	−2.0	1,014,290	542,905	−46.5
Michigan	11	11	9,485,147	10,615,927	+11.9	9,819,218	13,333,850	1.36	10,349,104	14,683,683	1.42	+5.4	+4.4	[2] 1,700,728	1,967,551	+15.7
Missouri	5	5	6,328,003	6,971,938	+10.2	6,516,345	10,272,509	1.58	7,397,960	11,515,907	1.56	+13.5	−1.3	[2] 988,247	562,225	−43.1
New York	11	11	11,444,508	11,067,269	−3.3	11,446,292	16,073,726	1.40	11,027,118	16,030,995	1.45	−3.7	+3.6	[2] 1,776,163	1,816,314	+2.3
Ohio	9	9	8,155,704	8,181,615	+.3	8,021,857	10,657,677	1.33	8,652,196	11,897,607	1.38	+7.9	+3.8	[2] 1,251,532	780,951	−37.6
Pennsylvania	25	24	32,199,184	34,114,074	+5.9	32,868,220	45,383,766	1.38	33,639,025	46,377,469	1.38	+2.3	------	[2] 4,328,429	4,803,478	+11.0
Puerto Rico [3]	1	2	462,628	666,698	+44.1	465,158	1,005,472	2.16	629,358	1,516,075	2.41	+35.3	+11.6	302	37,642	+12,364.2
Tennessee	6	6	5,588,488	6,402,291	+14.6	5,623,800	8,520,284	1.52	6,407,196	9,927,895	1.55	+13.9	+2.0	[2] 400,590	395,685	−1.2
Texas	10	10	9,679,696	12,132,707	+25.3	9,842,260	16,362,293	1.66	12,139,800	20,942,867	1.73	+23.3	−4.2	[2] 739,375	732,284	−1.0
Other States [4]	44	44	37,741,919	41,376,895	+9.6	39,019,126	61,394,143	1.57	42,181,570	69,722,926	1.65	+8.1	+5.1	[2] 4,144,487	3,339,812	−19.4
	155	155	164,030,559	182,781,184	+11.4	167,439,237	246,621,914	1.47	185,300,884	283,237,028	1.53	+10.7	+4.1	[2] 19,964,918	17,445,220	−12.6
DISTRICT																
Eastern Pennsylvania, New Jersey, and Maryland	22	22	31,017,939	31,520,249	+1.6	31,482,250	43,493,559	1.38	31,069,918	42,770,279	1.38	−1.3	------	[2] 3,694,923	4,145,254	+12.2
New York and Maine	12	12	11,995,299	11,707,273	−2.4	12,049,832	17,099,278	1.42	11,644,827	17,054,936	1.46	−3.4	+2.8	[2] 1,851,103	1,913,549	+3.4
Ohio, western Pennsylvania, and West Virginia	18	17	15,153,118	15,573,618	+2.8	15,340,784	20,509,369	1.34	16,043,856	22,165,074	1.38	+4.6	+3.0	[2] 2,438,073	1,967,835	−19.3
Michigan	11	11	9,485,147	10,615,927	+11.9	9,819,218	13,333,850	1.36	10,349,104	14,683,683	1.42	+5.4	+4.4	[2] 1,700,728	1,967,551	+15.7
Wisconsin, Illinois, Indiana, and Kentucky	11	11	16,224,049	18,618,434	+14.8	16,750,575	24,981,549	1.49	18,658,231	27,941,361	1.50	+11.4	+.7	[2] 1,614,073	1,574,276	−2.5

Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	18	18	19,982,460	21,808,052	+9.1	20,391,422	30,983,258	1.52	21,864,073	34,063,252	1.56	+7.2	+2.6	[2] 1,105,818	1,049,797	−5.1
Eastern Missouri, Iowa, Minnesota, and South Dakota	11	11	11,856,659	12,833,837	+8.2	12,443,248	19,990,722	1.61	13,896,927	22,058,737	1.59	+11.7	−1.2	[2] 2,440,004	1,376,914	−43.6
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	12	12	9,903,055	13,718,391	+38.5	10,179,426	15,372,190	1.51	14,687,616	22,375,075	1.52	+44.3	+.7	1,839,237	870,012	−52.7
Texas	10	10	9,679,696	12,132,707	+25.3	9,842,260	16,362,293	1.66	12,139,800	20,942,867	1.73	+23.3	+4.2	[2] 739,375	732,284	−1.0
Colorado, Montana, Utah, Wyoming, and Idaho	8	8	3,954,582	4,371,442	+10.5	4,024,563	7,317,339	1.82	4,588,428	8,766,019	1.91	+14.0	+4.9	[2] 536,133	319,147	−40.5
California	12	12	19,935,309	23,350,674	+17.1	20,186,028	28,019,494	1.39	23,787,808	36,895,916	1.55	+17.8	+11.5	[2] 1,372,211	935,077	−31.9
Oregon and Washington	9	9	4,380,618	5,863,882	+33.9	4,464,473	8,153,541	1.83	5,940,938	12,003,754	2.02	+33.1	+10.4	[2] 632,938	555,882	−12.2
Puerto Rico [3]	1	2	462,628	666,698	+44.1	465,158	1,005,472	2.16	629,358	1,516,075	2.41	+35.3	+11.6	302	37,642	+12,364.2
	155	155	164,030,559	182,781,184	+11.4	167,439,237	246,621,914	1.47	185,300,884	283,237,028	1.53	+10.7	+4.1	[2] 19,964,918	17,445,220	−12.6

[1] Subject to revision.
[2] Revised figures.
[3] Includes a new plant in Puerto Rico (September 1942 first month in production).
[4] 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.

Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1942, by months and 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	2,390	2,199	2,732	2,789	2,783	2,652	2,710	2,792	2,708	2,874	2,567	2,304
New York and Maine	850	579	748	882	1,037	1,173	1,194	1,198	1,177	1,145	971	739
Ohio, western Pennsylvania, and West Virginia	982	852	1,065	1,134	1,544	1,325	1,309	1,517	1,531	1,831	1,457	1,036
Michigan	496	384	482	836	1,068	1,140	1,068	968	1,116	1,177	1,061	803
Wisconsin, Illinois, Indiana, and Kentucky	1,265	1,180	1,229	1,362	1,559	1,627	1,775	1,855	1,882	2,008	1,700	1,214
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,687	1,447	1,633	1,749	1,991	1,776	1,868	1,947	1,942	2,015	1,937	1,802
Eastern Missouri, Iowa, Minnesota, and South Dakota	842	484	646	791	1,003	935	1,154	1,506	1,523	1,535	1,367	1,127
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	777	806	905	1,067	1,282	1,222	1,235	1,266	1,306	1,385	1,249	1,165
Texas	850	878	976	949	1,015	1,045	1,146	1,103	1,036	1,076	1,021	1,043
Colorado, Montana, Utah, Wyoming, and Idaho	181	113	169	367	407	480	513	476	428	445	392	402
California	1,742	1,553	1,656	1,590	1,829	2,019	2,180	2,293	2,263	2,186	2,048	1,968
Oregon and Washington	251	279	447	505	559	584	630	635	576	531	421	436
Puerto Rico [1]	47	43	45	46	42	44	51	49	53	85	83	77
United States: 1942	12,360	10,797	12,733	14,067	16,119	16,022	16,833	17,605	17,541	18,293	16,274	14,116
1941	9,021	8,345	10,596	12,196	14,732	15,223	16,000	16,345	16,115	16,688	14,931	13,810
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	1,614	1,570	2,707	3,046	3,005	3,089	3,154	3,055	3,031	2,982	2,524	1,294
New York and Maine	541	406	649	898	1,147	1,402	1,418	1,349	1,340	1,313	788	394
Ohio, western Pennsylvania, and West Virginia	590	533	893	1,246	1,385	1,669	1,687	1,888	2,022	2,388	1,246	485
Michigan	248	266	469	817	932	1,033	1,107	1,231	1,546	1,503	850	340
Wisconsin, Illinois, Indiana, and Kentucky	626	499	975	1,464	1,655	1,857	2,279	2,687	2,416	2,312	1,337	552
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,442	1,245	1,666	2,013	1,921	1,831	2,054	2,142	2,162	2,150	1,856	1,362
Eastern Missouri, Iowa, Minnesota, and South Dakota	404	308	739	834	946	1,276	1,775	2,446	1,835	1,845	1,163	326
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	765	750	1,142	1,091	1,141	1,181	1,977	1,842	1,393	1,494	1,149	761
Texas	847	811	973	921	1,152	1,321	1,324	1,136	900	1,007	965	789
Colorado, Montana, Utah, Wyoming, and Idaho	94	94	243	338	431	595	718	552	472	434	377	240
California	1,707	1,488	1,635	1,557	2,023	2,279	2,273	2,234	2,304	2,278	1,986	2,030
Oregon and Washington	193	280	423	509	564	677	688	674	684	590	349	304
Puerto Rico [1]	44	43	49	40	47	40	47	46	43	88	63	78
United States: 1942	9,115	8,293	12,563	14,774	16,349	18,250	20,501	21,282	20,148	20,384	14,653	8,955
1941	7,984	7,456	9,915	14,132	16,048	16,109	16,687	17,825	18,284	17,833	13,724	11,511

STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	4,496	5,124	5,150	4,893	4,671	4,225	3,780	3,516	3,192	3,084	3,126	4,144
New York and Maine	2,156	2,329	2,428	2,413	2,304	2,075	1,851	1,708	1,545	1,378	1,561	1,914
Ohio, western Pennsylvania, and West Virginia	2,823	3,141	3,314	3,202	3,361	3,016	2,637	2,256	1,763	1,206	1,436	1,985
Michigan	1,947	2,065	2,077	2,097	2,233	2,339	2,301	2,038	1,608	1,282	1,492	1,957
Wisconsin, Illinois, Indiana, and Kentucky	2,242	2,921	3,176	3,074	2,978	2,747	2,243	1,401	871	563	913	1,574
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,349	1,551	1,518	1,255	1,325	1,270	1,092	885	665	529	609	1,050
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,848	3,025	2,925	2,870	2,927	2,545	1,936	984	687	377	576	1,377
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,851	1,907	1,670	1,646	1,786	1,828	1,102	526	454	345	452	856
Texas	742	809	811	839	702	428	249	216	353	422	478	732
Colorado, Montana, Utah, Wyoming, and Idaho	623	642	567	595	570	456	250	175	131	142	157	319
California	1,409	1,473	1,495	1,525	1,336	1,076	988	1,049	1,018	937	997	937
Oregon and Washington	678	677	701	697	692	600	541	503	400	341	413	545
Puerto Rico [1]	4	4		6	1	4	9	11	21	18	38	38
United States: 1942	23,168	25,668	25,832	25,112	24,886	22,609	18,979	15,268	12,708	10,624	12,248	17,428
1941	24,416	25,307	25,988	24,056	22,745	21,865	21,178	19,732	17,561	16,417	17,638	19,925

[1] Includes a new plant in Puerto Rico (September 1942 first month in production).

Production and stocks of portland-cement clinker at mills in the United States in 1942, by months and 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	2,443	2,378	2,706	2,651	2,756	2,653	2,725	2,800	2,625	2,792	2,628	2,297
New York and Maine	880	630	764	895	1,055	1,169	1,112	1,111	1,139	1,109	943	733
Ohio, western Pennsylvania, and West Virginia	1,082	877	1,164	1,264	1,368	1,355	1,304	1,287	1,433	1,636	1,439	1,195
Michigan	592	533	568	823	1,063	1,027	1,015	922	941	1,039	1,017	854
Wisconsin, Illinois, Indiana, and Kentucky	1,321	1,226	1,412	1,269	1,518	1,586	1,792	1,734	1,817	1,919	1,765	1,381
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	1,702	1,624	1,631	1,801	1,929	1,776	1,882	1,917	1,839	1,897	1,893	1,792
Eastern Missouri, Iowa, Minnesota, and South Dakota	848	534	635	825	962	914	1,153	1,332	1,415	1,482	1,430	1,227
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	851	786	936	1,019	1,226	1,172	1,257	1,250	1,253	1,345	1,229	1,229
Texas	825	891	933	882	976	971	1,131	1,100	1,027	1,054	1,033	1,068
Colorado, Montana, Utah, Wyoming, and Idaho	273	206	218	311	352	391	421	458	391	435	402	388
California	1,668	1,572	1,964	1,869	1,921	1,964	2,048	2,070	2,064	2,044	2,056	2,103
Oregon and Washington	237	332	439	458	506	528	607	539	591	502	437	425
Puerto Rico [1]	31	38	49	50	36	35	57	45	59	88	85	89
United States: 1942	12,753	11,627	13,419	14,117	15,668	15,541	16,504	16,565	16,594	17,342	16,357	14,781
1941	9,269	8,773	11,325	12,129	14,524	14,964	15,739	16,086	15,668	16,018	14,935	14,197
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	600	782	774	655	644	657	688	706	644	581	650	653
New York and Maine	297	355	378	396	422	427	356	272	244	218	196	197
Ohio, western Pennsylvania, and West Virginia	695	726	831	965	802	842	851	604	518	327	287	452
Michigan	536	685	767	758	747	652	596	550	407	266	219	273
Wisconsin, Illinois, Indiana, and Kentucky	441	480	661	561	506	458	477	350	284	189	255	416
Virginia, Tennessee, Alabama, Georgia, Louisiana, and Florida	339	517	519	581	527	536	552	527	432	326	286	283
Eastern Missouri, Iowa, Minnesota, and South Dakota	269	318	346	396	366	336	349	194	111	75	146	250
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	319	300	333	282	232	185	197	185	162	130	124	192
Texas	232	256	224	172	144	83	87	97	99	89	116	141
Colorado, Montana, Utah, Wyoming, and Idaho	242	334	384	329	276	188	98	81	45	37	48	31
California	693	679	947	1,194	1,260	1,187	1,029	769	499	354	346	447
Oregon and Washington	351	405	398	353	305	255	238	149	145	120	140	138
Puerto Rico [1]	6	3	9	14	10	3	10	9	11	21	27	36
United States: 1942	5,020	5,840	6,571	6,656	6,241	5,809	5,528	4,493	3,601	2,733	2,840	3,509
1941	5,092	5,520	6,276	6,207	6,005	5,757	5,522	5,219	4,804	4,192	4,250	4,575

[1] Includes a new plant in Puerto Rico (September 1942 first month in production).

End-of-month stocks at mills of both finished portland cement and clinker were relatively stable in the 1935–39 period at average levels of approximately 22½ and 6 million barrels, respectively. However, beginning with 1940, monthly stocks have shown an increasing range of fluctuation in each year through 1942. During January–March 1942 production exceeded shipments, and stocks of finished cement were rebuilt from a relatively low condition at the end of 1941 to 25,832,000 barrels on March 31, or slightly above the customary level. Stocks declined somewhat to the end of May, and then as shipments greatly exceeded production they fell rapidly to a low of 10,624,000 barrels on October 31. The strong demand for cement and the prohibition of assignment of storage space to customers were the principal factors causing this badly depleted condition. A declining demand during November and December enabled producers to replenish stocks approximately halfway to the customary level by the end of 1942. On December 31 stocks of finished cement were 13 percent below those at the end of 1941.

Clinker stocks in 1942 followed essentially the same pattern as stocks of finished cement, except that recovery from the depleted condition at the end of October was less marked. On December 31 stocks were far below the customary level and were 23 percent lower than at the end of 1941.

Stocks of finished portland cement and portland-cement clinker at mills in the United States on Dec. 31, and yearly range in end-of-month stocks, 1938–42

		Dec. 31 (barrels)	Range			
			Low		High	
			Month	Barrels	Month	Barrels
1938 [1]	Cement	[2] 23,992,939	October	20,569,000	January	25,023,000
	Clinker	5,286,000	do	4,927,000	February	6,732,000
1939	Cement	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	23,364,657	October	18,008,000	March	26,118,000
	Clinker	4,886,000	do	4,470,000	April	6,606,000
1941	Cement	[3] 19,964,918	do	16,417,000	March	25,988,000
	Clinker	4,575,000	do	4,192,000	do	6,276,000
1942	Cement	17,445,220	do	10,617,000	do	25,832,000
	Clinker	3,509,000	do	2,723,000	April	6,656,000

[1] Does not include Puerto Rico, where production began in 1939.
[2] Revised figure.

DOMESTIC CONSUMPTION

Consumption of portland cement in States and regions, as indicated by destinations of shipments in 1942, underwent many changes. On a regional basis selected with reference to areas of cement consumption as well as other economic and geographic factors, consumption increased markedly in the Southern and Rocky Mountain States but gained only moderately over 1941 in the Middle and Pacific States. In the Northeastern States consumption declined slightly from 1941.

As shown by figure 2, in which relative rates of gain or loss may be compared readily by slopes of the curves from year to year, consumption of cement declined sharply from the late 1920's to 1933 in all regions except the Rocky Mountain States, where the decline ended in 1932. From these low points there have been irregular general

uptrends in all regions except the Southern States, in which the rising trend has persisted each year. The recovery has been marked in the Southern, Rocky Mountain, and Pacific regions, and it is notable that consumption in these areas in recent years has risen appreciably above the levels attained in the late 1920's. The higher rate and better recovery are attributable to the construction of large power and flood-control dams and, in 1942, to the erection of large war plants and facilities and military establishments in the areas. Consumption of cement in the Northeastern and Middle regions has recovered only moderately from the low points of 1932, and in 1942 the rate was well below the average volumes consumed during 1927–29. States in the regions

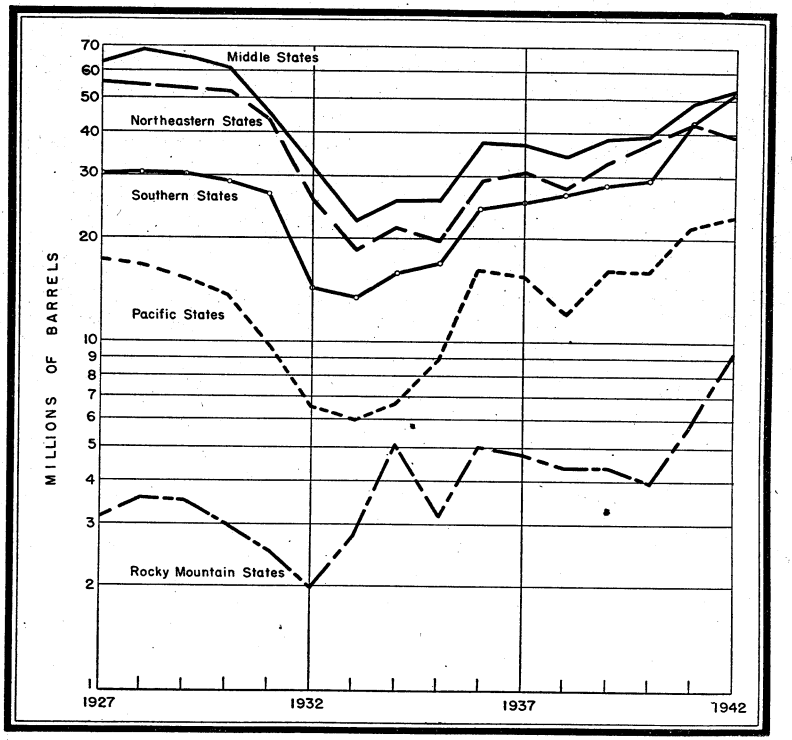

FIGURE 2.—Trends of indicated consumption of portland cement in the United States, 1927–42, by regions.

shown on figure 2 are as follows: Northeastern—Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; Southern—Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; Middle—Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; Rocky Mountain—Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming; Pacific—California, Oregon, and Washington.

Comparison of indicated cement consumption by States in 1942 and 1941 illustrates the striking effects that location of war construction had on the distribution of consumption. In 1942 consumption increased in 28 States and declined in 20 States and the District of Columbia. The quantities consumed during 1942 in Arkansas, Kansas, Nebraska, Nevada, and South Dakota were more than double the 1941 volumes. Ranking States, in order of consumption, were California, New York, Texas, and Pennsylvania.

The table listing destinations of monthly shipments of portland cement was compiled from the regular monthly reports of producers.

Destination of shipments of finished portland cement from mills in the United States, 1940–42, by States

Destination	1940 (barrels)	1941 (barrels)	1942	
			Barrels	Percent of change from 1941
Alabama	1,458,811	2,491,851	3,237,883	+29.9
Arizona [1]	558,629	793,838	1,379,825	+73.8
Arkansas	812,931	1,146,712	2,931,890	+155.7
California	11,619,397	16,850,718	17,444,451	+3.5
Colorado	1,028,753	1,520,646	2,204,461	+45.0
Connecticut [1]	1,893,733	2,379,471	1,996,198	−16.1
Delaware [1]	416,056	394,451	348,283	−11.7
District of Columbia [1]	1,605,768	1,590,499	1,566,360	−1.5
Florida	2,442,623	3,172,179	3,640,849	+14.8
Georgia	1,901,663	2,671,255	2,991,447	+12.0
Idaho	334,360	448,380	570,378	+27.2
Illinois	8,584,009	9,165,894	9,717,134	+6.0
Indiana	3,628,891	5,319,791	6,359,018	+19.5
Iowa	2,933,570	3,259,370	2,317,264	−28.9
Kansas	1,627,535	2,061,704	4,704,821	+128.2
Kentucky	2,006,097	2,705,374	2,613,180	−3.4
Louisiana	2,168,927	2,837,225	3,327,152	+17.3
Maine	331,685	623,245	559,731	−10.2
Maryland	2,141,788	3,093,522	3,036,945	−1.8
Massachusetts [1]	2,707,242	3,029,370	2,715,651	−10.4
Michigan	5,760,481	6,907,824	7,069,832	+2.3
Minnesota	2,562,578	3,035,480	2,320,780	−23.5
Mississippi [1]	1,330,367	1,407,063	1,467,849	+4.3
Missouri	3,150,489	5,029,976	3,877,208	−22.9
Montana	419,796	457,899	483,139	+5.5
Nebraska	1,122,140	1,380,339	4,519,493	+227.4
Nevada [1]	172,710	250,236	1,551,797	+520.1
New Hampshire [1]	428,752	518,691	456,845	−11.9
New Jersey	4,165,289	5,353,149	5,149,525	−3.8
New Mexico [1]	514,490	749,023	696,841	−7.0
New York	13,119,568	14,096,501	12,139,320	−13.9
North Carolina [1]	1,770,738	2,574,455	2,420,086	−6.0
North Dakota [1]	290,711	361,416	291,977	−19.2
Ohio	6,538,166	8,455,877	8,160,031	−3.5
Oklahoma	1,886,668	2,131,784	3,218,926	+51.0
Oregon	906,358	1,529,971	1,350,988	−11.7
Pennsylvania	10,008,425	10,000,181	10,157,308	+1.6
Rhode Island [1]	649,373	834,261	963,073	+15.4
South Carolina [1]	1,118,340	1,759,468	1,927,768	+9.6
South Dakota	427,254	432,431	1,055,170	+144.0
Tennessee	2,455,317	4,281,918	5,282,485	+23.4
Texas	6,478,976	8,598,148	11,401,189	+32.6
Utah	679,370	1,196,451	1,997,820	+67.0
Vermont [1]	246,820	238,436	126,412	−47.0
Virginia	2,381,902	4,771,954	6,435,358	+34.9
Washington	3,540,956	3,015,298	4,266,440	+41.5
West Virginia	1,318,364	1,690,142	1,481,319	−12.4
Wisconsin	2,604,168	3,187,293	3,056,916	−4.1
Wyoming	250,901	284,771	378,704	+33.0
	126,501,935	160,085,931	177,367,520	+10.8
Unspecified [2]	3,847,851	7,353,306	7,933,364	+7.9
Total shipped from cement plants	130,349,786	167,439,237	185,300,884	+10.7

[1] Non-cement-producing State.
[2] Includes shipments to Alaska, Hawaii, Puerto Rico, and foreign countries.

Destination of shipments of finished portland cement from mills in the United States in 1942, by months, in barrels

Destination	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	261,888	258,003	309,777	385,674	272,114	230,181	288,400	249,224	242,485	292,534	274,739	172,301
Arizona	37,970	54,467	61,688	58,370	84,708	132,695	164,661	176,093	166,289	160,058	152,334	129,928
Arkansas	166,559	163,096	194,386	170,318	149,269	215,874	339,062	391,075	451,260	335,284	215,165	139,238
California	1,448,286	1,127,592	1,274,509	1,166,352	1,177,312	1,647,084	1,697,570	1,539,703	1,629,143	1,649,885	1,376,030	1,419,739
Colorado	42,393	31,994	116,184	164,750	514,680	284,405	432,165	414,023	198,545	128,260	117,020	54,518
Connecticut	72,071	63,071	120,552	188,815	219,050	223,432	236,320	218,295	186,956	225,222	155,934	55,973
Delaware	13,368	8,475	22,555	27,396	26,924	50,605	42,281	33,627	31,254	38,194	32,541	14,258
District of Columbia	111,094	107,875	140,004	156,913	148,735	130,385	136,483	134,513	150,716	120,652	126,023	81,531
Florida	219,043	210,681	200,369	266,376	267,482	240,777	348,520	425,323	421,082	449,963	338,225	251,481
Georgia	217,904	172,222	215,729	262,722	247,258	250,782	297,382	285,519	251,567	311,804	277,210	200,240
Idaho	8,021	15,154	31,421	39,126	33,290	60,969	80,308	65,990	54,952	57,067	39,561	15,583
Illinois	324,494	273,253	546,633	731,065	748,489	864,042	1,092,098	1,368,640	1,204,326	1,232,749	624,236	305,945
Indiana	163,341	147,386	300,659	437,103	537,898	579,982	712,805	918,345	1,026,031	986,339	422,513	126,015
Iowa	42,072	40,339	135,078	210,888	250,116	304,466	361,692	485,851	341,634	374,574	158,927	23,872
Kansas	133,607	139,083	238,150	251,935	287,789	309,486	551,457	591,147	653,428	842,296	485,041	207,389
Kentucky	116,787	101,572	135,127	190,223	272,089	371,979	355,781	338,649	327,075	243,640	116,524	42,462
Louisiana	249,919	200,793	322,061	319,064	293,379	246,088	302,159	318,448	342,899	267,919	245,075	217,983
Maine	31,382	23,092	24,725	31,011	42,626	53,388	70,501	87,697	59,812	70,989	37,093	20,340
Maryland	156,843	134,965	222,266	270,115	300,302	306,412	311,597	307,455	322,619	274,727	256,705	166,458
Massachusetts	134,161	121,245	201,578	251,959	295,035	317,958	296,285	283,326	295,614	290,546	167,990	84,900
Michigan	177,648	190,478	348,795	598,752	688,310	693,911	680,017	814,901	1,044,500	989,892	631,501	269,823
Minnesota	47,458	51,082	157,293	203,604	234,130	285,830	296,035	368,331	260,116	278,165	90,175	28,613
Mississippi	136,086	64,719	73,434	91,378	87,687	123,091	172,038	154,473	147,838	186,950	142,110	88,101
Missouri	263,082	166,664	357,662	341,089	325,692	280,144	389,566	588,029	354,253	420,642	253,795	134,373
Montana	11,054	7,997	16,813	25,887	40,562	52,086	107,508	113,542	50,648	30,959	17,765	8,072
Nebraska	26,624	27,329	64,836	172,814	165,779	210,282	457,221	608,921	544,659	1,182,543	887,665	130,566
Nevada	55,464	70,609	91,054	92,041	97,999	96,184	119,876	160,118	182,839	204,893	176,133	204,183
New Hampshire	20,396	18,851	28,720	35,891	46,888	56,765	47,841	52,339	50,790	64,748	29,336	16,099
New Jersey	330,303	259,598	494,459	459,736	438,493	489,751	648,240	531,622	516,216	492,758	360,128	216,049
New Mexico	36,601	32,714	49,591	101,834	64,250	47,456	102,439	82,604	65,429	46,606	24,695	41,531
New York	541,952	446,775	740,214	1,027,596	1,249,721	1,500,903	1,435,146	1,444,380	1,281,642	1,233,610	781,039	358,089
North Carolina	150,714	119,666	169,353	215,684	208,337	221,979	260,654	255,674	260,557	249,724	185,111	120,391
North Dakota	4,754	8,574	25,262	13,169	23,739	62,062	61,895	49,929	16,211	19,356	5,602	1,276
Ohio	296,020	265,250	501,024	693,350	792,994	933,765	917,393	1,022,606	1,033,482	907,394	547,655	247,702
Oklahoma	216,730	186,720	342,260	204,590	286,807	225,585	306,577	227,814	234,780	345,880	349,048	287,926
Oregon	39,076	58,078	108,519	161,274	173,491	169,226	154,491	135,149	133,553	111,605	49,951	50,826
Pennsylvania	429,359	397,481	705,291	889,937	921,836	1,108,027	1,171,598	1,185,671	1,188,404	1,010,939	742,270	374,834
Rhode Island	29,612	25,432	49,172	75,164	101,389	116,909	131,790	108,361	114,227	119,440	88,364	36,379
South Carolina	95,811	68,300	102,488	116,909	176,784	222,460	157,815	148,714	125,216	198,710	270,204	243,993
South Dakota	12,215	9,315	39,017	35,165	53,833	165,618	251,277	198,861	168,646	93,744	22,412	4,766
Tennessee	207,137	156,545	318,541	357,297	462,071	433,946	480,658	505,792	589,404	695,263	699,340	359,413
Texas	802,429	774,183	962,925	749,199	1,029,717	1,253,896	1,434,997	1,288,220	879,917	815,148	767,016	643,483
Utah	14,951	21,328	49,180	66,954	87,296	152,389	199,937	336,651	355,045	295,550	248,402	169,475
Vermont	3,220	1,687	8,337	11,808	13,270	16,847	16,587	15,145	16,802	16,216	5,420	2,929
Virginia	329,043	395,665	568,507	688,159	730,881	640,012	670,939	589,033	628,876	482,797	495,087	234,773

Washington	159,386	218,396	307,126	341,720	383,780	500,847	510,057	518,586	541,276	460,716	304,716	247,303
West Virginia	70,616	63,092	102,574	142,748	135,551	187,669	176,278	157,831	137,711	144,655	108,757	55,165
Wisconsin	71,220	77,722	174,987	270,041	286,877	395,273	451,091	429,111	361,021	346,544	145,059	46,908
Wyoming	6,689	5,959	8,880	15,445	18,779	47,150	103,298	89,804	17,403	32,558	20,096	8,019
	8,536,853	7,584,567	11,779,765	13,779,410	15,495,488	17,511,054	20,030,786	20,815,155	19,659,148	19,830,707	14,067,738	8,361,214
Unspecified [1]	578,147	708,433	783,235	994,590	853,512	738,946	470,214	466,845	488,852	553,293	585,262	593,786
Total shipped from cement plants	9,115,000	8,293,000	12,563,000	14,774,000	16,349,000	18,250,000	20,501,000	21,282,000	20,148,000	20,384,000	14,653,000	8,955,000

[1] Includes shipments to Alaska, Hawaii, Puerto Rico, and foreign countries.

LOCAL SUPPLIES

Of the 35 producing States in 1942, more portland cement was produced than consumed internally in 17 and production was less than requirements within the State in 18. Puerto Rico consumed more cement than was produced. Owing to the large aggregate capacity of mills in the State, the greatest surplus was recorded for Pennsylvania. These data, however, do not show areas or States in which a definite shortage of cement existed, because parts of any State commonly are supplied from mills of a neighboring State.

The total surplus of the producing States was distributed as follows: In 1941—to non-cement-producing States, 16,880,678 barrels, and to foreign countries, Alaska, Hawaii, and unspecified destinations, 5,919,919 barrels; in 1942—to non-cement-producing States, 17,908,965 barrels, and to foreign countries, Alaska, Hawaii, and unspecified destinations, 6,930,952 barrels.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1941–42, in barrels

State or division	1941			1942		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	7,610,030	2,491,851	+5,118,179	8,598,332	3,237,883	+5,360,449
California	20,186,028	16,850,718	+3,335,310	23,787,808	17,444,451	+6,343,357
Illinois	5,958,376	9,165,894	−3,207,518	7,102,393	9,717,134	−2,614,741
Iowa	5,328,398	3,259,370	+2,069,028	5,662,733	2,317,264	+3,345,469
Kansas	4,734,129	2,061,704	+2,672,425	7,726,291	4,704,821	+3,021,470
Michigan	9,819,218	6,907,824	+2,911,394	10,349,104	7,069,832	+3,279,272
Missouri	6,516,345	5,029,976	+1,486,369	7,397,960	3,877,208	+3,520,752
Ohio	8,021,857	8,455,877	−434,020	8,652,196	8,160,031	+492,165
Pennsylvania	32,868,220	10,000,181	+22,868,039	33,639,025	10,157,308	+23,481,717
Puerto Rico	465,158	1,433,387	−968,229	629,358	1,002,412	−373,054
Tennessee	5,623,800	4,281,918	+1,341,882	6,407,196	5,282,485	+1,124,711
Texas	9,842,260	8,598,148	+1,244,112	12,139,800	11,401,189	+738,611
Colorado, Montana, Utah, Wyoming, and Idaho	4,024,563	3,908,147	+116,416	4,588,428	5,634,502	−1,046,074
Oregon and Washington	4,464,473	4,545,269	−80,796	5,940,938	5,617,428	+323,510
Georgia, Kentucky, Virginia, Florida, and Louisiana	8,493,161	16,157,987	−7,664,826	8,074,555	19,007,986	−10,933,431
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	15,500,432	16,633,830	−1,133,398	18,137,387	23,462,193	−5,324,806
Maryland, New Jersey, and West Virginia	5,932,957	10,136,813	−4,203,856	4,822,553	9,667,789	−4,845,236
New York and Maine	12,049,832	14,719,746	−2,669,914	11,644,827	12,699,051	−1,054,224
	167,439,237	144,638,640	+22,800,597	185,300,884	160,460,967	+24,839,917

TRANSPORTATION

Methods and means of shipping portland cement from producing mills have changed considerably in recent years. Because of conditions imposed by the war, the changes from 1941 to 1942 probably were more marked than those between any other successive years. As shown in figure 3, there was a growing use of truck haulage from 1934, the first year for which data are available, to 1941. However, in 1942, the percentage hauled by truck decreased from 1941, owing undoubtedly to war restrictions on tires and gasoline. Rail shipments, which represent by far the major part of total cement movements, showed a small decrease in percentage from 1934 to 1941

but in 1942 regained most of the loss and returned nearly to 1934 proportions. Shipments by boat constitute only a small part of the total and have declined in percentage from 1934.

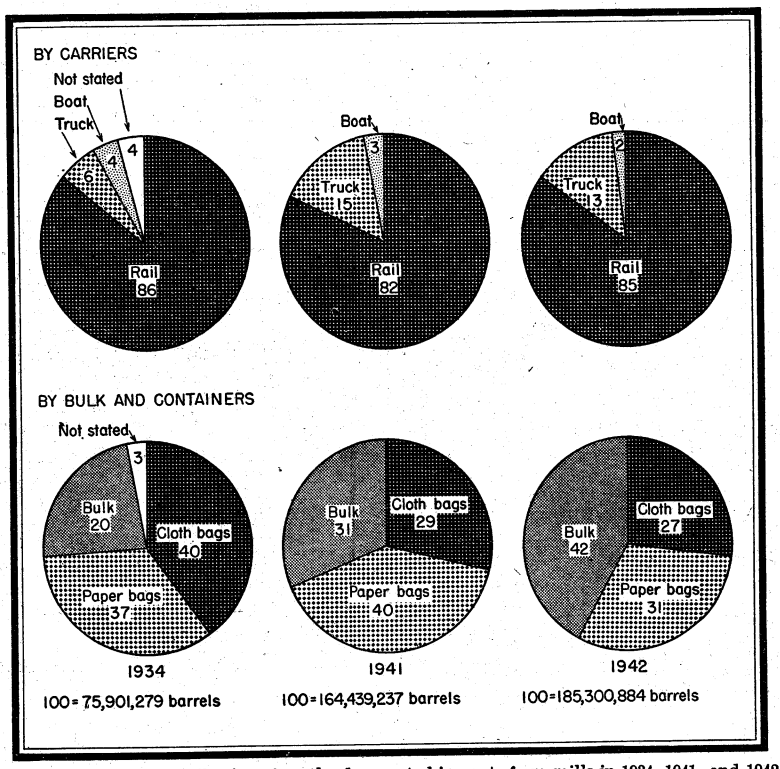

FIGURE 3.—Percentage distribution of portland-cement shipments from mills in 1934, 1941, and 1942, by types of carriers and by bulk and types of containers.

Distribution of cement shipments by bulk and types of containers in 1942 from 1941 differed considerably and differed also from the practice in 1934 and 1928. In 1928, only 2.4 percent of total shipments were made in bulk, and the rest were made in containers. Cloth bags apparently were the most popular containers used in 1928, although no specific data are available. After 1928 the proportions of bulk shipments increased rapidly to 20 percent in 1934 and 31 percent in 1941. Owing to the scarcity of packaging materials and to the fact that much of the construction in 1942 comprised large projects requiring much cement, the proportion of bulk shipments jumped to 42 percent of the total in 1942. Although the percentage of total shipments in cloth bags in 1934 was slightly higher than that in paper bags, by 1941 paper-bag shipments represented 40 percent of the total, compared with only 29 percent in cloth. As a result of the paper shortage in 1942 and the greater demand for bulk cement, the proportion shipped in paper declined to less than one-third of the total and was only slightly greater than the percentage shipped in cloth. The proportion shipped in cloth declined only slightly from 1941.

Shipments of portland cement from mills in the United States, 1940–42, in bulk and in containers, by types of carriers

[Barrels of 376 pounds]

Type of carrier	In bulk		In containers				Total shipments	
			Bags		Other containers [1]	Total		
			Paper	Cloth				
1940 [2]	*Barrels*	*Percent*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Percent*
Truck	[3] 3,873,113	11.6	8,325,992	8,095,980	-------	16,421,972	20,295,085	15.6
Railroad	28,870,110	86.5	45,724,386	32,522,949	23,527	78,270,862	107,140,972	82.2
Boat	614,471	1.9	1,319,683	971,870	-------	2,291,553	2,906,024	2.2
Pipe line	7,705	[4]	----------	----------	-------	----------	7,705	[4]
Percent of total	33,365,399	100.0	55,370,061	41,590,799	23,527	96,984,387	130,349,786	100.0
	25.6	-------	42.5	31.9	[4]	74.4	100.0	------
1941 [2]								
Truck	[3] 5,481,732	10.6	9,989,551	9,310,998	-------	19,300,549	24,782,281	14.8
Railroad	44,641,936	86.1	53,863,493	39,506,899	31,141	93,401,533	138,043,469	82.4
Boat	1,559,678	3.0	2,414,842	496,452	150	2,911,444	4,471,122	2.7
Pipe line	142,365	.3	----------	----------	-------	----------	142,365	.1
Percent of total	51,825,711	100.0	66,267,886	49,314,349	31,291	115,613,526	167,439,237	100.0
	31.0	-------	39.6	29.4	[4]	69.0	100.0	------
1942 [2]								
Truck	[3] 8,925,440	11.5	8,206,616	6,306,601	-------	14,513,217	23,438,657	12.6
Railroad	66,764,363	85.8	49,385,586	42,440,744	8,666	91,834,996	158,599,359	85.6
Boat	2,097,849	2.7	690,341	474,678	-------	1,165,019	3,262,868	1.8
Percent of total	77,787,652	100.0	58,282,543	49,222,023	8,666	107,513,232	185,300,884	100.0
	42.0	-------	31.4	26.6	[4]	58.0	100.0	------

[1] Includes steel drums and iron and wood barrels.
[2] Includes shipments for Puerto Rico.
[3] Includes cement used at mills by producers as follows—1940: 118,709 barrels; 1941: 196,765 barrels; 1942: 181,642 barrels.
[4] Less than 0.05 percent.

PRICES

Reflecting increased costs of production, the average selling value of all portland cement at the mill, excluding cost of containers and cash discounts, advanced 6 cents over 1941 to $1.53 per barrel in 1942. This average value, as computed from reported data, is higher than an average value for general-purpose cement because it includes special cements with relatively high prices.

Average mill value per barrel, in bulk, of portland cement in the United States, 1938–42

1938 [1]	$1.45	1941	$1.47
1939	1.47	1942	1.53
1940	1.46		

[1] Does not include Puerto Rico, where production began in 1939.

A study [1] of wholesale and retail prices of building materials states that portland cement generally is sold under the multiple basing-point price system, in which basing points are usually producing centers. The average wholesale and retail prices of portland cement in September 1939 in the 26 cities surveyed was $2.01 and $2.67 per barrel, respectively, an average spread of 33 percent. In general, the highest prices were reported in the West South Central and Rocky Mountain States, and the lowest were in the East North Central area. Both wholesale and retail prices showed fairly wide geographical variations.

[1] Temporary National Economic Committee, Geographical Differentials in Prices of Building Materials, Mono. 33, 1940, pp. 89–103.

CAPACITY OF PLANTS

Aggregate capacity of all portland cement plants increased slightly over 1941 and was utilized at 73.5 percent of the total to produce the record output in 1942. Capacity data for 1942 include 155 active plants and 1 inactive plant that produced or shipped since the beginning of 1935. Figures for 1 plant each in Indiana and New Jersey that ceased operations and were dismantled in 1942 also are included. The data were compiled from reports of producers, who were asked to make allowances for repairs and other unavoidable shut-downs, and are expressed in terms of finished portland cement so as to cover the limiting factor in production at each mill, whether it be in the raw-grinding, burning, or finish-grinding departments. During 1942, operators in the Texas, Virginia-Tennessee-Alabama-Georgia-Florida-Louisiana, California, and Puerto Rico districts used the largest percentage of installed capacity.

Portland-cement-manufacturing capacity of the United States, 1941–42, by producing districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1941	1942	1941	1942
Eastern Pennsylvania, New Jersey, and Maryland	45,274,000	45,554,000	68.5	69.2
New York and Maine	17,244,000	17,626,000	69.6	66.4
Ohio, western Pennsylvania, and West Virginia	26,574,000	26,243,000	57.0	59.3
Michigan	14,055,000	14,055,000	67.5	75.5
Wisconsin, Illinois, Indiana, and Kentucky	28,267,000	28,662,000	57.4	65.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	24,512,000	24,612,870	81.5	88.6
Eastern Missouri, Iowa, Minnesota, and South Dakota	22,475,000	20,936,622	52.8	61.3
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	16,598,000	16,915,000	59.7	81.1
Texas	12,352,000	13,200,154	78.4	91.9
Colorado, Montana, Utah, Wyoming, and Idaho	5,815,000	5,925,000	68.0	73.8
California	26,290,000	27,071,302	75.8	86.3
Oregon and Washington	7,440,000	7,440,000	58.9	78.8
Puerto Rico [1]	463,000	610,000	99.9	109.3
	247,359,000	248,850,948	66.3	73.5

[1] Includes a new plant in Puerto Rico (September 1942 first month in production).

It is noteworthy that of the 155 plants active in 1942, 83, or 54 percent of the total, had an installed annual capacity between 1,000,000 and 1,999,000 barrels.

Distribution of portland-cement plants in the United States in 1942, according to annual capacity

Estimated annual capacity, barrels:	*Number of plants*
Less than 1,000,000	37
1,000,000 to 1,999,000	83
2,000,000 to 2,999,000	25
Between 2,999,000 and 10,000,000	11
	156

Percentage of capacity used in each month of 1942 was well above that for the corresponding month of 1941. In 1942 the monthly percentage utilized increased steadily from the low of 57 in February to the high of 87 in September and October, from which it fell to 67 in December.

Percent of capacity used in the finished portland-cement industry in the United States, 1941–42

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1941	1942	1941	1942		1941	1942	1941	1942
January	42	59	53	67	July	75	80	60	71
February	43	57	54	69	August	77	85	61	73
March	50	61	56	69	September	78	87	62	73
April	59	69	57	70	October	79	87	64	73
May	69	77	57	71	November	73	80	65	74
June	74	79	58	71	December	65	67	65	74

Capacity of portland-cement plants in the United States, 1940–42, by processes

Process	Capacity						Percent of capacity utilized			Percent of total finished cement produced		
	Thousands of barrels			Percent of total								
	1940	1941	1942	1940	1941	1942	1940	1941	1942	1940	1941	1942
Wet	122,266	121,065	122,432	48.1	48.9	49.2	55.4	70.3	77.7	52.0	51.9	52.1
Dry	131,879	126,294	126,419	51.9	51.1	50.8	47.4	62.5	69.3	48.0	48.1	47.9
	254,145	247,359	248,851	100.0	100.0	100.0	51.2	66.3	73.5	100.0	100.0	100.0

Although in recent years the aggregate capacity of dry-process plants was slightly greater than that of wet-process plants, it seems significant that in recent years the wet-process capacity has been utilized more fully than the dry-process capacity.

CLINKER PRODUCTION

Production of clinker, the intermediate product of the industry, gained 11 percent over 1941. Stocks at mills on December 31, 1942, were unusually low and were 23 percent below those at the end of 1941.

Portland-cement clinker produced and in stock at mills in the United States, 1941–42, by processes, in barrels of 376 pounds [1]

Process	Plants		Production		Stock (Dec. 31)	
	1941	1942	1941	1942	1941 [2]	1942 [3]
Wet	90	90	84,568,000	93,817,195	2,499,495	1,722,266
Dry	65	65	79,061,000	87,450,266	2,075,033	1,787,070
	155	155	163,629,000	181,267,461	4,574,528	3,509,336

[1] Compiled from monthly estimates of the producers.
[2] Revised figures.
[3] Subject to revision.

PRODUCTION ACCORDING TO RAW MATERIALS

The relationship of the percentages of total output classified according to kinds of raw materials changed little in 1942 from 1941.

As indicated by the data available, mills employing cement rock and limestone have furnished approximately the same proportion of total output each year since 1912. However, in the 1900–1912

period there was a steady decline in the annual percentages supplied from these mills, which are mainly in eastern Pennsylvania and New Jersey. The decline was caused by the gradual spreading of the industry into all sections of the country and the concomitant erection of new plants using limestone and clay or shale as raw materials. Mills employing the latter group of raw materials supplied a generally rising percentage of total production until about 1926, from which, up to the present time, the annual proportion has fluctuated in a relatively narrow range. Since 1899, the proportion of total output of cement derived from marl and clay has declined more or less regularly to the present low percentages. Cements derived from slag and limestone have represented a relatively small and declining part of total production in recent years.

Production and percent of total output of portland cement in the United States, 1898–1914, 1926, 1929, 1933, 1935, 1941, and 1942, according to raw materials

Year	Cement rock and pure limestone		Limestone and clay or shale		Marl and clay		Blast-furnace slag and limestone	
	Barrels	Percent	Barrels	Percent	Barrels	Percent	Barrels	Percent
1898	2,764,694	74.9	365,408	9.9	562,092	15.2		
1899	4,010,132	70.9	546,200	9.7	1,095,934	19.4		
1900	5,960,739	70.3	1,034,041	12.2	1,454,797	17.1	32,443	0.4
1901	8,503,500	66.9	2,042,209	16.1	2,001,200	15.7	164,316	1.3
1902	10,953,178	63.6	3,738,303	21.7	2,220,453	12.9	318,710	1.8
1903	12,493,694	55.9	6,333,403	28.3	3,052,946	13.7	462,930	2.1
1904	15,173,391	57.2	7,526,323	28.4	3,332,873	12.6	473,294	1.8
1905	18,454,902	52.4	11,172,389	31.7	3,884,178	11.0	1,735,343	4.9
1906	23,896,951	51.4	16,532,212	35.6	3,958,201	8.5	2,076,000	4.5
1907	25,859,095	53.0	17,190,697	35.2	3,606,598	7.4	2,129,000	4.4
1908	20,678,693	40.6	23,047,707	45.0	2,811,212	5.5	4,535,300	8.9
1909	24,274,047	37.3	32,219,365	49.6	2,711,219	4.2	5,786,800	8.9
1910	26,520,911	34.6	39,720,320	51.9	3,307,220	4.3	7,001,500	9.2
1911	26,812,129	34.1	40,665,332	51.8	3,314,176	4.2	7,737,000	9.9
1912	24,712,780	30.0	44,607,776	54.1	2,467,368	3.0	10,650,172	12.9
1913	29,333,490	31.8	47,831,863	51.9	3,734,778	4.1	11,197,000	12.2
1914	24,907,047	28.2	50,168,813	56.9	4,038,310	4.6	9,116,000	10.3
1926	44,090,657	26.8	[1] 101,637,866	61.8	3,324,408	2.0	15,477,239	9.4
1929	51,077,034	29.9	[1] 97,623,502	57.2	4,832,700	2.9	17,112,800	10.0
1933	14,135,171	22.3	[1] 43,638,023	68.7	1,402,744	2.2	4,297,251	6.8
1935	23,811,687	31.0	[1] 45,073,144	58.8	1,478,569	1.9	6,378,170	8.3
1941	46,534,193	28.4	[1] 102,285,699	62.3	3,142,021	1.9	12,068,646	7.4
1942	49,479,304	27.0	[1] 115,948,373	63.4	3,009,562	1.7	14,343,945	7.9

[1] Includes output of 2 plants using oystershells and clay in 1926; 3 plants in 1929, 1933, and 1935; and 4 plants in 1941 and 1942.

RAW MATERIALS

Approximately 58,853,443 short tons of raw materials (exclusive of fuels and explosives) entered into the manufacture of 182,781,184 barrels (34,362,863 short tons) of portland cement in 1942, an average of 644 pounds to a 376-pound barrel of finished cement. The totals for 1942, with corresponding figures for 1941 (in parentheses), follow: 47,657,208 tons of limestone and cement rock (42,733,707 tons); 5,181,582 tons of clay and shale (4,726,192 tons); 809,371 tons of slag (659,201 tons); 903,360 tons of marl (1,066,635 tons); 1,248,448 tons of gypsum (1,035,179 tons); and 3,053,474 tons of other materials such as oyster shells, sandstone, sand, cinders, fluorspar, iron ore, diatomaceous shale, pumicite, fuller's earth, bentonite, silica, quartz, ashes, pyrite cinder and ore, roll scale, calcium chloride, and hydrated lime (2,534,339 tons).

FUELS AND POWER

Fuels.—The fuel-oil shortage in the Eastern States in the latter half of 1942 forced cement plants to convert from oil to coal wherever possible. As a result, and because of increased production, the quantity of coal consumed by the portland-cement industry increased markedly over 1941. However, total consumption of fuel oil declined only slightly owing to the greater output of cement in areas where oil was not restricted. Consumption of natural gas by the industry was well above 1941. At the end of 1942, greatly increased requirements for natural gas for industrial and heating purposes caused local shortages in Kansas and Nebraska, and mills in that area had difficulty in obtaining adequate supplies.

Finished portland cement produced and fuel consumed by the portland-cement industry in the United States, 1941–42, by processes

Process	Finished cement produced			Fuel consumed [1]		
	Plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1941						
Wet	90	85,153,919	51.9	[2] 3,325,823	2,090,700	34,045,968,833
Dry	65	78,876,640	48.1	3,506,002	1,461,330	20,161,932,000
	155	164,030,559	100.0	[3] 6,831,825	3,552,030	54,207,900,833
1942						
Wet	90	95,171,022	52.1	[4] 3,637,571	1,896,044	40,850,105,348
Dry	65	87,610,162	47.9	3,932,516	1,532,975	23,689,722,940
	155	182,781,184	100.0	[5] 7,570,087	3,429,019	64,539,828,288

[1] Figures compiled from monthly estimates of the producers.
[2] In addition to the coal shown for this group, 2 plants reported the use of petroleum coke with coal and natural gas.
[3] Includes 96,768 short tons of anthracite and 6,735,057 short tons of bituminous coal.
[4] In addition to the coal shown for this group, 1 plant reported the use of petroleum coke with coal and natural gas.
[5] Includes 107,653 short tons of anthracite and 7,462,434 short tons of bituminous coal.

Finished portland cement produced and fuel consumed by the portland-cement industry in the United States, 1941–42, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed [1]		
	Plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1941						
Coal	102	[2] 104,385,531	63.6	6,193,207		
Oil	11	[2] 11,341,543	7.0		2,524,587	
Natural gas	15	[2] 14,933,181	9.1			22,127,284,511
Coal and oil	6	9,501,559	5.8	508,571	567,318	
Coal and natural gas [3]	15	13,454,345	8.2	128,659		19,666,186,322
Oil and natural gas	5	10,414,400	6.3		422,223	11,073,254,000
Coal, oil, and natural gas	1			1,388	37,902	1,341,176,000
	155	164,030,559	100.0	[4] 6,831,825	3,552,030	54,207,900,833
1942						
Coal	98	[2] 107,168,837	58.6	6,329,228		
Oil	12	[2] 12,893,278	7.0		2,820,520	
Natural gas	12	[2] 15,103,415	8.3			21,641,045,940

[1] Figures compiled from monthly estimates of the producers.
[2] Average consumption of fuel per barrel of cement produced was as follows: 1941—coal, 118.7 pounds; oil, 0.2226 barrel; natural gas, 1,482 cubic feet. 1942—coal, 118.1 pounds; oil, 0.2188 barrel; natural gas, 1.433 cubic feet.
[3] In addition to the coal and natural gas included for this group, 2 plants reported the use of petroleum coke with coal and natural gas.
[4] Includes 96,768 short tons of anthracite and 6,735,057 short tons of bituminous coal.

Finished portland cement produced and fuel consumed by the portland-cement industry in the United States, 1941–42, by kinds of fuel—Continued

Fuel	Finished cement produced			Fuel consumed [1]		
	Plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1942—Continued						
Coal and oil	9	14,938,889	8.2	971,619	250,711	
Coal and natural gas [5]	13	14,443,714	7.9	260,153		18,585,083,957
Oil and natural gas	7	13,269,603	7.3		304,190	17,348,363,000
Coal, oil, and natural gas	4	4,963,448	2.7	9,087	53,598	6,965,335,391
	155	182,781,184	100.0	[6] 7,570,087	3,429,019	64,539,828,288

[5] 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.
[6] Includes 107,653 short tons of anthracite and 7,462,434 short tons of bituminous coal.

Electric power.—Ten percent more electric power was consumed by portland cement mills in 1942 than in 1941. However, the average quantity used per barrel of finished cement produced decreased slightly from 22.2 kilowatt-hours in 1941 to 21.9 kilowatt-hours in 1942.

Electric energy used at portland-cement-producing plants in the United States, 1941–42, by processes, in kilowatt-hours

Process	Electric energy used						Finished cement produced	Average electric 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
1941								
Wet	32	643,610,788	74	1,224,801,790	1,868,412,578	51.3	85,153,919	21.9
Dry	36	1,076,033,868	54	700,009,725	1,776,043,593	48.7	78,876,640	22.5
	68	1,719,644,656	128	1,924,811,515	3,644,456,171	100.0	164,030,559	22.2
Percent of total electric energy used		47.2		52.8	100.0			
1942								
Wet	31	656,101,658	76	1,370,871,010	2,026,972,668	50.6	95,171,022	21.3
Dry	35	1,229,365,051	52	752,007,188	1,981,372,239	49.4	87,610,162	22.6
	66	1,885,466,709	128	2,122,878,198	4,008,344,907	100.0	182,781,184	21.9
Percent of total electric energy used		47.0		53.0	100.0			

SPECIAL CEMENTS

In addition to the standard or general-purpose portland cement that constitutes most of the total production, several special varieties are made. Of these, the low- and moderate-heat and high-early-strength types are the most important, and demand for them has increased sharply in recent years. Demand for the other special cements was considerably below that in 1941.

Prepared masonry mortars.—Production of these mixed materials from 48 plants totaled 2,067,370 barrels and shipments 2,079,015 barrels, valued at $3,115,799, an average of $1.50 per barrel. These data are not included in the statistics of this chapter, but the portland cement used in their manufacture is included.

Special portland cements produced and shipped in the United States, 1938–42, by kinds

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
High-early-strength:					
1938	72	3,340,582	3,385,523	$6,247,699	$1.85
1939	79	3,780,716	3,693,460	6,964,608	1.89
1940	88	4,478,797	4,401,449	8,243,315	1.87
1941	90	6,063,638	6,123,224	11,443,792	1.87
1942	87	7,523,647	7,065,700	13,683,665	1.94
Masonry or mortar:					
1938	5	84,875	88,905	124,239	1.40
1939	5	173,737	155,781	211,711	1.36
1940	5	219,480	214,303	308,333	1.44
1941					
1942	1	(1)	(1)	(1)	(1)
Low- and moderate-heat:					
1938	38	4,181,568	3,808,927	5,710,698	1.50
1939	43	5,564,921	5,761,840	8,237,440	1.43
1940	55	8,559,487	7,709,503	10,307,976	1.34
1941	58	11,290,232	11,177,651	14,963,940	1.34
1942	60	13,020,467	13,404,761	19,136,773	1.43
Portland-puzzolan:					
1938	9	198,268	185,664	285,088	1.54
1939	9	337,187	321,217	434,281	1.35
1940	10	413,870	412,143	552,830	1.34
1941	8	441,500	439,354	632,713	1.44
1942	7	324,002	329,637	465,627	1.41
White:					
1938	4	369,390	369,847	1,351,875	3.66
1939	3	(1)	(1)	(1)	(1)
1940	3	(1)	(1)	(1)	(1)
1941	4	538,752	549,293	2,191,289	3.99
1942	5	345,613	306,120	1,214,422	3.97
Oil-well:					
1938	8	238,966	232,319	481,401	2.07
1939	12	375,866	375,027	710,032	1.89
1940	22	711,348	719,022	1,365,840	1.90
1941	19	786,167	806,364	1,550,301	1.92
1942	17	537,541	552,157	1,100,296	1.99
Sulfate-resisting:					
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
1941	9	342,400	353,885	544,767	1.54
1942	8	79,835	77,015	136,939	1.78
Miscellaneous:					
1938	15	642,854	625,860	1,004,393	1.60
1939	15	755,833	775,179	1,067,699	1.38
1940	13	580,502	577,579	755,764	1.31
1941	14	668,655	667,206	1,058,108	1.59
1942	12	242,170	269,705	468,083	1.74

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

NEW DEVELOPMENTS

To conserve power and grinding equipment and to increase production, emergency alternate specifications [2] approved early in June, reduced the types of portland cement from 5 to 3—general-purpose, moderate-heat, and high-early-strength. These specifications differed from those in effect before the emergency by limiting the maximum specific surface area to not more than 2,000 square centimeters per gram and lowering the minimum requirement to 1,500 square centimeters per gram; by raising the permitted expansion in the autoclave to 1 percent; by eliminating the 28-day test and requiring tests only

[2] Federal Specifications Board, Emergency Alternate Federal Specification for Cement, Portland-E-SS-C-191b; Portland-E-SS-C-201a; and Portland-E-SS-C-206a; June 5, 1942.
Am. Soc. for Testing Materials, Emergency Alternate Specifications for Portland Cement, A. S. T. M.: Designation EA-C-150-Type I; EA-C-150-Type II; and EA-C-150-Type III; June 6, 1942.

at 3 and 7 days; and by permitting the use of TDA in all three types and of vinol resin in the general-purpose and moderate-heat types.

Results of a study [3] on hydrated calcium aluminates yielded fundamental information on phase solubilities and equilibria of the CaO–Al_2O_3–H_2O system.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

Production of the natural, masonry (natural), and puzzolan cements declined slightly from 1941. Output of these cements had advanced from 1938 to 1941, in which year annual output was higher than at any time since 1907. In 1942 producers reported consumption of 36,808 short tons of coal and of gas equivalent to 70 tons of coal.

Shipments also declined in 1942 from 1941, and, as production exceeded shipments, stocks on December 31, 1942, were 26 percent greater than at the end of 1941.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1938–42

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1938	12	1,820,795	1,867,949	$2,725,776	373,816
1939	12	2,439,110	2,405,135	3,361,724	239,938
1940	12	2,534,566	2,514,597	3,386,801	259,868
1941	12	2,875,962	2,926,203	3,967,567	[1] 199,355
1942	11	2,560,425	2,508,324	3,668,169	251,466

[1] Revised figure.

FOREIGN TRADE

Because of wartime restrictions, no figures on imports and exports can be published. However, foreign trade of the United States in cement has little effect on the domestic industry; consequently, it is believed that lack of these data will not detract appreciably from the value of this chapter. Foreign-trade figures will be released at the termination of the war so as to preserve the continuity of the statistical record.

Imports.—During the 1935–39 period, imports of hydraulic cement ranged from 619,404 barrels valued at $615,866 (c. i. f. port of shipment) in 1935 to 1,913,853 barrels at $1,860,543 in 1939 and had an annual average of 1,544,700 barrels at $1,345,478. This average represents only 1.4 percent of the average annual consumption of 108,934,353 barrels in the United States during the 1935–39 period. In 1939, the last year with an undisturbed flow of imports, about 97 per cent of total imports of cement originated in Europe, more than half coming from Belgium and about a fourth from Denmark. Following the outbreak of war in Europe in 1939, the conquering of Denmark, Norway, Belgium, and France by Germany in the first half of 1940, and the blockade of Europe by the British Navy, cement imports during 1940 slumped to 538,060 barrels valued at $506,191.

[3] Wells, Lansing S., Clarke, W. F., and McMurdie, H. F., Study of the System CaO–Al_2O_3–H_2O at Temperatures of 21° and 90°C: National Bureau of Standards Jour. of Research, vol. 30, May 1943, pp. 367–409.

This quantity represents only 0.4 percent of the apparent consumption (131,734,848 barrels) in the United States in 1940. Importation virtually ceased in 1941, during the first 9 months of which 43,110 barrels valued at $57,914 were brought into the country. The monthly rate of import in 1941 was 4,790 barrels, compared with 44,838 barrels per month during 1940, a decline of 89 percent. It seems evident that imports in 1942 undoubtedly were insignificant.

Exports.—Exports in the 1935–39 period ranged from 334,673 barrels valued at $886,560 in 1936 to 1,146,339 barrels at $2,352,693 in 1939 and had an annual average of 566,778 barrels at $1,318,248. This average is only 0.5 percent of average annual domestic shipments of cement (107,956,430 barrels) in the United States during 1935–39. In 1940, the last year for which complete data are available, exports increased 45 percent over 1939 to 1,667,595 barrels valued at $3,294,118, a quantity representing only 1.3 percent of domestic shipments (132,864,383 barrels) from mills in the United States during the same year. Exports in 1940 were distributed as follows: 73 percent (1,212,909 barrels) to North American countries (including the West Indies), of which more than half went to Panama (Republic and Canal Zone); 26 percent (431,904 barrels) to South American countries, of which three-fourths went to Venezuela; and the remaining 1 percent was distributed to countries in Europe (452 barrels), Asia (7,810 barrels), Africa (14,108 barrels), and Oceania (412 barrels). Exports during the first 9 months of 1941 totaled 1,757,172 barrels valued at $3,793,511, a monthly rate of 195,241 barrels or 40 percent higher than the 138,966 barrels per month exported in 1940.

Shipments of domestic hydraulic cements to noncontiguous territories of the United States in 1940, the last year for which data were published, were nearly double those in 1939 and totaled 1,461,940 barrels valued at $2,628,402, of which 47 percent was sent to Hawaii and 46 percent to Puerto Rico. These 1940 shipments represent 1.1 percent of total domestic shipments from mills in the same year.

In 1942, both exports and shipments to noncontiguous countries undoubtedly were greater than in 1941, owing to such factors as increased construction of military and naval facilities by the United States in offshore locations and foreign countries, the accelerated construction of the Pan American Highway, and the continued blockade of European producers from world markets for cement. Partly offsetting these factors, the Army, Navy, and other governmental agencies performing construction work outside the United States have tended to use local or the nearest source of supply of cement to conserve shipping space.

WORLD PRODUCTION

World production of hydraulic cements in 1942, based upon the meager data available, is estimated at approximately 72 million metric tons.

Output in most of the countries of the Western Hemisphere doubtless was higher in 1942 than 1941, owing principally to the increased construction of war plants, military facilities, and the Pan American highway. However, in some countries production was below the 1941 level, as in Brazil, where a fuel shortage reportedly curtailed production.

In all European countries, except Spain, production probably was curtailed markedly because of labor and fuel shortages. Military uses undoubtedly consumed most of the product in these countries, and civilian and industrial consumption was kept at a bare minimum as was indicated by the regulation in Germany requiring approval of all purchases exceeding 10 sacks.

In most of the Mediterranean and Near-Eastern countries and in India and Australia production probably gained markedly over 1941, whereas output in the Far Eastern countries declined somewhat. Production in countries in southern and eastern Africa no doubt increased over 1941.

World production of hydraulic cements, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942
North America:						
Canada	975,231	876,193	909,875	1,200,143	1,328,587	1,456,850
Cuba	(2)	(2)	(3)	(3)	(3)	(3)
Guatemala	(2)	(2)	(3)	(3)	(3)	(3)
Mexico	344,693	373,712	409,784	484,992	537,464	(3)
United States	20,137,732	18,279,156	21,267,269	22,640,675	28,465,880	31,609,981
South America:						
Argentina	1,035,495	1,245,458	1,141,865	1,088,591	(3)	(3)
Bolivia	11,100	18,600	(3)	24,285	(3)	(3)
Brazil	571,462	617,896	697,793	743,634	767,506	(3)
Chile	313,110	363,987	447,992	385,091	359,720	[4] 308,700
Colombia	123,175	141,809	167,000	188,000	210,912	(3)
Ecuador	(2)	(2)	15,445	16,490	18,631	(3)
Peru	83,048	101,380	119,986	124,480	167,872	[5] 140,418
Uruguay	147,773	158,359	173,500	167,880	179,066	(3)
Venezuela	44,626	39,863	39,130	87,068	(3)	(3)
Europe:						
Albania	14,000	(2)	(3)	(3)	(3)	(3)
Belgium	3,008,016	3,054,144	2,551,756	(3)	(3)	(3)
Bulgaria	135,000	180,000	(3)	(3)	(3)	(3)
Czechoslovakia	1,360,000	(2)	(3)	(3)	(3)	(3)
Denmark	676,125	639,957	696,000	441,000	(3)	(3)
Estonia	65,931	79,740	77,000	(3)	(3)	(3)
Finland	410,371	475,152	563,000	(3)	(3)	(3)
France	4,254,800	(2)	(3)	(3)	(3)	(3)
Germany	12,605,000	15,600,000	(3)	(3)	(3)	(3)
Austria	430,000	650,000	(3)	(3)	(3)	(3)
Greece	290,000	308,000	(3)	(3)	(3)	(3)
Hungary	392,000	395,000	(3)	(3)	(3)	(3)
Ireland		110,000	261,000	272,000	(3)	(3)
Italy	4,359,112	4,607,454	4,800,000	(3)	(3)	(3)
Latvia	117,591	154,621	164,601	(3)	(3)	(3)
Netherlands	441,000	456,000	541,000	(3)	(3)	(3)
Norway	320,481	331,600	390,000	(3)	(3)	(3)
Poland	1,289,108	1,719,452	(3)	(3)	(3)	(3)
Portugal	254,000	268,000	297,000	271,173	(3)	[5] 186,967
Rumania	456,311	448,402	531,000	400,000	(3)	(3)
Spain	379,751	592,427	1,194,481	1,557,878	(3)	(3)
Sweden	875,541	992,932	1,184,991	700,749	(3)	(3)
Switzerland	(3)	[6] 650,000	(3)	650,000	[7] 700,000	[7] 500,000
U. S. S. R	5,459,000	5,696,000	5,700,000	5,800,000	(3)	(3)
United Kingdom	7,300,000	7,900,000	(3)	(3)	(3)	(3)
Yugoslavia	618,635	712,302	663,000	(3)	(3)	(3)
Asia:						
China	250,000	24,000	[6] 540,000	652,500	(3)	(3)
Manchuria	[7] 800,000	(3)	(3)	(3)	(3)	(3)
Chosen	665,000	(3)	(3)	(3)	(3)	(3)
Hong Kong	(2)	110,036	(3)	(3)	(3)	(3)
India, British	1,142,000	(2)	(3)	(3)	(3)	(3)
Indochina	234,638	266,366	305,800	278,500	(3)	(3)
Iran	(2)	(2)	(3)	(3)	(3)	(3)
Japan and colonies	6,034,000	5,519,000	5,074,000	[7] 4,250,000	(3)	(3)

[1] Data cover all hydraulic cements.
[2] Data not available; estimate included in total.
[3] Data not available.
[4] January to November, inclusive.
[5] January to September, inclusive.
[6] Shipments.
[7] Approximate production.

World production of hydraulic cements, 1937–42, by countries, in metric tons—Continued

Country	1937	1938	1939	1940	1941	1942
Asia—Continued.						
Netherlands Indies	(2)	(2)	[7] 170,000	(3)	(3)	(3)
Palestine	161,000	98,445	112,350	148,487	(3)	(3)
Philippine Islands	150,374	167,448	(3)	(3)	(3)	(3)
Syria and Lebanon	250,000	251,000	227,285	91,653	(3)	250,000
Thailand (Siam)	77,000	82,000	[8] 92,000	[8] 116,864	(3)	(3)
Turkey	214,794	267,568	283,624	266,637	(3)	(3)
Africa:						
Algeria	65,000	(2)	(3)	(3)	(3)	(3)
Belgian Congo	10,723	16,500	35,000	(3)	(3)	(3)
Egypt	330,000	375,763	371,941	360,832	420,107	(3)
Morocco, French	156,000	165,000	(3)	(3)	(3)	(3)
Mozambique	14,957	24,297	27,618	27,893	(3)	(3)
Tunisia	56,400	68,700	(3)	(3)	(3)	(3)
Union of South Africa	839,526	878,206	948,664	831,018	(3)	(3)
Oceania:						
Australia [9]	731,650	862,539	881,778	879,000	(3)	(3)
New Zealand [8]	176,000	220,000	235,000	(3)	(3)	(3)
	82,714,000	85,859,000	(10)	(10)	(10)	72,000,000

[2] Data not available; estimate included in total.
[3] Data not available.
[7] Approximate production.
[8] Year ended March 31 of year stated.
[9] Year ended June 30 of year stated.
[10] Estimate not prepared.

STONE

By Oliver Bowles and M. S. Jensen

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GENERAL CONDITIONS

Sales of crushed and dimension stone combined were 7 percent greater in 1942 than in 1941 and attained an all-time high record of 195,884,490 short tons. The total value of sales (which, for the first time in history, exceeded $200,000,000) was 5 percent greater than in 1941. The gains, however, were confined almost exclusively to crushed and broken stone because wartime construction requires very small quantities of building stone. Sales of dimension stone (exclusive of slate) were 31 percent lower in quantity and 22 percent in value. The crushed-stone industry, on the other hand, gained 7 percent in quantity and 8 percent in value. The trends in these two great branches of the stone industries were the same as in 1941, but the downward trend of dimension-stone sales was accelerated, whereas the upward movement of crushed stone was retarded.

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, 1938–42, 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
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
1941	14,298,750	24,968,489	17,936,950	18,641,852	176,460	4,785,710	133,163,600	127,585,118
1942	14,064,780	23,794,514	17,626,660	21,005,943	169,500	3,910,203	142,487,600	138,578,027

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	7,592,820	10,768,748	9,939,380	8,587,509	183,107,960	195,337,426
1942	6,700,920	8,620,453	14,835,030	9,092,879	195,884,490	205,002,019

[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, 1941–42, by uses

Use	1941		1942	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction, short tons	389,160	$1,706,591	267,100	$1,354,087
Cut stone, slabs, and mill blocks, cubic feet	5,596,240	8,111,376	2,848,180	4,572,074
Approximate equivalent in short tons	426,850		214,100	
Rubble, short tons	729,490	870,043	544,450	957,790
Monumental stone, cubic feet	2,882,310	9,110,846	2,737,240	8,976,566
Approximate equivalent in short tons	237,440		225,910	
Paving blocks, number	[1] 2,384,110	[1] 255,276	1,986,910	188,830
Approximate equivalent in short tons	[1] 20,850		18,540	
Curbing, cubic feet	[1] 820,470	[1] 896,209	314,830	361,590
Approximate equivalent in short tons	[1] 66,240		25,380	
Flagging, cubic feet	990,900	445,493	679,990	290,646
Approximate equivalent in short tons	76,950		51,980	
Total dimension stone (quantities approximate, in short tons)	1,946,980	21,395,834	1,347,460	16,701,583
Crushed and broken stone:				
Riprap, short tons	5,152,640	5,226,623	8,763,980	9,779,249
Crushed stone, do	120,963,910	114,522,259	125,267,650	116,394,778
Furnace flux (limestone and marble), do	27,436,440	20,069,296	30,262,910	24,152,113
Refractory stone [2], do	2,254,120	3,279,104	2,718,090	3,999,929
Agricultural (limestone), do	11,909,640	14,395,831	13,745,400	16,993,254
Other uses [3], do	13,444,230	16,448,479	13,779,000	16,981,113
Total crushed and broken stone, do	181,160,980	173,941,592	194,537,030	188,300,436
Grand total (quantities approximate, in short tons)	183,107,960	195,337,426	195,884,490	205,002,019

[1] To avoid disclosing confidential information, sandstone paving blocks in 1941 are included under "Curbing."

[2] Ganister (sandstone), mica schist, soapstone, and dolomite.

[3] Includes roofing granules as follows—1941: 177,439 tons, $715,068; 1942: 212,008 tons, $832,857. Slate granules used for roofing were produced, as follows—1941: 323,740 tons, $2,708,246; 1942: 356,510 tons, $2,955,562.

Stone sold or used by noncommercial producers in the United States in 1942, by uses

[Included in total production]

Use	Short tons	Value	Use	Short tons	Value
Dimension stone:			Crushed and broken stone:		
Building stone	148,650	$309,562	Riprap	2,787,210	$2,667,495
Rubble	95,940	241,359	Crushed stone	15,449,080	16,262,654
Curbing	1,470	9,157	Agricultural (limestone)	428,180	375,259
			Other uses	491,700	400,846
Total dimension stone	246,060	560,078	Total crushed and broken	19,156,170	19,706,254
			Grand total	19,402,230	20,266,332

Stone sold or used by producers in the United States, 1941–42, by States

State	1941		1942	
	Short tons (approximate)	Value	Short tons (approximate)	Value
Alabama	2,804,740	$3,745,651	3,141,300	$3,738,902
Arizona	455,900	340,872	227,220	219,231
Arkansas	[1] 1,788,470	[1] 1,763,196	2,033,410	2,152,956
California	[1] 9,139,390	[1] 7,535,017	[1] 12,288,700	[1] 11,031,326
Colorado	1,104,820	1,073,400	[1] 951,510	[1] 735,994
Connecticut	[1] 2,244,900	[1] 2,435,841	1,556,350	1,692,399
Delaware	109,850	147,212	[2]	[2]
Florida	[1] 4,065,450	[1] 3,852,539	[1] 6,632,680	[1] 5,733,697
Georgia	2,808,790	5,809,755	[1] 3,623,160	[1] 6,620,633
Hawaii	[1] 1,330,170	[1] 2,149,535	[2]	[2]
Idaho	767,750	644,006	470,590	588,989
Illinois	[1] 11,856,340	[1] 10,706,996	14,056,050	12,686,759
Indiana	5,257,530	6,742,744	[1] 6,460,540	[1] 7,007,241
Iowa	5,790,920	5,657,585	4,474,480	4,849,803
Kansas	2,727,290	3,171,598	2,588,200	3,031,049
Kentucky	[1] 5,779,800	[1] 5,177,170	[1] 5,641,280	[1] 5,454,914
Louisiana	[2]	[2]	[2]	[2]
Maine	324,060	1,295,180	[1] 196,010	[1] 556,655
Maryland	1,604,430	2,218,478	1,220,190	1,807,265
Massachusetts	2,602,120	4,547,808	[1] 1,800,600	[1] 3,468,788
Michigan	15,161,820	8,349,607	16,093,050	9,433,035
Minnesota	1,002,190	1,811,805	[1] 1,451,210	[1] 1,858,631
Mississippi	[1] 500	[1] 750		
Missouri	6,501,460	7,048,207	[1] 9,235,540	[1] 8,347,132
Montana	455,680	336,632	393,200	303,250
Nebraska	[1] 328,690	[1] 660,573	267,020	630,413
Nevada	183,170	226,827	137,920	196,726
New Hampshire	[1] 167,270	[1] 373,157	237,090	440,714
New Jersey	3,206,050	3,782,036	3,393,510	3,776,745
New Mexico	118,180	111,709	515,240	248,895
New York	10,406,740	10,806,450	11,244,670	11,513,020
North Carolina	3,820,200	4,806,623	3,039,580	3,774,472
North Dakota	18,590	19,713	[2]	[2]
Ohio	[1] 13,842,870	[1] 12,469,498	14,831,660	13,546,490
Oklahoma	1,876,570	1,945,753	5,946,520	3,172,547
Oregon	2,836,390	2,436,783	2,596,030	2,635,086
Pennsylvania	[1] 23,506,540	[1] 25,013,400	[1] 23,131,670	[1] 26,892,960
Puerto Rico	675,970	968,448	[2]	[2]
Rhode Island	212,580	493,715	191,420	351,664
South Carolina	2,055,090	2,574,797	2,040,610	2,624,284
South Dakota	[1] 401,550	[1] 1,189,564	714,750	1,763,790
Tennessee	7,896,970	9,157,673	7,716,540	9,018,272
Texas	3,497,720	2,908,364	3,772,040	3,658,802
Utah	408,140	340,551	285,170	318,261
Vermont	185,840	4,190,112	244,110	3,831,399
Virginia	9,195,450	9,586,541	7,052,930	7,938,383
Washington	2,148,970	1,757,873	1,965,820	1,809,757
West Virginia	[1] 4,547,200	[1] 5,988,840	3,223,330	3,238,008
Wisconsin	4,376,720	5,666,120	4,492,740	6,309,369
Wyoming	838,050	737,455	179,290	207,122
Undistributed	672,080	563,267	4,129,560	5,786,191
	183,107,960	195,337,426	195,884,490	205,002,019

[1] To avoid disclosing confidential information, certain State totals are incomplete, the figures not included being combined under "Undistributed."
[2] Included under "Undistributed."

DIMENSION STONE

Dimension stone and crushed stone are so diverse in character and use that they are considered in separate sections of this chapter. The term "dimension stone" is applied to blocks or slabs of natural stone, most of which are cut to definite shapes and sizes. The principal uses of dimension stone are for construction of masonry walls and for memorials. Crushed and broken stone, on the other hand, consists of irregular fragments or grains, sized chiefly by mechanical screening or air separation. The principal uses are as roadstone, concrete aggregate, railroad ballast, furnace flux, and a great variety of industrial applications that have little or no relation to masonry construction.

Dimension-stone producers may be divided into three main groups upon the basis of plant operation. The first group quarries stone and sells it as rough blocks or slabs; the second quarries stone and also manufactures it into finished products; and the third buys sawed slabs or rough blocks of stone and manufactures them into finished products but does not operate quarries. The Bureau of Mines statistical canvass covers the first and second groups, but 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 1942 declined 32 percent in quantity and 24 percent in value compared with 1941. These figures include slate, but details of the slate industry are given in the separate chapter on Slate. Basalt in the form of rubble and sandstone used for rough construction and rubble made gains in quantity, but all varieties of stone suffered declines in value of sales that ranged from 7 percent for basalt to 43 percent for limestone.

The following table presents salient statistics for 1941 and 1942.

Dimension stone sold or used by producers in the United States, 1941–42, by kinds and uses

Kind and use	1941	1942	
		Total	Percent of change
Granite:			
Building stone:			
Rough construction, short tons	167,440	36,380	−78.3
Value	$298,253	$132,276	−55.6
Average per ton	$1.78	$3.64	+104.5
Cut stone, slabs, and mill blocks, cubic feet	736,730	413,180	−43.9
Value	$1,853,203	$1,030,223	−44.4
Average per cubic foot	$2.52	$2.49	−1.2
Rubble, short tons	277,950	215,730	−22.4
Value	$349,739	$404,460	+15.6
Monumental stone, cubic feet	2,576,550	2,442,630	−5.2
Value	$7,489,197	$7,092,572	−5.3
Average per cubic foot	$2.91	$2.90	−.3
Paving blocks, number	2,384,110	1,986,910	−16.7
Value	$255,276	$188,830	−26.0
Curbing, cubic feet	528,420	200,540	−62.0
Value	$585,808	$232,392	−60.3
Total:			
Quantity, approximate short tons	782,120	522,170	−33.2
Value	$10,831,476	$9,080,753	−16.2

Dimension stone sold or used by producers in the United States, 1941–42, by kinds and uses—Continued

Kind and use		1941	1942	
			Total	Percent of change
Basalt and related rocks (trap rock):				
Building stone:				
Rough construction	short tons	10,170	4,880	−52.0
Value		$17,182	$12,652	−26.4
Average per ton		$1.69	$2.59	+53.3
Rubble	short tons	130	7,870	+5,953.8
Value		$550	$3,869	+603.5
Total:				
Quantity	short tons	10,300	12,750	+23.8
Value		$17,732	$16,521	−6.8
Marble:				
Building stone (cut stone, slabs, and mill blocks)	cubic feet	511,810	278,460	−45.6
Value		$2,748,572	$1,567,736	−43.0
Average per cubic foot		$5.37	$5.63	+4.8
Monumental stone	cubic feet	305,760	294,610	−3.6
Value		$1,621,649	$1,883,994	+16.2
Average per cubic foot		$5.30	$6.39	+20.6
Total:				
Quantity	approximate short tons	69,300	48,590	−29.9
Value		$4,370,221	$3,451,730	−21.0
Limestone:				
Building stone:				
Rough construction	short tons	106,290	96,610	−9.1
Value		$367,995	$209,313	−43.1
Average per ton		$3.46	$2.17	−37.3
Cut stone, slabs, and mill blocks	cubic feet	3,834,860	1,891,930	−50.7
Value		$2,909,728	$1,582,254	−45.6
Average per cubic foot		$0.76	$0.84	+10.5
Rubble	short tons	405,220	221,180	−45.4
Value		$439,479	$324,097	−26.3
Flagging	cubic feet	210,290	100,790	−52.1
Value		$62,794	$28,823	−54.1
Total:				
Quantity	approximate short tons	813,620	462,970	−43.1
Value		$3,779,996	$2,144,487	−43.3
Sandstone:				
Building stone:				
Rough construction	short tons	31,850	84,980	+166.8
Value		$106,426	$174,730	+64.2
Average per ton		$3.34	$2.06	−38.3
Cut stone, slabs, and mill blocks	cubic feet	512,840	264,610	−48.4
Value		$599,873	$391,861	−34.7
Average per cubic foot		$1.17	$1.48	+26.5
Rubble	short tons	33,990	77,400	+127.7
Value		$46,253	$166,369	+259.7
Paving blocks	number	(1)		−100.0
Value		(1)		−100.0
Curbing	cubic feet	[1] 292,050	114,290	[1] −60.9
Value		[1] $310,401	$129,198	[1] −58.4
Flagging	cubic feet	743,680	559,060	−24.8
Value		$366,426	$251,354	−31.4
Total:				
Quantity	approximate short tons	183,040	232,850	+27.2
Value		$1,429,379	$1,113,512	−22.1
Miscellaneous stone: [2]				
Building stone	cubic feet	870,800	536,450	−38.4
Value		$916,735	$825,116	−10.0
Average per cubic foot		$1.05	$1.54	+46.7
Rubble	short tons	12,200	22,270	+82.5
Value		$34,022	$58,995	+73.4
Flagging	cubic feet	36,930	20,140	−45.5
Value		$16,273	$10,469	−35.7
Total:				
Quantity	approximate short tons	88,600	68,130	−23.1
Value		$967,030	$894,580	−7.5
Total dimension stone, excluding slate:				
Quantity	approximate short tons	1,946,980	1,347,460	−30.8
Value		$21,395,834	$16,701,583	−21.9
Slate as dimension stone [3]	approximate short tons	180,990	107,030	−40.9
Value		$4,409,834	$2,955,807	−33.0
Total dimension stone, including slate:				
Quantity	approximate short tons	2,127,970	1,454,490	−31.6
Value		$25,805,668	$19,657,390	−23.8

[1] To avoid disclosing confidential information, paving blocks in 1941 are included under "Curbing."
[2] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.
[3] Details of production, by uses, are given in the chapter on Slate in this volume.

BUILDING STONE

The use of stone as a material of construction predates the most ancient historic records, and building stone is still the principal form in which dimension stone is sold. The following table gives the quantity and value of each kind of stone used for construction in 1942.

Building stone sold or used by producers in the United States in 1942, by kinds

Kind	Rough			
	Construction		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite	580,610	$132,276	81,680	$86,736
Basalt	59,150	12,652		
Marble			58,800	111,722
Limestone	1,332,570	209,313	866,540	257,212
Sandstone	1,087,290	174,730	156,950	178,073
Miscellaneous	536,450	825,116		
	3,596,070	1,354,087	1,163,970	633,743

Kind	Finished				Total	
	Sawed [1]		Cut [1]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite	237,320	$556,687	94,180	$386,800	993,790	$1,162,499
Basalt					59,150	12,652
Marble	66,650	315,129	153,010	1,140,885	278,460	1,567,736
Limestone	187,370	132,724	838,020	1,192,318	3,224,500	1,791,567
Sandstone	78,940	108,739	28,720	105,049	1,351,900	566,591
Miscellaneous					536,450	825,116
	570,280	1,113,279	1,113,930	2,825,052	6,444,250	5,926,161

[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 in the form of dimension stone declined 33 percent in quantity and 16 percent in value in 1942 compared with 1941. Rough-construction building stone declined greatly, although dressed stone gained moderately. Sales of memorial granite were a little lower than in 1941. The value per cubic foot of dressed building stone declined from $4.41 in 1941 to $2.85 in 1942, and the value of dressed monumental stone increased from $6.35 to $7.22. Sales of paving stones and curbing declined greatly. Building stone, paving stones, and curbing are all associated closely with types of construction that receive very little encouragement in a time of war. Sales of monumental stone, however, depend principally on buying power, which was high in 1941, and their moderate declines may be attributed to shortage of labor and materials rather than to recession in market demands.

Granite (dimension stone) sold or used by producers in the United States in 1942, 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)	5,940	$42,476	22,920	$43,854	10,910	$87,470			(1)	(1)	10,830	$268,253
Colorado	5							(1)	(1)	(1)	(1)	(1)	(1)					580	21,060
Connecticut	5	(1)	(1)	(1)	(1)	(1)	(1)	5,220	10,268	(1)	(1)	(1)	(1)			610	$806	7,240	63,914
Georgia	20	7,360	$10,651			(1)	(1)	20,660	30,587	628,270	799,869	140,860	669,831	(1)	(1)	35,420	26,575	95,020	1,547,831
Maine	10	14,070	65,756	2,250	$3,700	17,430	$75,450	3,330	2,042	12,270	8,488	7,720	12,843	1,004,410	$100,182	2,810	1,855	30,900	270,316
Maryland	4	1,520	7,569					39,950	77,104							2,050	656	41,630	85,329
Massachusetts	14			(1)	(1)	228,740	556,091	14,540	26,253	20,090	55,454	(1)	(1)	376,950	24,206	117,840	147,408	49,790	951,430
Minnesota	19			(1)	(1)	(1)	(1)			243,140	232,415	29,760	199,262					24,090	446,884
Missouri	2	700	2,480							15,790	31,580	80	351					2,030	34,411
Montana	7					200	812			970	1,530	720	5,160					160	7,502
New Hampshire	5	3,080	13,232	200	527	14,200	43,100	290	1,326	4,220	8,160	8,000	43,000			380	445	5,630	109,790
New Jersey	1	260	2,080	50	205													260	2,285
New York	5	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	3,370	30,090
North Carolina	7			18,860	13,477	(1)	(1)	5,310	11,315	12,400	25,085	(1)	(1)	139,850	13,924	(1)	(1)	14,830	221,011
Oklahoma	10			200	187	100	200	8,500	73,039	34,290	57,895	22,400	212,316			50	200	13,210	343,837
Pennsylvania	13	6,900	13,185					67,130	99,786	(1)	(1)	30,000	136,736	(1)	(1)	(1)	(1)	77,760	270,628
Rhode Island	3							100	100	59,550	168,704							4,950	168,804
South Carolina	4									(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)
South Dakota	7			(1)	(1)	(1)	(1)			93,390	71,427	80,640	705,392					14,920	792,419
Texas	7					4,290	40,860	31,340	19,178	12,320	24,372	10,850	89,629					33,640	174,039
Vermont	8			7,840	5,840					629,220	2,051,727							51,610	2,057,567
Virginia	1									(1)	(1)			(1)	(1)			(1)	(1)
Washington	3							(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)
Wisconsin	14			(1)	(1)	(1)	(1)			17,330	29,674	59,430	705,731	(1)	(1)			10,350	795,365
Undistributed		2,490	17,323	52,280	62,800	66,540	226,974	13,420	10,986	212,330	421,264	22,760	193,353	465,700	50,518	41,380	54,447	29,310	417,988
	190	36,380	132,276	81,680	86,736	331,500	943,487	215,730	404,460	2,018,500	4,031,498	424,130	3,061,074	1,986,910	188,830	200,540	232,392	522,170	9,080,753
Average unit value			$3.64		$1.06		$2.85		$1.87		$2.00		$7.22		$0.10		$1.16		$17.39
Short tons (approximate)		(2)		6,730		27,370				165,850		35,020		18,540		16,550			

[1] Included under "Undistributed."

[2] 580,610 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., 1938–42 [1]

Year	Active plants	Cubic feet	Value	Year	Active plants	Cubic feet	Value
1938	3	33,300	$73,832	1941	3	26,670	$65,062
1939	3	25,620	61,955	1942	3	16,738	46,079
1940	3	24,540	60,139				

[1] Quincy granite is sold also for construction, curbing, rubble, riprap, and crushed stone.

Monumental granite sold by quarrymen in the Barre district, Vermont, 1938–42 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1938	605,660	$1,849,607	1941	764,280	$2,431,152
1939	684,310	2,029,801	1942	612,220	2,035,327
1940	601,190	2,039,960			

[1] Barre granite is sold also for construction and crushed stone.

Estimated output of monumental granite in the Barre district, Vermont, 1940–42 [1]

	1940	1941	1942
Total quarry output, rough stock—cubic feet	548,412	668,544	750,000
Shipped out of Barre district in rough—do	109,682	133,709	150,000
Manufactured in Barre district—do	438,730	534,835	600,000
Light stock consumed in district—do	274,206	334,272	468,750
Dark stock consumed in district—do	164,524	200,563	281,250
Number of cutters in district	1,295	1,295	1,295
Average daily wage	$8.50	$9.00	$9.50
Average number of days worked	220	230	230
Total pay roll for year	$2,421,650	$3,729,600	$2,829,575
Estimated overhead	1,210,825	1,864,800	1,414,787
Estimated value of light stock	1,199,651	1,398,605	1,640,625
Estimated value of dark stock	874,033	1,097,367	1,265,625
Estimated polishing cost	346,980	422,988	474,525
Output from saws	115,660	140,996	158,175
Total value of granite	6,168,799	8,654,356	7,783,312

[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. The tonnage sold in 1942 was somewhat higher than in 1941, but the value per ton declined from $1.72 to $1.30. Sales for rough construction were less than half as great as in 1941; but rubble sales, which were insignificant in 1941, increased greatly. Basalt is not important as a building stone, and demands for it fluctuate greatly from year to year. 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 1942, by States and uses

State	Active plants	Building stone				Total	
		Rough construction		Rubble		Short tons	Value
		Short tons	Value	Short tons	Value		
Colorado	1			(1)	(1)	(1)	(1)
Connecticut	1	(1)	(1)			(1)	(1)
Hawaii	2	(1)	(1)	(1)	(1)	(1)	(1)
Idaho	1			(1)	(1)	(1)	(1)
Massachusetts	1			(1)	(1)	(1)	(1)
Nevada	1			(1)	(1)	(1)	(1)
New Jersey	2			(1)	(1)	(1)	(1)
Oregon	3	(1)	(1)	(1)	(1)	2,100	$5,512
Pennsylvania	1	(1)	(1)			(1)	(1)
Undistributed		4,880	$12,652	7,870	$3,869	10,650	11,009
	13	[2] 4,880	12,652	7,870	3,869	12,750	16,521
Average unit value			$2.59		$0.49		$1.30

[1] Included under "Undistributed." [2] 59,150 cubic feet (approximate).

MARBLE

Sales of marble blocks in 1942 declined 30 percent in quantity and 21 percent in value compared with 1941. Trends in marble sales were similar to those in granite, in that building marble suffered serious declines, but sales of monumental marble were sustained almost at 1941 levels. Munition factories, barracks, and defense housing—the types of buildings that dominated the construction field in 1942—do not have marble halls. The unit value of finished monumental marble made a decisive gain. Georgia sales were maintained at a level comparable with that of 1941, but this condition was exceptional.

Marble (dimension stone) sold by producers in the United States, 1941–42, by uses

Use	1941		1942	
	Cubic feet	Value	Cubic feet	Value
Building stone:				
Rough:				
Exterior	31,300	$63,647	(1)	(1)
Interior [2]	67,500	175,729	[1] 58,800	[1] $111,722
Finished:				
Exterior	153,360	731,479	66,590	260,768
Interior	259,650	1,777,717	153,070	1,195,246
Total exterior	184,660	795,126	[1] 66,590	[1] 260,768
Total interior	327,150	1,953,446	[1] 211,870	[1] 1,306,968
Total building stone	511,810	2,748,572	278,460	1,567,736
Monumental stone:				
Rough	61,790	68,165	18,450	23,489
Finished	243,970	1,553,484	276,160	1,860,505
Total monumental stone	305,760	1,621,649	294,610	1,883,994
Total building and monumental	817,570	4,370,221	573,070	3,451,730
Approximate short tons	69,300		48,590	

[1] A small quantity of rough exterior building marble included under rough interior building marble.
[2] 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 1942, by States and uses

State	Active plants	Building		Monumental		Total		
						Quantity		
		Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value
Alabama	2	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Arkansas	1	3,400	$8,000	300	$750	3,700	320	$8,750
California	1	(1)	(1)			(1)	(1)	(1)
Georgia	1	50,960	236,492	163,150	990,843	214,110	18,200	1,227,335
Maryland	1	140	1,732			140	10	1,732
Massachusetts	1	1,300	3,132	10,340	67,975	11,640	990	71,107
Minnesota	1	2,980	11,750			2,980	210	11,750
Missouri	4	32,400	130,717	9,600	23,271	42,000	3,480	153,988
North Carolina	1			(1)	(1)	(1)	(1)	(1)
Tennessee	7	108,030	675,447	9,960	83,638	117,990	10,030	759,085
Utah [2]	1	2,400	3,970			2,400	200	3,970
Vermont	5	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	1	(1)	(1)			(1)	(1)	(1)
Undistributed		76,850	496,496	101,260	717,517	178,110	15,150	1,214,013
	27	278,460	1,567,736	294,610	1,883,994	573,070	48,590	3,451,730
Average unit value			$5.63		$6.39			[3] $6.02
Short tons (approximate)		23,550		25,040				

[1] Included under "Undistributed."
[2] Figures represent onyx rough blocks for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.
[3] Average value per cubic foot.

LIMESTONE

Limestone in block form is used almost exclusively for building purposes. Small quantities are employed for flagging, but employment for memorials is negligible. Limestone is used more extensively than any other type of building stone, and Indiana producers supplied about 75 percent of the rough architectural and finished (sawed and cut) limestone sold in 1942. Dimension limestone sold in 1942 was 43 percent less both in quantity and value than in 1941. This drastic decline is due to the fact that limestone sales depend almost exclusively on erection volume of the higher types of buildings, such as stores, churches, schools, post offices, courthouses, libraries, office buildings, and other similar edifices, the construction of which was virtually at a standstill in 1942. Unit prices of the various classes of limestone fluctuated considerably. Rough construction stone declined from $3.46 to $2.17 a ton, whereas cut stone, slabs, and mill blocks increased from 76 to 84 cents a cubic foot.

Limestone (dimension stone) sold or used by producers in the United States in 1942, by States and uses

State	Active plants	Building								Flagging		Total	
		Rough				Finished (cut and sawed)		Rubble					
		Construction		Architectural									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Short tons (approximate)	Value
Alabama	2	(1)	(1)	(1)	(1)							(1)	(1)
California	5	230	$650					(1)	(1)	(1)	(1)	400	$952
Colorado	1			2,570	$4,490							190	4,490
Georgia	1							670	$1,070			670	1,070
Illinois	9	(1)	(1)					9,870	15,458	(1)	(1)	10,680	18,407
Indiana	16			526,620	160,117	901,680	$1,168,683	12,140	5,803			115,640	1,334,603
Iowa	5	3,700	3,265					1,420	1,252	930	$132	5,160	4,649
Kansas	15	12,500	21,550	108,150	20,155	(1)	(1)	9,730	9,990	(1)	(1)	34,820	98,919
Kentucky	9	9,510	33,670	(1)	(1)			(1)	(1)			9,970	34,299
Michigan	3	(1)	(1)					(1)	(1)			(1)	(1)
Minnesota	6	550	6,600	(1)	(1)	(1)	(1)	4,120	5,630	(1)	(1)	7,110	38,050
Missouri	11	43,950	87,890					34,330	57,117	4,620	1,916	78,660	146,923
Montana	1			(1)	(1)							(1)	(1)
New York	4	(1)	(1)					(1)	(1)			8,470	12,310
Ohio	8	2,750	4,084					4,400	4,066	2,430	208	7,360	8,358
Oklahoma	1							(1)	(1)			(1)	(1)
Pennsylvania	18	7,660	8,614					8,510	10,402	8,310	1,063	16,770	20,079
Puerto Rico	4	(1)	(1)					(1)	(1)			(1)	(1)
South Dakota	1									(1)	(1)	(1)	(1)
Tennessee	4	360	417					5,860	6,360			6,220	6,777
Texas	6	(1)	(1)	(1)	(1)	(1)	(1)	12,750	28,687	(1)	(1)	16,950	108,822
Vermont	1							(1)	(1)			(1)	(1)
Virginia	4	(1)	(1)					(1)	(1)			4,840	7,052
West Virginia	2	(1)	(1)					(1)	(1)			(1)	(1)
Wisconsin	16	(1)	(1)	204,500	55,606	(1)	(1)	11,050	23,821	50,540	17,991	38,520	141,151
Undistributed		15,400	42,573	24,700	16,844	123,710	156,359	106,330	154,441	33,960	7,513	100,540	157,576
	153	96,610	209,313	866,540	257,212	1,025,390	1,325,042	221,180	324,097	100,790	28,823	462,970	2,144,487
Average unit value			$2.17		$0.30		$1.29		$1.47		$0.29		$4.63
Short tons (approximate)		(2)		62,820		74,280				8,080			

[1] Included under "Undistributed."

[2] 1,332,570 cubic feet (approximate).

The following tables show detailed figures, by uses, for limestone produced near Bedford and Bloomington, Ind., and Carthage, Mo., over a 5-year period.

Limestone sold by producers in the Indiana oolitic-limestone district, 1938–42, by classes

Year	Construction					
	Rough block		Sawed and semifinished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
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
1941	1,047,000	309,444	1,029,970	567,706	826,510	1,177,651
1942	526,620	160,117	135,360	98,518	766,320	1,070,164

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
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
1941	2,903,480	210,500	2,054,801	135,610	98,547	346,110	2,153,348
1942	1,428,300	103,500	1,328,800	87,770	69,404	191,270	1,398,204

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, 1938–42, by classes

Year	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
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	272,510	182,239	1,034,100	1,629,273	1,306,610	1,811,512
1941	86,690	47,502	690,250	1,043,774	776,940	1,091,276
1942:						
Mills not operated by quarry companies	54,680	17,128	287,130	511,021	341,810	528,149
Mills of quarry companies from stock obtained at quarries other than their own	(1)	(1)	[1] 162,820	[1] 235,291	162,820	235,291
	[1] 54,680	[1] 17,128	[1] 449,950	[1] 746,312	504,630	763,440

[1] A small amount of sawed and semifinished stone included under cut stone.

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1938–42, 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
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	124,180	248,498	8,430	18,844	132,610	11,070	267,342	90,390	128,627	101,460	395,969
1941	50,000	219,361	8,680	19,868	58,680	4,900	239,229	253,030	414,770	257,930	653,999
1942	22,580	100,581	9,590	23,271	32,170	2,650	123,852	436,600	538,697	439,250	662,549

SANDSTONE

Sales of sandstone increased 27 percent in quantity, but their value was 22 percent less than in 1941. The gains in quantity sold were all of relatively low-priced rough construction stone and rubble, hence the low sales value. Sales of cut stone, slabs, and mill blocks declined 48 percent, but the value per cubic foot increased from $1.17 to $1.48. Curbing and flagging sales were far below those of 1941. The sandstone paving-block industry has almost disappeared. The number of active sandstone plants declined from 93 to 82.

Ohio is the leading producer, its quarries supplying 44 percent of the total value of output in 1942. The largest quarries are in the Amherst area in the northern part of the State. New York, Pennsylvania, Tennessee, and Massachusetts follow in order of sales value. The thin-bedded ornate sandstones of the Crab Orchard area, Cumberland County, Tenn., have attracted considerable attention during recent years.

The second table following presents a 20-year history of the bluestone industry. This type of sandstone, which has remarkable splitting properties, is used as a building stone and for curbing and flagging. Sales in 1942 were down 35 percent in quantity and 34 percent in value compared with 1941.

Sandstone (dimension stone) sold or used by producers in the United States in 1942, by States and uses

State	Active plants	Building								Rubble		Curbing		Flagging		Total	
		Rough construction		Rough architectural		Dressed											
						Sawed		Cut									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons (approximate)	Value
Arizona	1	(1)	(1)													(1)	(1)
Arkansas	1	(1)	(1)													(1)	(1)
California	9	1,200	$6,265							5,150	$8,118			18,210	$8,387	7,770	$22,770
Colorado	3	11,420	12,610							20	25			2,670	2,400	11,650	15,035
Connecticut	1	(1)	(1)													(1)	(1)
Kansas	1	60	67											1,800	1,833	200	1,900
Maryland	3	(1)	(1)							(1)	(1)			(1)	(1)	(1)	(1)
Massachusetts	1							9,420	$44,325							730	44,325
Michigan	1	350	1,700							130	750					480	2,450
Minnesota	1							950	2,500							80	2,500
New Mexico	1	(1)	(1)													(1)	(1)
New York [2]	18	(1)	(1)			(1)	(1)	(1)	(1)	31,370	47,519	51,410	$56,898	58,740	49,103	42,220	191,099
Ohio	7	540	1,381	156,950	$178,073	71,260	$87,391	15,420	40,050	310	1,400	62,030	71,855	359,430	112,700	49,070	492,850
Pennsylvania [3]	16	8,380	17,080							5,950	17,148	850	445	49,620	37,356	18,520	72,029
South Dakota	1	(1)	(1)													(1)	(1)
Tennessee	3									7,260	39,944			31,220	27,489	9,700	67,433
Texas	1	(1)	(1)							(1)	(1)					(1)	(1)
Vermont	1									2,820	4,229					2,820	4,229
Virginia	6	200	325							350	400			10,400	4,296	1,380	5,021
Washington	1					(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
West Virginia	2	(1)	(1)							(1)	(1)					(1)	(1)
Wisconsin	3							(1)	(1)	(1)	(1)					(1)	(1)
Undistributed		62,830	135,302			7,680	21,348	2,930	18,174	24,040	46,836			26,970	7,790	88,230	191,871
	82	84,980	174,730	156,950	178,073	78,940	108,739	28,720	105,049	77,400	166,369	114,290	129,198	559,060	251,354	232,850	1,113,512
Average unit value			$2.06		$1.13		$1.38		$3.66		$2.15		$1.13		$0.45		$4.78
Short tons (approximate)		(4)		11,380		5,790		2,180				8,830		42,290			

[1] Included under "Undistributed."
[2] Includes 108,440 cubic feet of bluestone (approximately 12,800 short tons) valued at $128,169 sold for construction, curbing, and flagging.
[3] Includes 75,030 cubic feet of bluestone (approximately 6,340 short tons) valued at $38,618 sold for construction, curbing, and flagging.
[4] 1,087,290 cubic feet (approximate).

Bluestone (dimension stone) sold or used in the United States, 1923–42 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1923	618,360	$747,422	1933	116,246	$123,867
1924	769,240	875,734	1934	181,968	168,720
1925	987,300	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
1931	356,210	427,801	1941	284,190	252,313
1932	185,960	185,643	1942	183,470	166,787

[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 in 1942 decreased 23 percent and the value 8 percent compared with 1941.

Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1942, by States and uses

State	Active plants	Building				Flagging		Total	
		Rough and dressed		Rubble					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	1			(1)	(1)			(1)	(1)
California	4			9,370	$28,894			9,370	$28,894
Florida	1	(1)	(1)					(1)	(1)
Georgia	2					(1)	(1)	(1)	(1)
Maryland	5	4,940	$14,188	5,050	21,936	460	$2,315	10,450	38,439
Michigan	1			(1)	(1)			(1)	(1)
New York	3	(1)	(1)	(1)	(1)			620	2,676
North Carolina	1			(1)	(1)			(1)	(1)
Ohio	1	(1)	(1)					(1)	(1)
Pennsylvania	7	25,520	40,443					25,520	40,443
Virginia	2	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Washington	1	(1)	(1)					(1)	(1)
Undistributed		13,790	770,485	7,850	8,165	1,150	8,154	22,170	784,128
	29	[2] 44,250	825,116	22,270	58,995	[2] 1,610	10,469	68,130	894,580
Average unit value			$18.65		$2.65		$6.50		$13.13

[1] Included under "Undistributed."
[2] Building stone (rough and dressed), approximately 536,450 cubic feet; flagging, approximately 20,140 cubic feet.

TRENDS IN USE OF DIMENSION STONE

Figure 1 shows graphically the history of production of dimension stone, by kinds, for a 27-year period. Dimension stone includes all classes of building stone, as well as memorial stone, paving blocks, curbing, and flagging. Limestone and granite are the leading varieties. All types of stone follow closely the general trends of national peacetime prosperity.

Figure 2 traces the history of production of all building stones and of the principal variety—limestone—in their relation to nonresidential building, the class of construction using stone most extensively. Stone is a dignified, substantial, and enduring building material that

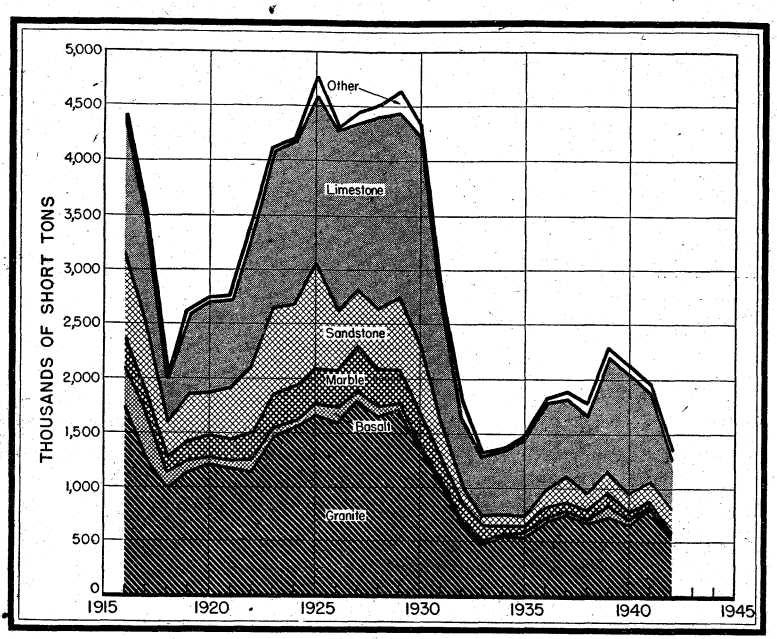

FIGURE 1.—Sales of dimension stone in the United States, by kinds, 1916–42.

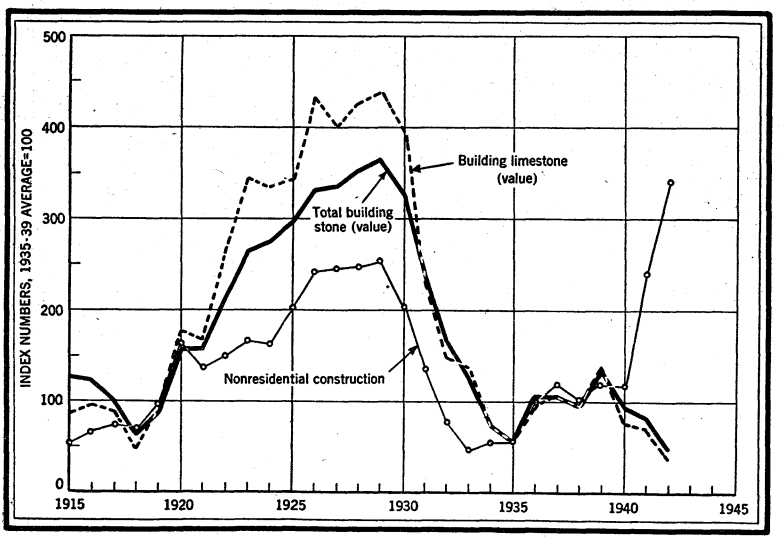

FIGURE 2.—Sales of all building stone and building limestone compared with nonresidential construction (public and private), 1915–42. Data on nonresidential building construction from Bureau of Foreign and Domestic Commerce.

is used chiefly in permanent and relatively costly structures. Wars discourage the use of dimension stone. Although military needs demand enormous expansion of factory and housing facilities, natural stone finds little or no place in such types of construction. Similarly, Nation-wide depressions have sudden and serious effects on construction, upon which the prosperity of the building-stone industries depends. As indicated in figure 2, building limestone enjoyed an 8-year period of prosperity (1923–30) after the First World War. The industry sank to low levels during the depression and was just emerging from this dark period with the prospect of another era of wider sales when the Second World War wiped out the moderate gains of 1936 to 1939 and depressed the level of activity to a point lower than that of 1918.

NEW DEVELOPMENTS

Dimension stone occupies a rather subordinate position in the war program, and no new developments in use or in technique of manufacture are to be recorded. Stone-working activities have fallen to low levels, and at the same time an unprecedented demand has arisen for men and machines to make war equipment. This condition has influenced the versatile stone industry to accommodate its facilities and manpower to the more urgent needs. Producers of monumental granite near Barre, Vt., have established a War Work Division having machine shops adapted to manufacture of munitions. The marble industry centered near Proctor, Vt., and the granite industry at Cold Springs, Minn., have likewise diverted their machinery, power, and skilled personnel to making metal parts of war equipment. Many granite workers along the coast of Maine, skilled in woodcraft of the northern forests, heeded the call in 1942 for more ships and devoted their energies to making wooden barges. It is probable that other companies are engaged in similar activities of which we have no record.

Efforts were also made to expand the manufacture of useful by-products. One Barre (Vt.) memorial stone company makes chicken grit from waste granite, thus aiding the expanding food program and simplifying the transportation of grit to New England poultry centers.

CRUSHED AND BROKEN STONE

Over 194,000,000 short tons of crushed and broken stone were sold in 1942, exclusive of that used for making cement and lime. Sales increased 7 percent in quantity and 8 percent in value compared with 1941. The average value at point of origin increased 1 cent a ton.

The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1941 and 1942 by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters on Asphalt and Slate.

Crushed and broken stone sold or used by producers in the United States, 1941–42, by principal uses

Use	1941			1942		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	110, 192, 610	$106, 985, 808	$0. 97	107, 701, 010	$105, 583, 801	$0. 98
Railroad ballast	10, 771, 300	7, 536, 451	. 70	17, 566, 640	10, 810, 977	. 62
Metallurgical	27, 436, 440	20, 069, 296	. 73	30, 262, 910	24, 152, 113	. 80
Alkali works	5, 888, 260	2, 721, 635	. 46	6, 350, 450	3, 005, 483	. 47
Riprap	5, 152, 640	5, 226, 623	1. 01	8, 763, 980	9, 779, 249	1. 12
Agricultural	11, 909, 640	14, 395, 831	1. 21	13, 745, 400	16, 993, 254	1. 24
Refractory (ganister, mica schist, dolomite, soapstone)	2, 254, 120	3, 279, 104	1. 45	2, 718, 090	3, 999, 929	1. 47
Asphalt filler	443, 480	1, 050, 927	2. 37	439, 430	1, 026, 138	2. 34
Calcium carbide works	468, 600	343, 241	. 73	430, 600	399, 169	. 93
Sugar factories	624, 450	936, 874	1. 50	625, 520	986, 210	1. 58
Glass factories	385, 680	578, 226	1. 50	434, 080	656, 775	1. 51
Paper mills	361, 830	643, 124	1. 78	435, 200	760, 332	1. 75
Other uses	5, 271, 930	10, 174, 452	1. 93	5, 063, 720	10, 147, 006	2. 00
Portland cement (including "cement rock")[1]	181, 160, 980	173, 941, 592	. 96	194, 537, 030	188, 300, 436	. 97
Natural cement ("cement rock")[1]	42, 735, 000	(2)		47, 657, 000	(2)	
Lime[3]	12, 159, 000	(2)		12, 208, 000	(2)	
Total stone	236, 055, 000	(2)		254, 402, 000	(2)	
Asphaltic stone	654, 692	2, 312, 227	3. 53	935, 295	3, 450, 979	3. 69
Slate granules and flour	437, 670	3, 105, 800	7. 10	483, 740	3, 404, 416	7. 04

[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 1942.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1938–42

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	110, 192, 610	106, 985, 808	10, 771, 300	7, 536, 451	120, 963, 910	114, 522, 259
1942	107, 701, 010	105, 583, 801	17, 566, 640	10, 810, 977	125, 267, 650	116, 394, 778

Concrete and road metal and railroad ballast sold or used by producers in the United States in 1942, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	[1] 818,600	[1] $941,403	8,490	$4,076	[1] 827,090	[1] $945,479
Arizona	[1] 110,750	[1] 152,647			[1] 110,750	[1] 152,647
Arkansas	1,429,950	1,588,929	436,070	312,240	1,866,020	1,901,169
California	7,563,300	5,074,009	[1] 274,590	[1] 91,179	[1] 7,837,890	[1] 5,165,188
Colorado	247,370	194,416	(2)	(2)	[1] 247,370	[1] 194,416
Connecticut	[1] 1,316,340	[1] 1,313,448	86,260	77,691	[1] 1,402,600	[1] 1,391,139
Delaware	(2)	(2)			(2)	(2)
Florida	[1] 5,430,920	[1] 4,674,967	183,960	141,665	[1] 5,614,880	[1] 4,816,632
Georgia	2,091,620	2,406,067	91,190	85,052	2,182,810	2,491,119
Hawaii	(2)	(2)	(2)	(2)	(2)	(2)
Idaho	459,390	573,162			459,390	573,162
Illinois	8,674,670	7,458,575	863,230	688,591	9,537,900	8,147,166
Indiana	[1] 4,736,890	[1] 4,197,660	448,400	362,886	[1] 5,185,290	[1] 4,560,576
Iowa	3,031,540	3,192,268	131,990	63,017	3,163,530	3,255,285
Kansas	[1] 1,891,540	[1] 2,184,517	294,230	227,205	[1] 2,185,770	[1] 2,411,722
Kentucky	[1] 4,154,430	[1] 4,013,844	501,550	334,673	[1] 4,655,980	[1] 4,348,517
Louisiana	(2)	(2)			(2)	(2)
Maine	46,040	62,855			46,040	62,855
Maryland	822,540	946,158	156,240	176,853	978,780	1,123,011
Massachusetts	1,225,330	1,456,453	236,200	218,156	1,461,530	1,674,609
Michigan	1,918,210	1,205,765	141,370	112,723	2,059,580	1,318,488
Minnesota	[1] 867,410	[1] 775,739	347,740	331,650	[1] 1,215,150	[1] 1,107,389
Missouri	6,140,960	5,932,834	1,594,920	306,980	7,735,880	6,239,814
Montana	[1] 196,110	122,423	(2)	(2)	[1] 196,110	[1] 122,423
Nebraska	107,320	114,115			107,320	114,115
Nevada	[1] 50,820	[1] 72,415			[1] 50,820	[1] 72,415
New Hampshire	179,150	267,942			179,150	267,942
New Jersey	2,832,850	2,892,354	172,570	182,509	3,005,420	3,074,863
New Mexico	(2)	(2)	(2)	(2)	(2)	(2)
New York	[1] 7,094,890	[1] 7,468,341	[1] 1,276,910	[1] 885,203	[1] 8,371,800	[1] 8,353,544
North Carolina	[1] 2,339,210	[1] 2,797,812	[1] 307,390	[1] 285,238	[1] 2,646,600	[1] 3,083,050
North Dakota	(2)	(2)			(2)	(2)
Ohio	[1] 6,473,950	[1] 5,755,322	1,056,800	827,185	[1] 7,530,750	[1] 6,582,507
Oklahoma	[1] 3,034,020	[1] 2,148,450	2,796,130	547,078	[1] 5,830,150	[1] 2,695,528
Oregon	2,508,870	2,492,564	4,290	3,630	2,513,160	2,496,194
Pennsylvania	7,970,300	8,843,516	1,381,540	1,227,829	9,351,840	10,071,345
Puerto Rico	(2)	(2)	(2)	(2)	(2)	(2)
Rhode Island	181,670	166,676			181,670	166,676
South Carolina	1,483,990	1,733,913	425,840	382,875	1,909,830	2,116,788
South Dakota	609,420	839,296			609,420	839,296
Tennessee	4,928,140	5,464,542	662,000	471,210	5,590,140	5,935,752
Texas	2,353,420	2,420,909	933,930	421,812	3,287,350	2,842,721
Utah	(2)	(2)			(2)	(2)
Vermont	26,310	44,090			26,310	44,090
Virginia	3,757,900	3,818,543	[1] 900,910	[1] 755,940	[1] 4,658,810	[1] 4,574,483
Washington	[1] 1,257,550	[1] 1,100,399	191,790	116,171	[1] 1,549,340	[1] 1,216,570
West Virginia	[1] 919,870	[1] 983,622	382,370	321,601	[1] 1,302,240	[1] 1,305,223
Wisconsin	2,445,750	2,062,884	444,810	413,531	2,890,560	2,476,415
Wyoming	(2)	(2)	(2)	(2)	(2)	(2)
Undistributed	3,871,700	5,627,927	832,930	434,528	4,704,630	6,062,455
	107,701,010	105,583,801	17,566,640	10,810,977	125,267,650	116,394,778

[1] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."
[2] Included under "Undistributed."

COMMERCIAL AND NONCOMMERCIAL OPERATIONS

The following table shows 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 27 percent in 1942 compared with 1941, whereas production by Government agencies declined 55 percent. Eighty-eight percent of the total production was made by commercial companies. The large decline in noncommercial output reflects the curtailment of make-work enterprises established to combat the depression.

Concrete and road metal and railroad ballast sold or used by commercial and noncommercial operators in the United States, 1938–42

[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
1938	60,254,170	$0.88	−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
1941	86,360,120	.91	+36.6	71.4	34,603,790	1.04	−6.6	28.6	120,963,910	−20.6
1942	109,818,570	.91	+27.2	87.7	15,449,080	1.05	−55.4	12.3	125,267,650	+3.6

SIZE OF PLANTS

Presented herein for the first time is an analysis of production by size of plant. The determinations are based upon 1941 figures. The largest group of plants, comprising 46 percent of the total, includes those ranging in output from 1,000 to 25,000 tons a year. The second-largest group includes plants that produce 25,000 to 50,000 tons a year. These two groups, although comprising 61 percent of the total number of plants, produce less than 12 percent of the total output. The third group in importance, based upon the number of plants, includes those producing 100,000 to 200,000 tons a year; this group is second in importance in production, for it contributes 15 percent of total output. Plants producing 900,000 tons and over a year, although only 19 in number, furnish more than 23 percent of the total production. The accompanying table gives details of production by size groups.

Number and production of commercial crushed-stone plants, by sizes of output, 1941 [1]

Range of output	Number of plants	Total production of plants (short tons)	Percent of total	Cumulative total (short tons)
Less than 1,000 tons	141	99,460	0.07	99,460
1,000 to 25,000	805	7,639,860	5.34	7,739,320
25,000 to 50,000	254	8,893,690	6.22	16,633,010
50,000 to 75,000	141	8,655,220	6.05	25,288,230
75,000 to 100,000	82	7,125,430	4.98	32,413,660
100,000 to 200,000	147	21,549,890	15.07	53,963,550
200,000 to 300,000	58	14,235,700	9.95	68,199,250
300,000 to 400,000	39	13,556,340	9.48	81,755,590
400,000 to 500,000	29	13,139,480	9.19	94,895,070
500,000 to 600,000	7	3,850,070	2.69	98,745,140
600,000 to 700,000	5	3,243,550	2.27	101,988,690
700,000 to 800,000	6	4,494,440	3.14	106,483,130
800,000 to 900,000	4	3,367,900	2.35	109,851,030
900,000 tons and over	19	33,186,870	23.20	143,037,900
Total	1,737	143,037,900	100.00	143,037,900

[1] Exclusive of marble, which is primarily a dimension-stone industry.

METHODS OF TRANSPORTATION

The following table shows the quantities of concrete and road metal conveyed during 1941 and 1942 by each of the principal methods of transportation. The general trend in mode of transport for the past 10 years has been toward wider use of trucks at the expense of railroads. In 1942, for the first time, this trend was reversed, and truck haulage declined from 65 percent of the total commercial output in 1941 to only 55 percent in 1942; conversely, rail tonnage increased from 24 to 30 percent of the total. This condition doubtless reflects the restrictions in use of rubber and gasoline prevalent in 1942.

Concrete and road metal sold or used by commercial producers in the United States, 1941–42, by methods of transportation [1]

Method of transportation	1941		1942	
	Short tons	Percent of total	Short tons	Percent of total
Truck	49,107,430	65.0	50,830,270	55.1
Rail	18,047,780	23.9	27,932,080	30.3
Waterway	4,690,770	6.2	4,311,930	4.7
Unspecified	3,742,840	4.9	9,177,650	9.9
	75,588,820	100.0	92,251,930	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—1941: Truck 76 percent, rail 16 percent, waterway 4 percent, and unspecified 4 percent; 1942: Truck 62 percent, rail 26 percent, water 4 percent, and unspecified 8 percent.

GRANITE

Granite (crushed and broken stone) sold or used by producers in the United States in 1942, 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
California	1,040,370	$1,389,960	1,233,260	$749,924	89,010	$43,390	29,830	$13,888	2,392,470	$2,197,162
Colorado	(2)	(2)	(2)	(2)					122,280	79,500
Connecticut	(2)	(2)					(2)	(2)	(2)	(2)
Delaware			(2)	(2)			(2)	(2)	(2)	(2)
Georgia	962,930	745,564	1,909,050	2,219,661	91,190	85,052	203,050	214,409	3,166,220	3,264,686
Idaho			(2)	(2)					(2)	(2)
Maine	(2)	(2)	(2)	(2)					9,120	17,465
Maryland	(2)	(2)	(2)	(2)	(2)	(2)			110,940	217,073
Massachusetts	8,210	9,979	334,360	483,615			11,370	15,361	353,940	508,955
Minnesota	94,480	49,240	21,400	40,400	60,950	60,278			176,830	149,918
Missouri	400	500							400	500
Montana	1,840	845	113,020	62,058					114,860	62,903
New Hampshire	(2)	(2)	179,150	267,942			(2)	(2)	230,150	319,143
New Jersey			(2)	(2)	(2)	(2)			(2)	(2)
New York	12,340	9,895	202,850	182,328	44,320	35,454	12,810	5,843	272,320	233,520
North Carolina	219,910	219,737	2,011,400	2,357,328	307,390	285,238	18,450	101,913	2,557,150	2,964,216
Oklahoma	6,650	6,644	41,530	47,649					48,180	54,293
North Dakota			(2)	(2)					(2)	(2)
Pennsylvania	12,360	13,380	333,220	482,740			560	2,444	346,140	498,564
Puerto Rico			(2)	(2)					(2)	(2)
Rhode Island			(2)	(2)					(2)	(2)
South Carolina	35,270	39,864	1,353,880	1,576,955	425,840	382,875	12,520	5,150	1,827,510	2,004,844
South Dakota	26,380	26,803	226,640	298,010					253,020	324,813
Tennessee			(2)	(2)					(2)	(2)
Texas	280	496							280	496
Virginia	(2)	(2)	889,190	1,022,776	187,640	199,562	(2)	(2)	1,132,170	1,264,735
Washington	(2)	(2)	(2)	(2)			(2)	(2)	24,440	28,090
Wisconsin	3,170	2,337	79,640	40,527			2,180	5,732	84,990	48,596
Wyoming			(2)	(2)					(2)	(2)
Undistributed	131,580	219,786	465,840	586,139	23,850	32,241	71,050	71,849	319,200	474,289
	2,556,170	2,735,030	9,394,430	10,418,052	1,230,190	1,124,090	361,820	436,589	13,542,610	14,713,761
Average unit value		$1.07		$1.11		$0.91		$1.21		$1.09

[1] Includes stone used for artificial stone, fertilizer filler, poultry grit, spalls, stone sand, and terrazzo.

[2] Included under "Undistributed."

Sales of crushed and broken granite were about the same in 1942 as in 1941, but the value was 4 percent greater owing to an increase in sales value from $1.05 to $1.09 a ton. Production of riprap was unusually high, but on the other hand sales of concrete aggregate and stone for highway construction dropped about 1 million tons.

The number of individual operations supplying noncommercial crushed stone cannot be determined with any degree of accuracy from the reports submitted. Therefore, in the accompanying tables covering granite and other kinds of crushed and broken stone, the number of active plants is not given. For many years before 1939, when noncommercial production had less importance, such figures appeared in the tables.

BASALT AND RELATED ROCKS (TRAP ROCK)

The dark igneous rocks, basalt, gabbro, and diorite, known commercially as trap rock, are used widely for highway construction and concrete aggregate. Sales of crushed and broken trap rock were 2 percent less in 1942 than in 1941, and the value was 13 percent higher. The value per ton increased from $1.04 to $1.19.

Sales of riprap, which had declined in 1941, gained 57 percent in 1942. Stone for concrete aggregate and road metal declined moderately, but railroad-ballast sales increased substantially. The latter condition reflected the increasing care devoted to roadbeds at a time when rail traffic was exceptionally heavy.

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1942, 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)
Arkansas			(2)	(2)					(2)	(2)
California	500,010	$615,092	1,284,730	$1,264,658	5,670	$5,683	51,510	$47,981	1,841,920	$1,933,414
Colorado			89,210	90,900					89,210	90,900
Connecticut	95,000	86,319	1,316,340	1,313,448	86,260	77,691			1,497,600	1,477,458
Hawaii	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Idaho	1,500	700	345,060	437,713					346,560	438,413
Maine			33,990	41,100					33,990	41,100
Maryland	(2)	(2)	(2)	(2)	(2)	(2)			424,950	545,072
Massachusetts	(2)	(2)	809,670	871,213	236,200	218,156	(2)	(2)	1,091,010	1,168,994
Michigan	320	316	98,300	145,002	350	350			98,970	145,668
Minnesota	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Montana	(2)	(2)							(2)	(2)
New Jersey	117,580	166,001	2,572,700	2,826,272	151,940	154,506	84,640	66,626	2,926,860	3,213,405
New York			733,580	933,110	244,490	306,145			978,070	1,239,255
North Carolina			42,120	72,203					42,120	72,203
Oregon	13,120	3,357	2,316,680	2,327,934	4,290	3,630			2,334,090	2,334,921
Pennsylvania	4,690	5,855	1,050,660	1,223,475	317,170	236,778			1,372,520	1,466,108
Puerto Rico			(2)	(2)	(2)	(2)			(2)	(2)
Rhode Island			(2)	(2)					(2)	(2)
Texas			(2)	(2)	(2)	(2)			(2)	(2)
Virginia	(2)	(2)	(2)	(2)	(2)	(2)			310,920	335,674
Washington	214,770	177,463	1,322,090	1,081,596	191,790	116,171			1,728,650	1,375,230
Wisconsin			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Undistributed	25,790	23,838	2,873,860	4,908,972	280,740	270,517	97,090	868,651	2,496,470	5,111,607
	972,780	1,078,941	14,888,990	17,537,596	1,518,900	1,389,627	233,240	983,258	17,613,910	20,989,422
Average unit value		$1.11		$1.18		$0.91		$4.22		$1.19

[1] Includes stone sold for fill material, roofing granules, and unspecified uses.

[2] Included under "Undistributed."

MARBLE

Waste material from most marble quarries and mills in the United States consists of relatively pure calcium carbonate and therefore is interchangeable with high-calcium limestone for various uses. As many blocks quarried are structurally defective and as a considerable share of the good blocks is cut away in marble dressing, large quantities of waste material accumulate. Marble producers are active, therefore, in seeking profitable outlets for such waste. Some of them manufacture finely pulverized, relatively high-priced products, such as whiting and fillers. Others prepare it for terrazzo, stucco, or agricultural limestone. The rough blocks may be sold for riprap or may be crushed for use as roadstone or concrete aggregate. This diversity in preparation and use explains the great variation in price obtained in different States as indicated in the accompanying table.

Marble (crushed and broken stone) sold by producers in the United States in 1942, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Alabama	2	(2)	(2)	Texas	2	6,150	$41,392
California	3	2,940	$25,950	Utah	1	5,130	42,828
Georgia	1	10,000	10,431	Virginia	2	3,830	16,113
Maryland	1	1,700	19,349	Washington	4	(2)	(2)
Massachusetts	1	3,500	4,428	Undistributed		42,520	132,685
Missouri	1	(2)	(2)				
New York	1	21,900	140,144		24	120,910	458,473
Tennessee	5	23,240	25,153	Average unit value			$3.79

[1] Includes artificial stone, crushed stone, flux, mineral food, poultry grit, riprap, spalls, stucco, terrazzo, whiting (excluding marble whiting made by companies that purchase their marble).
[2] Included under "Undistributed."

LIMESTONE

Limestone occurs in every State, and sales were reported to the Bureau of Mines from 44 of them. Because of its wide occurrence it is, in many areas, the most convenient kind of stone for highway or building construction and railroad ballast. The over-all cost of quarrying and crushing limestone is generally lower than that of the harder rocks. Limestone is an essential raw material for many metallurgical, chemical, and processing industries for which no other kinds of stone can be substituted. As a result of these various favorable conditions, limestone is by far the most widely used type of stone in the United States. In 1942 limestone constituted 73 percent of all crushed and broken stone sold (excluding that used for making cement and lime).

Sales in 1942 were 7 percent higher in quantity and 10 percent in value than in 1941. Riprap sales made small gains, and the value per ton increased from 95 cents to $1.09. Fluxing-stone sales, which reached an all-time high of more than 30 million tons, reflect the unprecedented iron-furnace activity in 1942. There was no substantial change in limestone sold for concrete aggregate and road building, but the increase in railroad-ballast sales was comparable with that of basalt and for the same reason. The 15-percent increase in sales of agricultural limestone relates directly to the stimulation of crop growing that characterized 1942.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1942, by States and uses

State	Riprap		Fluxing stone		Crushed stone				Agriculture		Other		Total	
					Concrete and road metal		Railroad ballast							
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	17,080	$28,507	1,912,380	$1,614,240	818,600	$941,403	8,490	$4,076	181,700	$217,348	91,640	$542,287	3,029,890	$3,347,861
Arizona			23,680	14,298	64,190	89,152							87,870	103,450
Arkansas	(1)	(1)	(1)	(1)	584,900	564,801	(1)	(1)	(1)	(1)	(1)	(1)	660,670	713,482
California	(1)	(1)	54,560	96,207	433,830	320,159	(1)	(1)	(1)	(1)	278,310	755,556	1,056,740	1,441,253
Colorado	(1)	(1)	(1)	(1)							185,300	177,658	573,720	399,697
Connecticut			(1)	(1)	(1)	(1)			36,190	110,974	(1)	(1)	47,480	145,759
Florida	3,100	1,327			5,430,920	4,674,967	183,960	141,665	51,720	176,877	893,720	675,754	6,563,420	5,670,590
Georgia			(1)	(1)	182,570	186,406			74,070	194,873	(1)	(1)	333,050	569,280
Hawaii					(1)	(1)							(1)	(1)
Idaho											(1)	(1)	(1)	(1)
Illinois	92,310	91,435	498,150	458,273	8,653,740	7,442,875	863,230	688,591	3,268,120	3,075,835	645,940	886,267	14,021,490	12,643,276
Indiana	50,230	38,285	15,530	9,518	4,736,890	4,197,690	448,400	362,886	965,720	948,601	128,130	115,658	6,344,900	5,672,638
Iowa	71,010	63,773	25,120	24,038	3,031,540	3,192,268	131,990	63,017	1,171,890	1,293,367	37,770	208,691	4,469,320	4,845,154
Kansas	53,160	60,000	(1)	(1)	1,629,760	2,146,000	189,500	213,748	67,430	70,055	(1)	(1)	1,979,180	2,621,200
Kentucky	307,340	309,359			4,154,430	4,013,844	501,550	334,673	655,950	709,423	12,040	53,316	5,631,310	5,420,615
Louisiana					(1)	(1)					(1)	(1)	(1)	(1)
Maine			61,260	89,129	340	516			22,960	72,730	37,380	65,399	121,940	227,774
Maryland	(1)	(1)	(1)	(1)	476,310	471,171	36,240	44,574	30,110	93,474	(1)	(1)	610,650	864,496
Massachusetts			16,870	25,763					152,850	464,075	24,750	97,386	194,470	587,224
Michigan	4,730	6,241	9,259,080	5,299,088	1,817,530	1,056,005	141,020	112,373	240,180	184,824	4,422,390	2,390,657	15,884,930	9,049,188
Minnesota	20,480	18,249	(1)	(1)	846,010	735,339	(1)	(1)	131,000	181,155	25,620	61,998	1,241,490	1,208,272
Missouri	152,180	167,993	11,860	18,038	5,166,300	5,670,847	84,370	81,362	1,004,370	1,112,758	246,680	472,707	6,665,760	7,523,705
Montana			(1)	(1)	(1)	(1)	(1)	(1)			41,860	66,420	177,670	180,082
Nebraska	(1)	(1)			107,320	114,115			(1)	(1)	67,530	377,963	267,020	630,413
Nevada			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
New Jersey			(1)	(1)	14,520	27,053			(1)	(1)	(1)	(1)	197,960	487,678
New Mexico	(1)	(1)			(1)	(1)	(1)	(1)					(1)	(1)
New York	371,880	538,714	109,130	98,220	6,053,390	6,231,115	988,100	543,604	365,200	891,919	1,677,230	1,114,157	9,564,930	9,417,729
North Carolina					179,720	234,908	(1)	(1)	(1)	(1)			196,630	258,761
Ohio	30,040	29,616	5,091,320	3,562,637	6,473,450	5,754,522	1,056,800	827,185	1,418,370	1,533,276	453,280	641,454	14,523,260	12,348,690
Oklahoma	54,210	56,745	(1)	(1)	1,803,390	1,933,689	402,100	204,415	23,000	42,045	(1)	(1)	2,288,440	2,251,029
Oregon					(1)	(1)			14,200	49,652	(1)	(1)	53,900	119,023
Pennsylvania	39,970	46,767	10,472,660	10,517,487	5,944,580	6,415,878	823,230	732,313	680,740	1,671,390	1,062,320	1,862,832	19,023,500	21,246,667
Puerto Rico					(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Rhode Island			(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)
South Carolina					(1)	(1)			(1)	(1)			(1)	(1)
South Dakota	200	300			276,000	399,025					15,100	28,100	291,300	427,425

Tennessee	641,450	658,596	66,940	68,251	4,913,140	5,447,542	662,000	471,210	983,540	1,059,629	111,280	161,871	7,378,350	7,867,099
Texas	47,250	46,969	(1)	(1)	2,118,760	2,236,190	789,730	299,937	(1)	(1)	285,960	326,435	3,304,440	2,954,244
Utah	(1)	(1)	167,320	137,171	(1)	(1)					58,870	99,852	272,910	255,559
Vermont			(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	141,140	779,460
Virginia	28,670	42,194	668,490	695,393	2,476,890	2,401,135	646,580	512,253	791,350	794,726	756,460	817,507	5,368,440	5,263,208
Washington			4,720	3,576	3,260	4,568			13,960	54,978	133,950	284,733	155,890	347,855
West Virginia	(1)	(1)	1,160,060	959,524	499,990	602,761	382,370	321,601	120,030	183,641	(1)	(1)	2,563,440	2,469,986
Wisconsin	19,620	18,908	47,570	40,922	2,313,410	1,951,701	439,790	409,794	982,290	1,219,917	52,430	71,209	3,855,110	3,712,451
Wyoming	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	172,760	203,699
Undistributed	366,810	372,466	592,550	415,540	1,597,610	1,396,570	865,620	553,948	298,460	585,712	1,453,960	2,563,222	2,709,260	2,157,568
	2,371,720	2,596,444	30,259,250	24,147,313	72,803,290	70,854,215	9,645,070	6,923,225	13,745,400	16,993,254	13,199,900	14,919,089	142,024,630	136,433,540
Average unit value		$1.09		$0.80		$0.97		$0.72		$1.24		$1.13		$0.96

[1] Included under "Undistributed."

Limestone (crushed and broken stone) sold or used by producers in the United States for miscellaneous uses, 1941–42

Use	1941		1942	
	Short tons	Value	Short tons	Value
Alkali works	5,888,260	$2,721,635	6,350,450	$3,005,483
Calcium carbide works	468,600	343,241	430,600	399,169
Coal-mine dusting	136,180	388,962	193,260	491,819
Filter (not whiting substitute):				
Asphalt	443,480	1,050,927	439,430	1,026,138
Fertilizer	301,650	548,104	226,910	407,301
Other	68,980	295,713	107,760	379,948
Filter beds	32,950	41,787	66,310	111,417
Glass factories	385,680	578,226	434,080	656,775
Limestone sand	877,730	812,517	484,810	369,408
Limestone whiting [1]	417,750	2,421,609	326,930	2,277,835
Magnesia works (dolomite)	105,670	136,180	117,650	151,756
Mineral food	115,400	546,784	169,880	792,949
Mineral (rock) wool	115,760	93,167	119,620	106,985
Paper mills	361,830	643,124	435,200	760,332
Poultry grit	62,070	351,809	62,620	371,221
Refractory (dead-burned dolomite)	980,190	729,792	1,354,090	1,197,386
Road base	575,130	441,355	931,680	740,557
Stucco, terrazzo, and artificial stone	25,840	166,021	17,890	123,643
Sugar factories	624,450	936,874	625,520	986,210
Other uses [2]	156,250	287,933	213,980	317,478
Use unspecified	159,980	252,972	91,230	245,279
	12,303,830	13,788,732	13,199,900	14,919,089

[1] Includes stone for filler for calcimine, caulking compounds, chewing gum, cosmetics, explosives, flavoring extracts, imitation leather, linoleum, paint, paper, parting compounds, phonograph records, plastics, pottery, printing ink, putty, regrinding, roofing, rubber, sealing wax, tile, tooth powder, wire, and unspecified uses.

[2] Includes stone for acid neutralization, carbon dioxide, ceramics, chemicals (unspecified), concrete blocks and pipes, dye, foundry facings, motion-picture snow, oil-well drilling, rayon, rice milling, spalls, and spray.

Dolomite (calcium-magnesium carbonate), which occurs extensively in the United States, is attaining increasing commercial importance. Its new use as a source of magnesium metal, plus growing demands for refractory magnesia, one of its derivatives, led the Bureau of Mines to make a comprehensive survey of United States resources of this important rock.[1] Data on high-grade dolomite deposits assembled from all available published sources were supplemented by additional information secured from State geological surveys, geologists, and mining engineers. This report covers the occurrences by geographic areas and by States. The extent and thickness of the deposits, altitude of beds, accessibility, workability, and composition are described. An important feature of the paper is a series of tables comprising about 1,000 representative analyses of dolomites from all parts of the country. A map shows the location of the deposits.

The record-breaking demand for refractories to maintain maximum operation of innumerable furnaces turning out metal for war munitions resulted in so many calls for information on special types of heat-resisting products that the Bureau prepared a report [2] dealing with all recent developments in the refractories for which dolomite is used as raw material.

Sales of dolomite and its primary product of calcination—dolomitic lime—for certain special uses are covered in the following table:

[1] Weitz, John H., High-Grade Dolomite Deposits of the United States: Bureau of Mines Inf. Circ. 7226, 1942, 86 pp.

[2] Schallis, Alvin, Dolomite-Base Refractories: Bureau of Mines Inf. Circ. 7227, 1942, 11 pp.

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1941–42

	1941	1942
Dolomite for—		
Basic magnesium carbonate:		
Short tons	105,670	117,650
Value	$136,180	$151,756
Dead-burned dolomite or refractory stone:		
Short tons	980,190	1,354,090
Value	$729,792	$1,197,386
Dolomitic lime for—		
Refractory (dead-burned dolomite):		
Short tons	1,069,887	1,229,357
Value	$9,111,172	$10,817,634
Paper mills:		
Short tons	78,000	85,000
Value	$551,000	$604,000
Total (calculated as raw stone)—short tons	3,382,000	4,100,000

Fluxing limestone has attained such importance that the Bureau of Mines for the first time has separated the figures by principal uses, as indicated in the accompanying table.

Sales of fluxing limestone, 1938–42, by uses

Year	Blast furnaces		Open-hearth plants		Other smelters [1]		Other metallurgical [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1938	6,449,520	$4,455,693	2,459,820	$1,919,097	721,930	$502,642	60,860	$56,189	9,692,130	$6,933,621
1939	13,115,580	9,505,807	3,471,570	2,638,935	522,330	331,969	162,080	142,227	17,271,560	12,618,938
1940	15,611,720	10,638,341	6,500,680	4,462,852	342,240	278,726	402,270	358,968	22,856,910	15,738,887
1941	20,244,510	14,832,938	6,332,210	4,469,838	481,100	398,839	374,700	362,544	27,432,520	20,064,159
1942	23,663,630	18,523,158	5,843,820	4,886,157	494,720	460,270	257,080	277,728	30,259,250	24,147,313

[1] Includes flux for copper, gold, lead, zinc, and unspecified smelters.
[2] Includes flux for foundries and for cupola and electric furnaces.

Limestone is quarried not only for use raw but also for manufacture into cement and lime. The large and important industries manufacturing these products are covered in separate chapters of the Yearbook. It is of interest, however, to show in one table, as follows, the total tonnage of limestone consumed for all purposes.

Limestone sold or used for all purposes in the United States, 1940–42, in short tons

Use	1940	1941	1942
Limestone (as given in this report) (approximate)	112,658,000	133,164,000	142,488,000
Portland cement (including "cement rock") [1]	34,041,000	42,735,000	47,657,000
Natural cement ("cement rock") [1]			
Lime [2]	9,774,000	12,159,000	12,208,000
	156,473,000	188,058,000	202,353,000

[1] Reported in terms of cement in chapter on Cement.
[2] Reported in terms of lime in chapter on Lime.

SANDSTONE

Sales of crushed sandstone were 13 percent lower in quantity and 20 percent lower in value in 1942 than in 1941. Ganister, the principal raw material of silica brick used extensively to line open-hearth steel furnaces, was produced in larger quantities in 1942 than in any previous year. The output was 2 percent greater than the former high of 1917.

Sandstone (crushed and broken stone) sold or used by producers in the United States in 1942, 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)					66,670	$69,388
Arizona			(2)	(2)							(2)	(2)
Arkansas					353,690	$382,750					353,690	382,750
California	16,350	$68,239	20,760	$24,404	887,870	651,725	1,000	$501	383,490	$93,186	1,309,470	838,055
Colorado	22,980	34,456	12,120	23,027	2,120	2,387					37,220	59,870
Idaho					(2)	(2)					(2)	(2)
Illinois	(2)	(2)	(2)	(2)							2,950	9,376
Kansas			(2)	(2)	(2)	(2)					207,490	257,056
Kentucky					(2)	(2)					(2)	(2)
Maryland			(2)	(2)							(2)	(2)
Michigan					(2)	(2)			(2)	(2)	(2)	(2)
Minnesota			1,400	1,257							1,400	1,257
Montana	(2)	(2)	(2)	(2)	(2)	(2)					91,030	43,189
Nevada			(2)	(2)							(2)	(2)
New York					105,070	121,788			8,500	10,625	113,570	132,413
North Carolina			(2)	(2)	(2)	(2)					(2)	(2)
Ohio	96,970	483,765	142,260	207,779	500	800					239,730	692,344
Oklahoma			(2)	(2)	(2)	(2)					(2)	(2)
Oregon					(2)	(2)			(2)	(2)	128,610	128,130
Pennsylvania	770,140	1,398,188	183,580	185,933	540,780	595,075	241,140	258,738	343,650	271,855	2,079,290	2,709,789
South Dakota	(2)	(2)	22,940	26,833	84,950	118,664			(2)	(2)	133,430	194,833
Tennessee	(2)	(2)	(2)	(2)							(2)	(2)
Texas			(2)	(2)	(2)	(2)					2,190	1,957
Utah	(2)	(2)									(2)	(2)
Vermont					8,820	14,545					8,820	14,545
Virginia	25,840	32,303	150	76	55,560	31,562	66,690	44,125	18,060	8,608	166,300	116,674
Washington			(2)	(2)							(2)	(2)
West Virginia	(2)	(2)	55,860	114,718	419,880	380,861			(2)	(2)	605,090	673,002
Wisconsin	230,040	348,306	(2)	(2)	(2)	(2)			(2)	(2)	395,440	747,821
Wyoming			(2)	(2)							(2)	(2)
Undistributed	166,940	259,070	636,930	527,394	331,200	346,634			209,840	436,764	525,680	434,492
Average unit value	1,329,260	2,624,327 $1.97	1,076,000	1,111,421 $1.03	2,790,440	2,646,791 $0.95	308,830	303,364 $0.98	963,540	821,038 $0.85	6,468,070	7,506,941 $1.16

[1] Includes sandstone for chemical use, fill material, filter stone, poultry grit, road base, rock wool, roofing granules, and stone sand. [2] Included under "Undistributed."

MISCELLANEOUS STONE

Crushed and broken 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 States and uses, in 1942; such sales increased 50 percent in quantity and 8 percent in value over 1941.

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1942, 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			46,560	$63,495					46,560	$63,495
Arkansas	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
California	1,631,430	$2,083,923	3,723,610	2,087,543	178,910	$41,605	122,840	$61,552	5,656,790	4,274,623
Colorado	(2)	(2)	(2)	(2)	(2)	(2)			116,660	65,442
Florida			(2)	(2)			(2)	(2)	69,260	63,107
Illinois			20,930	15,700					20,930	15,700
Indiana			(2)	(2)					(2)	(2)
Kansas [3]			261,780	33,517	104,730	13,457			366,510	51,974
Maine			(2)	(2)					(2)	(2)
Maryland	1,980	1,823	5,200	9,260					7,180	11,083
Massachusetts	24,870	30,700	81,300	101,625					106,170	132,325
Michigan			(2)	(2)			(2)	(2)	(2)	(2)
Missouri [3]			[4] 974,660	[4] 261,987	1,510,550	225,618			[4] 2,485,210	[4] 487,605
Nevada			50,820	72,415					50,820	72,415
New Hampshire							1,310	11,781	1,310	11,781
New Jersey			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
New York	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	239,200	113,784
North Carolina			105,970	133,373					105,970	133,373
Ohio			(2)	(2)					(2)	(2)
Oklahoma [3]			1,189,100	167,112	2,394,030	342,663			3,583,130	509,775
Oregon			77,330	47,500					77,330	47,500
Pennsylvania	120	115	101,060	126,348			70,470	442,190	171,650	568,653
Rhode Island			(2)	(2)					(2)	(2)
South Carolina			(2)	(2)					(2)	(2)
South Dakota	80	80	21,830	23,597					21,910	23,677
Tennessee			(2)	(2)					(2)	(2)
Texas			(2)	(2)	(2)	(2)			227,450	174,067
Utah							(2)	(2)	(2)	(2)
Vermont			(2)	(2)			(2)	(2)	(2)	(2)
Virginia	(2)	(2)	(2)	(2)			(2)	(2)	55,860	153,637
Washington	12,000	12,000	32,200	14,235					44,200	26,235
West Virginia			(2)	(2)					(2)	(2)
Wisconsin			(2)	(2)	(2)	(2)			(2)	(2)
Undistributed	116,830	128,772	1,131,510	964,440	675,430	447,328	97,460	227,545	1,312,800	1,198,048
	1,787,310	2,257,413	7,823,860	4,127,147	4,863,650	1,070,671	292,080	743,068	14,766,900	8,198,299
Average unit value		$1.26		$0.53		$0.22		$2.54		$0.56

[1] Includes stone used for filler (unspecified), poultry grit, refractory, road base, roofing granules, tennis courts, and terrazzo.
[2] Included under "Undistributed."
[3] Chats; figures collected by Joplin (Mo.) office of the Bureau of Mines.
[4] A small quantity of stone included with chats.

MARKETS

As crushed stone is an important building material, sales generally are related closely to the volume of building construction. One of its leading uses is as aggregate in concrete, therefore sales should normally follow the trends of cement shipments and the area of concrete pavements that are constructed. These relationships are indicated in figure 3. Concrete aggregate failed to pace the enormous increase in total building because concrete was employed less extensively in the temporary or semipermanent types of structures erected in 1942 than in normal peacetime structures.

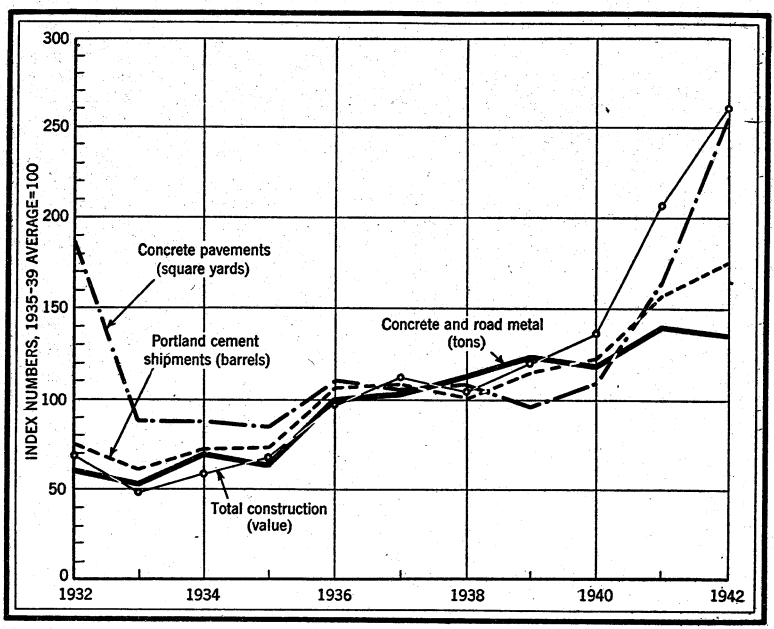

FIGURE 3.—Crushed-stone aggregates (concrete and road metal) sold or used in the United States compared with shipments of portland cement, total construction (value), and concrete pavements (contract awards, thousands of square yards), 1932–42. Data on construction and concrete pavements from Bureau of Foreign and Domestic Commerce.

Pig-iron production, which reached more than 59 million tons in 1942, surpassed all previous records, and therefore the demands for limestone furnace flux were unprecedented. To produce more than 86 million tons of steel, mills were forced to capacity. To replace burned-out furnace linings and to keep them in repair placed an unusual burden on producers of dolomite for refractory use and of ganister for manufacture of silica brick. The relations of fluxing-stone output to pig-iron production and of refractory stone to steel-ingot manufacture over an 11-year period are indicated in figure 4. The demand for refractory stone in excess of normal requirements of the iron and steel industries, as indicated in this figure, probably was due to the shorter life of furnace linings under the stress of forced output.

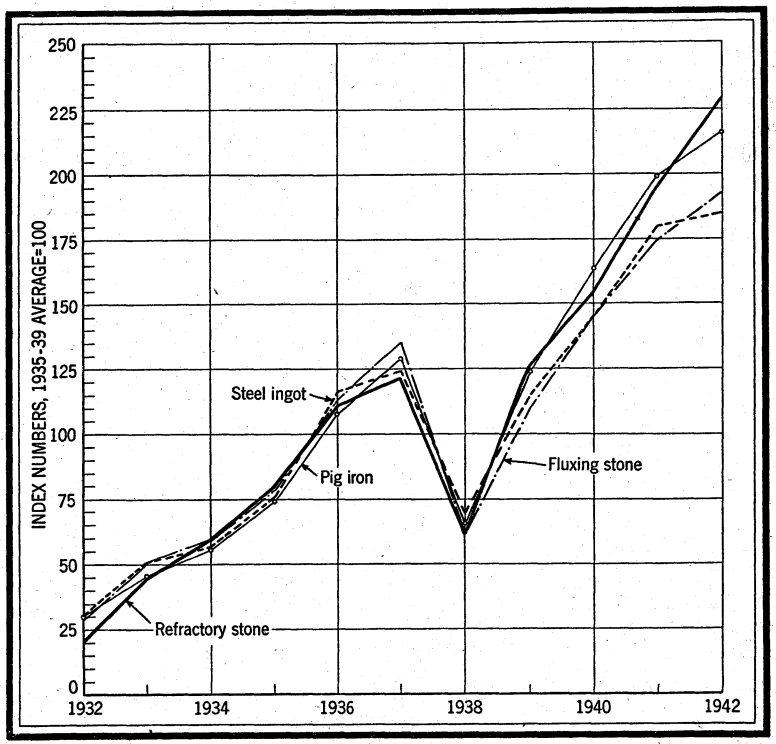

FIGURE 4.—Sales (tons) of fluxing stone and refractory stone including that used in making lime as recorded in the chapter on Lime compared with production of steel ingot and pig iron, 1932–42. Statistics of steel-ingot production compiled by American Iron and Steel Institute.

NEW DEVELOPMENTS

Little is to be reported for 1943 on new plant construction or plant rehabilitation because necessity had to be shown and priorities obtained for all new equipment. Some increased facilities were authorized where the quarry output was used in military projects. Quarry operators had difficulty at times in obtaining necessary supplies and repairs, and their ingenuity and inventiveness were exercised in devising ways and means of coping with equipment difficulties. Used equipment was accommodated to replacement needs in some instances.

A good example of ways in which valuable materials are conserved is a method devised for reusing drill steel that ordinarily would be unserviceable. High-carbon drill steel is in heavy demand, and to maintain maximum supplies short lengths and broken quarry drills are now reclaimed by joining them into long drills. This is accomplished by skillful oxyacetylene welding.

FOREIGN TRADE

Exports and imports of stone are relatively small. Figures for a recent 5-year period are shown in the accompanying table. Average exports for the 3-year period, 1938 to 1940, for which figures are comparable, were only 0.1 percent of average domestic sales during the same period. Average imports for the 4 years, 1937 to 1940,

were only 0.5 percent of average domestic sales for that period. Owing to wartime restrictions, no figures on foreign trade can be published, but it is apparent from the data on foreign movement of stone recorded herein that their absence for 1942 will not detract appreciably from the value of the report, particularly in view of the recent rigid restrictions on foreign movement of commodities deemed unessential to the war program. Foreign trade figures will be released at the termination of the present war emergency to preserve the continuity of the statistical record.

Value of United States exports and imports of stone, 1937–41

Year	Exports	Imports					
	Marble and other building and monumental stone	Marble	Granite	Quartzite	Travertine	Other	Total
1937	[1] $88,528	$435,361	$245,819	$249,003	$18,677	$32,566	$981,426
1938	141,815	301,671	249,573	224,738	32,313	30,223	838,518
1939	134,416	335,696	165,167	199,454	29,211	83,197	812,725
1940	158,008	209,675	29,760	190,599	23,468	70,336	523,838
1941 [2]	108,706	100,859	14,786	111,055	3,295	35,527	265,522

[1] Marble only.
[2] January to September, inclusive.

Exports.—Marble is the principal variety of stone exported. Normally over 90 percent of the exports are shipped to Canada and the remainder chiefly to Cuba, Newfoundland, Mexico, and various Central and South American countries. Before the war small quantities were shipped to Germany, the United Kingdom, and other parts of Europe.

Imports.—Before the war Italy, France, Belgium, and Spain were the chief sources of foreign marbles. Mexico and Argentina are the principal suppliers of onyx marbles.

Moderate quantities of granite are imported from Canada, and when shipping was unrestricted Finland and Sweden were the most important sources outside of the American continent. Red granite from Finland is popular for polished monumental work, and gabbro (black granite) from Sweden finds a ready market, particularly in the New York area. Other European countries have furnished limited quantities.

Quartzite imports originate in Canada and are used principally for the manufacture of ferrosilicon. Travertine has been obtained almost exclusively from Italy. Before 1940 it was an important foreign building material that was popular thoughout the United States for floor tile, steps, and wainscoting.

SLATE

By Oliver Bowles and M. S. Jensen

SUMMARY OUTLINE

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SUMMARY

Sales of slate as dimension stone were 41 percent lower in quantity and 33 percent lower in value in 1942 than in 1941. This drastic decline may be attributed chiefly to rigid curtailment of private residential building and small demand for slate in the types of defense-housing units that were constructed in 1942. Very few homes of the type that commonly have slate roofs were erected during the year. Unit prices were in general higher than in 1941.

Roofing-slate sales were little more than half as great as in 1941, in quantity or value; the average value per square in 1942 was $8.87, whereas in 1941 it was $8.39. Sales in the Pennsylvania area were 49 percent lower, in both quantity and value, than in 1941. In the New York-Vermont area, sales declined 49 percent in quantity and 39 percent in value. Virginia sales dropped 49 percent in quantity and 48 percent in value.

Sales of mill stock declined only about 1 percent in quantity but gained 3 percent in value. Sales of electrical slate, which made phenomenal gains in 1941, made a further advance of 10 percent in quantity and 14 percent in value in 1942, attaining the highest level of production since 1930. These gains during the past 2 years undoubtedly reflect the great increase in utilization of electric power in connection with the enormous growth in manufacture of war munitions. Although total new construction increased from 208 percent of the 1935–39 average in 1941 to 261 percent in 1942, sales of structural and sanitary slate declined 1 percent in quantity; they gained 3 percent in value. It is evident that the types of military building that predominated in the construction field in 1942 require less slate than peace-time building. Sales of vaults and covers increased 2 percent in quantity and value.

A decline of only 6 percent in quantity and 10 percent in value of blackboards and bulletin boards, even though school and college construction was almost negligible, indicates that blackboards found considerable use in military instruction centers. A decline of 31 percent, in both quantity and value, in sales of billiard-table tops indicates that they are not essential from a military standpoint. Sales of

school slates increased 8 percent in quantity and 15 percent in value. Sales of flagstones and stepping stones were lower than in 1941.

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 are used in roofing products that compete in the roofing-slate market. For the most part, slate used for the manufacture of granules is unsuitable for other slate products. Sales of granules increased 10 percent in quantity and 9 percent in value and sales of flour 12 percent in quantity and 13 percent in value compared with 1941. Granules are used chiefly in the manufacture of low-cost roofing, and their wide employment was to satisfy the demands of military camps, warehouses, and other more or less temporary structures built for military needs. In 1942, the average sales value of granules f. o. b. mill was $8.29 and of flour $3.53 per short ton, compared with $8.37 and $3.49, respectively, in 1941. Figures for sales of granules made of rock other than slate are given in the chapter of this volume on Stone.

The following table, presenting the principal statistical data for the slate industry during 1941 and 1942, is arranged to permit ready comparison of the 2 years.

Salient statistics of the slate industry in the United States, 1941–42

	1941			1942				
	Quantity		Value	Quantity		Value	Percent of change in—	
	Unit of measurement	Approximate equivalent short tons		Unit of measurement	Approximate equivalent short tons		Quantity (unit as reported)	Value
Domestic production (sales by producers):								
Roofing slate	*Squares* 378,980	140,830	$3,180,766	*Squares* 192,070	71,400	$1,704,053	−49.3	−46.4
Mill stock:								
Electrical slate	*Sq. ft.* 628,720	5,870	477,047	*Sq. ft.* 692,680	6,640	543,531	+10.2	+13.9
Structural and sanitary slate	738,220	5,740	254,616	727,490	5,880	263,390	−1.5	+3.4
Grave vaults and covers	255,890	2,410	63,030	260,230	2,510	64,250	+1.7	+1.9
Blackboards and bulletin boards	857,990	2,230	198,466	804,860	1,980	178,002	−6.2	−10.3
Billiard-table tops	241,620	1,880	71,388	166,250	1,210	49,205	−31.2	−31.1
School slates	[1] 522,830	550	12,267	[1] 561,900	500	14,048	+7.5	+14.5
Total mill stock	3,245,270	18,680	1,076,814	3,213,410	18,720	1,112,426	−1.0	+3.3
Flagstones, etc.[2]	3,002,380	21,480	152,254	2,499,870	16,910	139,328	−16.7	−8.5
Total slate as dimension stone	----------	180,990	4,409,834	----------	107,030	2,955,807	−40.9	−33.0
Granules and flour	----------	437,670	3,105,800	----------	483,740	3,404,416	+10.5	+9.6
Grand total domestic production	----------	618,660	7,515,634	----------	590,770	6,360,223	−4.5	−15.4

[1] Square feet approximate. Number of pieces: 1941, 977,250; 1942, 1,050,270.
[2] Includes walkways, stepping stones, and miscellaneous slate.

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 such products for a 5-year period.

Slate (other than granules and flour) sold by producers in the United States, 1938–42

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
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
1941	378,980	140,830	3,180,766	18,680	1,076,814	21,480	152,254	180,990	4,409,834
1942	192,070	71,400	1,704,053	18,720	1,112,426	16,910	139,328	107,030	2,955,807

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

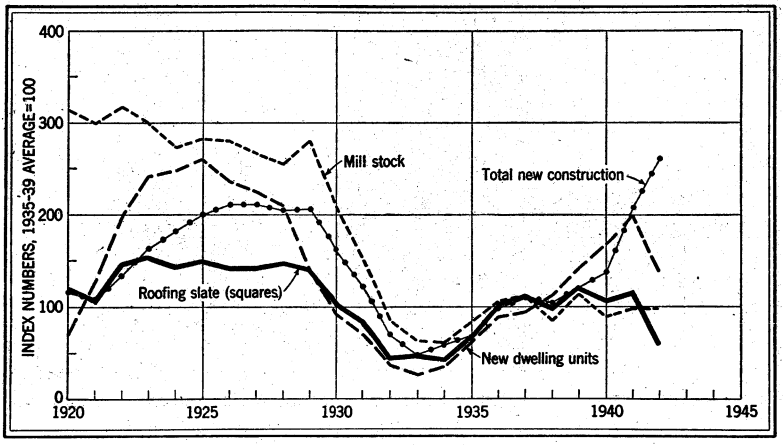

FIGURE 1.—Sales of roofing slate and mill stock compared with new dwelling units and total new construction, 1920–42. Data on new construction from Bureau of Foreign and Domestic Commerce and on new dwelling units from Bureau of Labor Statistics.

Figure 1 compares sales of roofing slate and mill stock with the number of new dwelling units and total new construction from 1920 to 1942. Roofing slate, which is used chiefly in residential construction, failed to keep pace with new dwelling units from 1921 to 1929. From that date until 1938, residential building was at a low ebb, with roofing-slate sales showing small proportional gains. From 1939 to 1941, new residential building made rapid strides and slate roofing made relatively small gains. In 1942, residential construction underwent a decline comparable in severity with that of 1929; and roofing-slate sales, already at a low level, experienced a similar decline.

Mill stock is used most widely in nonresidential building. As indicated in figure 1, mill-stock sales maintained a favorable position with respect to total new construction from 1920 to 1937, but thereafter

they lagged. The demand for mill stock failed to respond to the upsurge of total construction in 1941 and 1942 because the predominant military construction consisted largely of temporary structures, in which little or no slate was used.

Figure 2 presents graphically a statistical history of slate by uses over a 28-year period. All branches of the industry experienced a serious decline during the depression years, and although some recovery took place in subsequent years the upturn was reversed in 1942 because dimension slate is used very little in military building. Slate-granule sales, however, have expanded, because slate-surfaced composition roofing is in wide demand for temporary and semipermanent building.

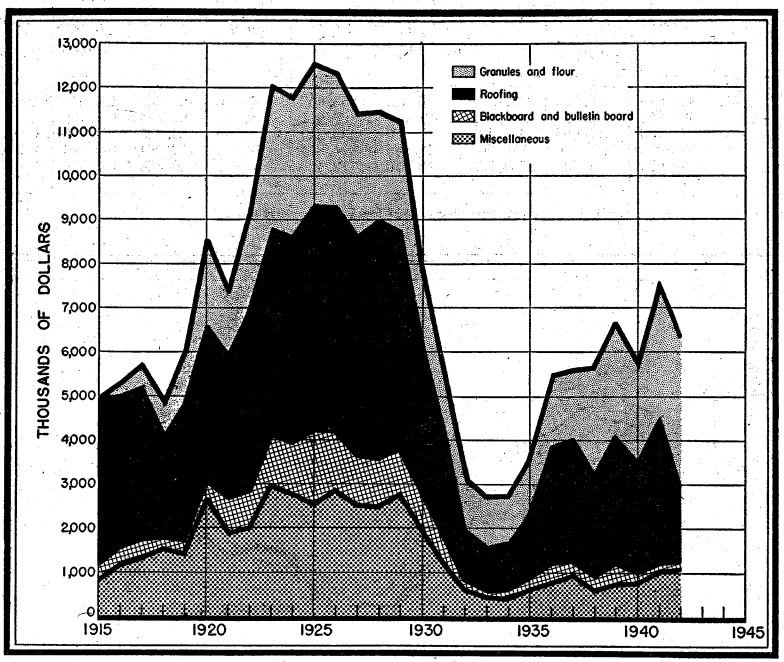

FIGURE 2.—Value of slate sold in the United States, 1915–42, by uses.

Figure 3 presents the same history as figure 2, except that quantities rather than values are used. Products of low unit value naturally assume greater prominence in this chart, whereas the higher-priced products, such as blackboards, become relatively insignificant on a quantity basis.

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 use of these commodities showed substantial gains in 1942 because of their application to military needs.

Crushed slate (granules and flour) sold by producers in the United States. 1938–42

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	323, 740	2, 708, 246	113, 930	397, 554	437, 670	3, 105, 800
1942	356, 510	2, 955, 562	127, 230	448, 854	483, 740	3, 404, 416

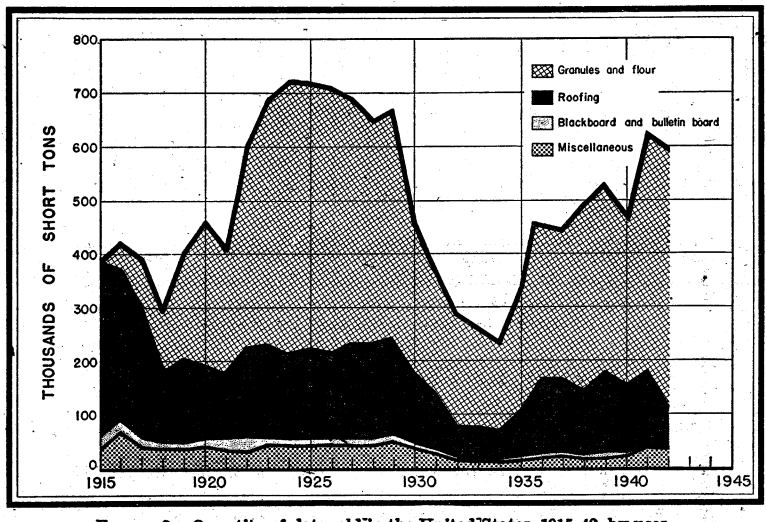

FIGURE 3.—Quantity of slate sold in the United States, 1915–42, by uses.

PRICES

The average price of roofing slate f. o. b. quarry or mill, as reported to the Bureau of Mines, increased 48 cents a square in 1942 compared with 1941. In Pennsylvania it increased 14 cents, in the New York-Vermont area $1.57, and in Virginia 23 cents a square.

The price of mill stock increased from 33 cents a square foot in 1941 to 35 cents in 1942. Average values of electrical and structural and sanitary slate increased 2 cents a square foot; those for vaults and covers and billiard-table tops remained unchanged; those for blackboards and bulletin boards decreased 1 cent a square foot; and those for granules and flour decreased 6 cents a short ton.

Price history.—Figure 4 shows the trend in slate prices compared with building materials in general over a 28-year period. Slate prices were lower than those of building materials in general from 1915 to 1920, but from that time until 1932 prices of both roofing and mill stock were well above the average of all building materials. Since 1932 slate prices have varied only moderately from the general average.

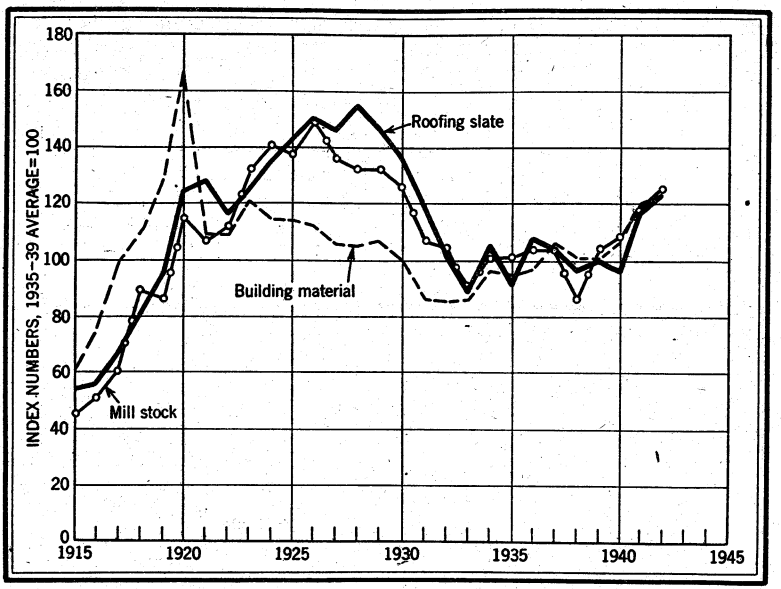

FIGURE 4.—Prices of slate compared with wholesale prices of building materials in general, 1915–42. Wholesale prices are from Bureau of Labor Statistics.

REVIEW BY STATES AND DISTRICTS

The following table gives sales of slate in 1942, by States and uses.

Slate sold by producers in the United States in 1942, by States and uses

State	Operators	Roofing		Mill stock		Other uses [1] (value)	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas	2					(2)	(2)
California	1					(2)	(2)
Georgia	1					(2)	(2)
Maine	2	1,130	$9,100	604,200	$471,291		$480,391
Maryland	1					(2)	(2)
New York	8	2,200	32,518			$627,072	659,590
Pennsylvania [3]	22	125,950	1,068,300	2,530,900	571,843	966,656	2,606,799
Vermont	26	41,850	396,601	78,310	69,292	1,193,896	1,659,789
Virginia	5	20,940	197,534			(2)	(2)
Undistributed						756,120	953,654
Total: 1942	68	192,070	1,704,053	3,213,410	1,112,426	3,543,744	6,360,223
1941	85	378,980	3,180,766	[4] 3,245,270	[4] 1,076,814	[4] 3,258,054	7,515,634

[1] Flagging and similar products, granules, and flour
[2] Included under "Undistributed."
[3] For details of production in Pennsylvania, see following table.
[4] Small amount of mill stock from New York in 1941 included under "Other uses."

Maine.—Slate produced in Maine is used chiefly for electrical panels, for which it possesses superior qualities. Sales of this product increased 16 percent in quantity and 14 percent in value compared with 1941. Sales of roofing slate were approximately only one-third as large in quantity and value as in 1941; such slate, however, is a small fraction of the Maine slate industry.

New York-Vermont.—Continuing the decline in roofing-slate sales recorded for the 2 preceding years, sales in 1942 were little more than half as great as in 1941; the value of sales declined 39 percent. Mill-stock sales declined 44 percent in quantity and 13 percent in value; but the value of other products, chiefly granules and flour, dropped less than 1 percent. The value of all slate products sold in Vermont in 1942 was 14 percent and in New York 4 percent lower than in 1941. This slate area is the outstanding source of colored roofing slates in the United States. Their attractive green, red, purple, and mottled colors and adaptability to architectural design, combined with excellent enduring qualities, fit them especially for churches, libraries, colleges, and Government and other public buildings, as well as for moderate- and high-priced homes. It was because such types of construction were so lacking in 1942 that the roofing-slate industry of the New York-Vermont area declined so severely.

Peach Bottom district.—Blue-black slates of high quality have been quarried for more than 200 years on the Maryland-Pennsylvania border near Delta, Pa. Many years ago several companies produced roofing slate in this area, but all ceased operation because of drainage difficulties and costly slides of overburden and debris. In 1937 a new roofing-slate operation was developed in Pennsylvania, and it has become a substantial producer. Granules and slate flour are manufactured in both States.

Lehigh district.—The most productive slate area in the United States is in Lehigh and Northampton Counties, Pa.; all kinds of slate products are manufactured. As separate figures cannot be shown for York County, Pa., it is included with Northampton County in the accompanying table.

The value of total sales of slate products in the Lehigh district was 25 percent lower in 1942 than in 1941. Sales of roofing slate were 49 percent less in both quantity and value. The following mill-stock products gained in both quantity and value: Structural and sanitary slate (8 percent in quantity and 18 percent in value), vaults and covers (2 percent in both quantity and value), and school slates (7 percent in quantity and 15 percent in value); the following declined in both quantity and value: Electrical slate (26 percent in quantity and 28 percent in value), blackboards and bulletin boards (6 percent in quantity and 10 percent in value), and billiard-table tops (30 percent in quantity and 29 percent in value). Other products, chiefly granules and flour, gained 20 percent in value compared with 1941.

Slate sold by producers in Pennsylvania in 1942, 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	6	10,510	$71,717	43,180	$18,613	6,190	$2,098	(1)	(1)
Northampton and York [2]	16	115,440	996,583	15,700	6,910	681,440	241,910	[1] 251,380	[1] $61,057
Total: 1942	22	125,950	1,068,300	58,880	25,523	687,630	244,008	251,380	61,057
1941	25	248,980	2,075,490	79,260	35,496	638,680	206,881	246,700	59,659

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	246,540	$46,311	----	----	561,900	$14,048	(3)	[1] [3] $152,787
Northampton and York [2]	558,320	131,691	166,250	$49,205	----	----	[3] $966,656	[1] [3] 2,454,012
Total: 1942	804,860	178,002	166,250	49,205	561,900	14,048	966,656	2,606,799
1941	857,990	198,466	238,850	69,674	522,830	12,267	806,415	3,464,348

[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.

NEW DEVELOPMENTS

The possibilities of using waste slate as a source of lightweight aggregates have been studied by the Bureau of Mines, and the results appear in a recent publication.[1] Slates from Pennsylvania, Maine, and Maryland gave a satisfactory degree of bloating upon calcination. Concretes made with the resulting aggregates weighed 103 to 107 pounds per cubic foot, whereas concretes made with standard crushed-stone or gravel aggregates weigh about 142 pounds per cubic foot. Concrete made with expanded slate aggregates was found to possess adequate strength for general structural uses. Such lightweight concretes can be used advantageously for bridge decks, arches, floors, and walls where the structural design demands a minimum dead load. As enormous quantities of waste accumulate in all slate-producing centers, the development of such a byproduct industry is highly desirable.

The results of a survey of roofing materials in the South Central States, recently published by the National Bureau of Standards,[2] bring out the interesting fact that slate covered only 0.75 percent of all the roofs examined. In view of the fact that one of the major roofing slate-producing regions of the United States—Buckingham

[1] Conley, John E., Waste Slate as a Raw-Material Source of Lightweight Aggregates: Trans. Am. Inst. Min. and Met. Eng., vol. 148, Industrial Minerals (Nonmetallics), 1942, pp. 161–166.
[2] Snoke, Hubert R., and Waldron, Leo J., Survey of Roofing Materials and Structures: U. S. Dept. of Commerce Building Materials and Structures Report, BMS 84, 1942, 19 pp.

County, Va.—is within easy reach of the northern part of the area covered in the survey, it is remarkable that slate, which possesses superior durability and attractive appearance, should have been used so sparingly. The potential market for roofing slate is enormous, but the industry has made little progress in developing the market.

Considerable publicity has been given to a patent process of laying roofing slate with a single lap over heavily coated asphalt roofing. Each slate is held in place with a single nail and a metal clip. The advantages claimed are a reduction of nearly 50 percent in the quantity of slate needed, weight of roof, and cost, compared with roofs laid according to the American method. At the same time, the roof is said to equal the ordinary slate roof in appearance and durability. Wide acceptance of this new method by architects and builders would tend greatly to increase the use of roofing slate, particularly in the field of low-cost housing where slate is commonly regarded as too costly for extensive use.

FOREIGN TRADE

Owing to wartime restrictions no figures on foreign trade can be published; they are, however, of so little significance in the slate industry that their absence will not detract appreciably from the value of this report.

The total annual value of imports for the 10-year period 1932 to 1941 ranged from a high of $17,317 in 1932 to a low of $520 in 1940 and averaged about $7,000 a year. This is only about 0.2 percent of the average annual domestic sales for the period. These small imports originated in various countries, chiefly Italy, Poland, Netherlands, Czechoslovakia, and United Kingdom.

Exports of slate products (exclusive of granules and flour), as reported by producers, are higher than imports. From 1932 to 1941 their value ranged from $26,042 in 1933 to $75,656 in 1940 and averaged about $55,000 a year. This is a little more than 1 percent of the average annual sales value (including granules and flour) during the period. Exports consist of roofing, school slates, electrical slates, blackboards, billiard-table tops, and various structural slate products. Canada, Mexico, and South and Central America are the principal destinations.

SAND AND GRAVEL

By G. W. Josephson and G. E. Tucker

SUMMARY OUTLINE

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SUMMARY

As an integral part of the great wave of wartime construction, the production of sand and gravel in 1942 exceeded 300 million tons and surpassed all previous records. The quantity and value of total production over a period of years are indicated in figure 1.

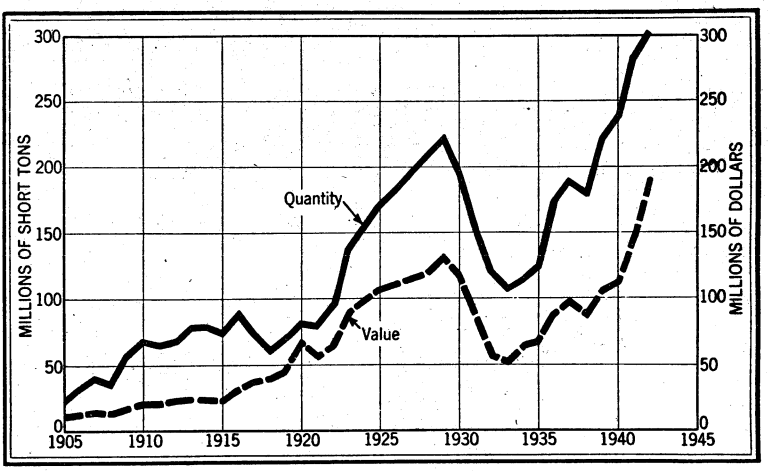

Figure 1.—Total production of sand and gravel in the United States, 1905–42.

With the increase in activity came an appreciable improvement in production efficiency and firmer prices, counterbalanced by rising operating expenses in the form of increased wage, transportation, and material costs. The War Production Board, the Office of Price Administration, and the Office of Defense Transportation greatly influenced the practices of the industry in 1942.

A noteworthy trend is visible in the fact that whereas commercial operations increased their tonnage 28 percent in 1942 compared with 1941, the output of Government-and-contractor [1] operations was 33

[1] Prior to 1939 classified as "noncommercial"; details of change in designation given in Minerals Yearbook, 1940, Review of 1939, p. 1214.

percent lower. Private building, highway construction, and many large public works projects like those of the Work Projects Administration have been curtailed or eliminated to concentrate the men, money, equipment, and materials on more critical wartime activities. Salient statistics on sand and gravel for 1941 and 1942 are summarized in the following table.

Sand and gravel sold or used by producers in the United States, 1941–42, by commercial and Government-and-contractor operations and by uses

	1941			1942			Percent of change in—	
	Short tons	Value		Short tons	Value			
		Total	Average		Total	Average	Tonnage	Average value
COMMERCIAL OPERATIONS								
Sand:								
Glass	3,475,111	$6,113,529	$1.76	3,622,487	$6,784,427	$1.87	+4.2	+6.3
Molding	7,246,081	8,412,725	1.16	8,255,991	10,745,552	1.30	+13.9	+12.1
Building	40,164,731	21,698,378	.54	46,035,701	26,901,356	.58	+14.6	+7.4
Paving	27,013,283	14,834,378	.55	33,307,106	20,035,796	.60	+23.3	+9.1
Grinding and polishing [1]	1,001,814	1,388,966	1.39	806,878	1,363,168	1.69	−19.5	+21.6
Fire or furnace	325,803	357,240	1.10	368,465	491,972	1.34	+13.1	+21.8
Engine	2,022,782	1,312,433	.65	2,559,008	1,749,204	.68	+26.5	+4.6
Filter	263,966	324,107	1.23	176,833	223,137	1.26	−33.0	+2.4
Railroad ballast [2]	1,634,335	445,181	.27	1,969,758	675,778	.34	+20.5	+25.9
Other [3]	2,022,604	1,455,384	.72	1,698,134	1,345,823	.79	−16.0	+9.7
Total commercial sand	85,170,510	56,342,321	.66	98,800,361	70,316,213	.71	+16.0	+7.6
Gravel:								
Building	37,900,243	26,729,788	.71	46,389,536	35,827,822	.77	+22.4	+8.5
Paving	38,310,304	24,624,898	.64	60,874,506	43,193,937	.71	+58.9	+10.9
Railroad ballast [4]	16,302,175	5,456,300	.33	23,110,558	8,377,991	.36	+41.8	+9.1
Other [5]	3,873,235	1,553,606	.40	3,772,826	1,711,310	.45	−2.6	+12.5
Total commercial gravel	96,385,957	58,364,592	.61	134,147,426	89,111,060	.66	+39.2	+8.2
Total commercial sand and gravel	181,556,467	114,706,913	.63	232,947,787	159,427,273	.68	+28.3	+7.9
GOVERNMENT-AND-CONTRACTOR OPERATIONS [6]								
Sand:								
Building	5,789,000	1,797,000	.31	3,482,000	2,018,000	.58	−39.9	+87.1
Paving	12,876,000	4,013,000	.31	5,089,000	2,109,000	.41	−60.5	+32.3
Total Government-and-contractor sand	18,665,000	5,810,000	.31	8,571,000	4,127,000	.48	−54.1	+54.8
Gravel:								
Building	8,779,000	3,797,000	.43	8,022,000	3,942,000	.49	−8.6	+14.0
Paving	79,715,000	22,893,000	.29	54,806,000	21,004,000	.38	−31.2	+31.0
Total Government-and-contractor gravel	88,494,000	26,690,000	.30	62,828,000	24,946,000	.40	−29.0	+33.3
Total Government-and-contractor sand and gravel	107,159,000	32,500,000	.30	71,399,000	29,073,000	.41	−33.4	+36.7
COMMERCIAL AND GOVERNMENT-AND-CONTRACTOR OPERATIONS								
Sand	103,835,000	62,152,000	.60	107,371,000	74,443,000	.69	+3.4	+15.0
Gravel	184,880,000	85,055,000	.46	196,975,000	114,057,000	.58	+6.5	+26.1
Grand total	288,715,000	147,207,000	.51	304,346,000	188,500,000	.62	+5.4	+21.6

[1] Includes blast sand as follows—1941: 371,049 tons valued at $912,626; 1942: 422,922 tons, $1,071,018.
[2] Includes ballast sand produced by railroads for their own use as follows—1941: 37,911 tons valued at $5,676; 1942, 39,252 tons, $8,740.
[3] Includes some sand used by railroads for fills and similar purposes as follows—1941: 351,537 tons valued at $36,737; 1942: 178,191 tons, $27,500.
[4] Includes ballast gravel produced by railroads for their own use as follows—1941: 7,536,591 tons valued at $1,506,121; 1942: 10,243,680 tons, $2,031,339.
[5] Includes some gravel used by railroads for fills and similar purposes as follows—1941: 1,157,557 tons valued at $128,993; 1942: 1,294,861 tons, $141,917.
[6] Approximate figures for States, counties, municipalities, and other Government agencies directly or under lease.

PRODUCTION

Approximately 5 percent more sand and gravel was produced in 1942 than in 1941 and for the fourth successive year a new record was attained. As stocks of sand and gravel held by producers are small in tonnage and not subject to great variation from year to year, the quantity of materials sold or used is virtually equivalent to production. Throughout this report, sales and production are used interchangeably. The following table summarizes total production of sand and gravel during the 5-year period 1938–42.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States, 1938–42

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1938	57,113,828	$33,935,725	124,206,405	$51,987,122	181,320,233	$85,922,847
1939	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
1941	103,835,000	62,152,000	184,880,000	85,055,000	288,715,000	147,207,000
1942	107,371,000	74,443,000	196,975,000	114,057,000	304,346,000	188,500,000

Details of production in 1942, by States and uses, are presented in the following tables. California, with the greatest tonnage ever recorded from a single State, was the leading producer, and Texas, Illinois, New York, Michigan, Ohio, and Indiana followed in the order named.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1942, by States

State	Short tons	Value	State	Short tons	Value
Alabama	4,659,624	$2,538,738	New Hampshire	1,287,394	$159,058
Alaska	(1)	(1)	New Jersey	6,032,978	5,726,860
Arizona	1,611,353	1,193,603	New Mexico	[1] 261,358	[1] 146,866
Arkansas	5,831,867	3,919,212	New York	16,285,367	11,841,245
California	34,791,974	22,067,004	North Carolina	4,280,198	2,491,820
Colorado	4,631,942	3,220,706	North Dakota	2,509,684	343,612
Connecticut	2,960,477	1,610,583	Ohio	13,753,393	10,570,888
Delaware	169,267	95,298	Oklahoma	3,109,630	1,946,644
Florida	[1] 1,834,863	[1] 1,339,361	Oregon	6,660,311	4,497,514
Georgia	[1] 969,934	[1] 732,528	Pennsylvania	10,614,411	10,700,743
Idaho	3,118,581	1,983,054	Puerto Rico	(1)	(1)
Illinois	17,720,343	11,532,848	Rhode Island	572,437	361,881
Indiana	12,715,469	6,609,929	South Carolina	729,543	355,170
Iowa	6,700,745	2,190,452	South Dakota	3,577,983	1,443,908
Kansas	5,201,000	2,773,283	Tennessee	[1] 3,550,427	[1] 3,086,499
Kentucky	2,403,635	1,743,695	Texas	17,727,971	11,639,412
Louisiana	4,615,418	3,551,750	Utah	3,874,841	2,079,302
Maine	2,249,254	800,147	Vermont	476,331	173,258
Maryland	5,940,123	5,547,434	Virginia	5,610,753	5,460,232
Massachusetts	[1] 5,179,419	[1] 3,105,674	Washington	8,172,550	4,094,900
Michigan	15,542,941	7,362,231	West Virginia	3,058,878	3,747,351
Minnesota	10,900,493	2,602,324	Wisconsin	9,265,512	3,496,621
Mississippi	3,257,551	1,766,367	Wyoming	3,978,673	1,613,407
Missouri	4,490,650	2,931,924	Undistributed [2]	6,949,000	3,569,000
Montana	5,246,242	2,986,468		304,346,000	188,500,000
Nebraska	6,527,665	3,241,622			
Nevada	2,735,859	1,508,471			

[1] Output of Government-and-contractor operations included under "Undistributed."
[2] Includes items covered by "1."

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1942, 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			105,371	$79,752	946,074	$424,835	2,776	$2,054
Alaska								
Arizona					160,558	145,316		
Arkansas	(1)	(1)	(1)	(1)	709,607	460,977	306,185	297,317
California	157,773	$600,190	155,441	361,900	5,249,990	3,088,987	1,434,788	757,797
Colorado			5,331	5,057	458,924	235,677	186,644	184,200
Connecticut	1,300	7,800	(1)	(1)	873,682	441,653	3,380	2,028
Delaware			4,903	2,094	32,484	22,334		
Florida	3,300	1,650			529,949	335,976	(1)	(1)
Georgia	17,996	35,991	2,034	3,764	228,057	114,252	(1)	(1)
Idaho					14,473	7,855	313	75
Illinois	(1)	(1)	1,984,605	2,210,003	2,722,051	1,266,968	20,089	11,893
Indiana			300,877	190,834	1,362,693	643,817	27,401	2,512
Iowa			(1)	(1)	682,292	315,330	95	95
Kansas					1,209,417	566,882	15,919	5,594
Kentucky			9,356	19,095	595,505	458,161	123,385	55,295
Louisiana			(1)	(1)	861,184	413,288	61	50
Maine					116,435	50,681		
Maryland	14,100	21,150			(1)	(1)		
Massachusetts			(1)	(1)	1,591,079	871,036	(1)	(1)
Michigan	(1)	(1)	1,334,410	598,370	1,433,509	650,530	6,481	1,654
Minnesota	(1)	(1)	23,026	29,168	784,291	283,664	16,146	6,274
Mississippi					357,324	177,070	26,655	1,823
Missouri	(1)	(1)	107,174	111,473	1,001,232	534,321	37,044	27,471
Montana					121,769	103,842	1,341	2,114
Nebraska			(1)	(1)	1,133,172	467,517	489	89
Nevada	(1)	(1)	(1)	(1)	14,563	20,156	6,132	9,146
New Hampshire					(1)	(1)		
New Jersey	321,690	434,031	1,606,571	2,672,342	1,808,279	933,286		
New Mexico					(1)	(1)	(1)	(1)
New York			529,809	851,575	4,847,665	2,852,823	76,975	115,741
North Carolina					1,170,139	472,991	197,760	46,519
North Dakota					(1)	(1)	972	65
Ohio	(1)	(1)	983,607	1,785,376	2,550,572	1,663,056	1,321	484
Oklahoma	(1)	(1)	4,236	6,778	408,244	253,126	16,983	36,926
Oregon					480,730	371,593	6,340	3,676
Pennsylvania	(1)	(1)	499,665	832,840	2,244,761	2,060,238	29,000	10,000
Puerto Rico							(1)	(1)
Rhode Island			(1)	(1)	59,611	35,474	3,576	3,149
South Carolina					332,128	129,666	44,286	17,787
South Dakota					100,512	37,973	532	285
Tennessee	10,380	15,570	111,080	204,383	703,800	604,782	(1)	(1)
Texas	(1)	(1)	(1)	(1)	2,176,122	1,466,842	73,867	24,415
Utah			(1)	(1)	491,959	286,409	1,915	719
Vermont					(1)	(1)		
Virginia	(1)	(1)	35,334	37,434	1,454,595	1,005,499	3,369	505
Washington			5,828	18,925	1,099,649	554,391	15,796	6,283
West Virginia	(1)	(1)	(1)	(1)	332,466	323,960	823	983
Wisconsin			99,448	132,030	1,087,673	467,826	127,162	42,454
Wyoming					70,836	43,516	376	454
Undistributed [2]	3,095,948	5,668,045	347,885	592,359	1,431,646	1,236,780	666,000	341,000
	3,622,487	6,784,427	8,255,991	10,745,552	46,035,701	26,901,356	3,482,000	2,018,000

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1942, 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	476,657	$240,630	178,605	$10,134			(1)	(1)
Alaska			(1)	(1)				
Arizona	39,460	33,083	55,322	47,675	275	$212		
Arkansas	598,136	309,422	11,792	15,668	(1)	(1)		
California	3,868,982	2,159,780	708,515	466,714	(1)	(1)		
Colorado	22,232	9,767	69,341	27,393				
Connecticut	168,359	94,255	410,688	31,279	(1)	(1)		
Delaware	36,232	24,726			4,103	5,961	143	$347
Florida	600,805	396,173	(1)	(1)				
Georgia	546,243	383,406	(1)	(1)	9,447	24,747		
Idaho	(1)	(1)	144,808	76,657				
Illinois	1,979,556	1,041,040	5,285	1,924	(1)	(1)	66,837	77,655
Indiana	1,638,374	907,244	15,401	8,247			103,920	52,068
Iowa	362,077	173,335	21,600	1,600	(1)	(1)		
Kansas	1,742,606	899,824	46,371	20,384	(1)	(1)		
Kentucky	215,489	176,209	2,744	1,132				
Louisiana	498,861	301,708	92	68	(1)	(1)		
Maine	62,526	33,300	146,166	37,292	650	250		
Maryland	(1)	(1)	22,803	1,689	(1)	(1)	(1)	(1)
Massachusetts	407,967	211,655	(1)	(1)	(1)	(1)		
Michigan	2,141,808	1,113,516	316,322	66,186	(1)	(1)		
Minnesota	396,525	107,737	221,083	37,582	234	585	220	220
Mississippi	439,316	204,647	12,040	524				
Missouri	527,168	244,197	3,623	1,839	(1)	(1)		
Montana	80,364	98,260	935	716				
Nebraska	2,106,571	1,047,352	24,972	6,277				
Nevada	56,576	57,014	5,250	3,173	146	402		
New Hampshire	26,665	12,624	308,036	18,152				
New Jersey	695,419	351,489	815	240	110,203	233,294	42,659	57,756
New Mexico			(1)	(1)				
New York	1,867,851	1,112,547	407,064	480,464	340	136	(1)	(1)
North Carolina	667,672	224,255	664,761	130,890				
North Dakota	30,943	17,764	8,969	3,102				
Ohio	1,854,517	1,148,097	22,675	6,741	(1)	(1)	(1)	(1)
Oklahoma	338,611	145,422	86,245	63,189	4,000	2,000		
Oregon	382,052	374,170	25,833	5,833				
Pennsylvania	2,181,606	1,834,746	185	157	(1)	(1)	51,118	86,815
Puerto Rico			(1)	(1)				
Rhode Island	28,187	17,197	25,468	10,764	1,511	3,372		
South Carolina	132,386	37,356	37,065	32,411	(1)	(1)		
South Dakota	8,633	4,706	109,410	43,400				
Tennessee	739,358	706,468	(1)	(1)	(1)	(1)	486	570
Texas	1,983,210	1,341,602	143,896	73,778	(1)	(1)		
Utah	5,778	3,310	2,025	1,142				
Vermont	11,129	6,472	3,601	1,775	(1)	(1)		
Virginia	773,013	543,369	36,766	16,300				
Washington	358,171	227,879	218,864	83,873	(1)	(1)		
West Virginia	290,705	264,928	13,652	12,873	(1)	(1)		
Wisconsin	275,795	165,002	250,405	62,964	34,496	67,346		
Wyoming	10,140	18,800	10,364	6,977				
Undistributed [2]	1,632,375	1,209,313	289,000	190,000	641,473	1,024,863	103,082	216,541
	33,307,106	20,035,796	5,089,000	2,109,000	806,878	1,363,168	368,465	491,972

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1942, 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	175,655	$39,968						
Alaska								
Arizona	21,995	20,567			5,269	$4,635	1,260	$1,600
Arkansas	(1)	(1)	(1)	(1)	(1)	(1)	8,460	8,471
California	(1)	(1)	4,283	$22,025	(1)	(1)	105,718	93,088
Colorado	42,099	37,311					38,333	21,810
Connecticut			13,681	7,080			14,975	7,125
Delaware	62,655	21,930	743	165	995	1,658	4,351	1,033
Florida	200	160	2,482	1,241	4,900	970	(1)	(1)
Georgia	12,790	6,010	3,222	12,889			58,711	37,757
Idaho							17,107	7,036
Illinois	140,298	80,521	(1)	(1)	(1)	(1)	126,414	146,960
Indiana	97,644	39,706			138,848	44,787	31,954	13,115
Iowa	48,880	35,431	(1)	(1)	(1)	(1)	35,723	14,812
Kansas	39,734	22,582	(1)	(1)			36,088	22,215
Kentucky	(1)	(1)			(1)	(1)	(1)	(1)
Louisiana	15,603	6,335			101,895	55,523	2,704	810
Maine							3,334	1,331
Maryland	(1)	(1)	(1)	(1)			(1)	(1)
Massachusetts	49,299	23,575	(1)	(1)			58,180	17,147
Michigan	(1)	(1)	400	200	227,855	44,056	72,386	33,559
Minnesota	(1)	(1)	(1)	(1)	206,233	43,209	39,612	14,543
Mississippi	9,052	3,046					4,109	1,918
Missouri	40,715	32,091	(1)	(1)	(1)	(1)	77,198	111,136
Montana	1,245	1,300	(1)	(1)	(1)	(1)	23,935	3,245
Nebraska	(1)	(1)			(1)	(1)	17,798	3,705
Nevada							26,270	23,518
New Hampshire			2,460	4,920				
New Jersey	47,012	25,256	42,082	55,884	(1)	(1)	51,778	48,188
New Mexico	(1)	(1)						
New York	45,850	35,682	367	228	(1)	(1)	16,492	8,478
North Carolina	(1)	(1)			77,875	22,275	(1)	(1)
North Dakota							(1)	(1)
Ohio	90,687	68,997	6,663	8,938	31,000	9,343	(1)	(1)
Oklahoma	64,642	32,679			500	300	(1)	(1)
Oregon	13,992	2,694			22,422	9,796	24,258	8,509
Pennsylvania	392,418	499,056	(1)	(1)			131,018	186,797
Puerto Rico								
Rhode Island			(1)	(1)			(1)	(1)
South Carolina	(1)	(1)	(1)	(1)	12,070	2,473	(1)	(1)
South Dakota					7,000	1,400		
Tennessee	(1)	(1)	366	2,562			1,404	1,428
Texas	55,225	20,390	3,559	15,980	179,366	102,211	30,554	10,996
Utah	(1)	(1)					(1)	(1)
Vermont	(1)	(1)					1,525	585
Virginia	43,260	21,755	51,660	20,664			56,535	32,760
Washington	(1)	(1)	(1)	(1)	20,728	5,098	63,428	24,536
West Virginia	381,885	356,130					(1)	(1)
Wisconsin	(1)	(1)	(1)	(1)	6,427	1,398	33,999	16,803
Wyoming	2,100	1,470					4,550	1,700
Undistributed [2]	664,073	314,562	44,865	70,361	926,375	326,646	477,973	418,209
	2,559,008	1,749,204	176,833	223,137	1,969,758	675,778	1,698,134	1,345,823

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1942, 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	1,367,900	$995,666	676	$434	702,178	$540,699	438,232	$25,839
Alaska			(1)	(1)			(1)	(1)
Arizona	201,160	206,109	1,559	175	85,054	71,287	1,020,676	654,486
Arkansas	1,091,304	1,052,887	440,758	433,851	699,943	446,777	1,216,565	311,783
California	6,525,459	4,989,508	3,725,767	1,678,241	6,562,239	4,594,510	5,192,752	2,827,298
Colorado	749,864	517,273	366,958	341,409	486,664	476,479	2,126,045	1,348,887
Connecticut	1,141,738	906,754			71,631	41,744	102,600	38,000
Delaware	7,744	7,450			14,914	6,700		
Florida	557,263	460,649	(1)	(1)	72,275	94,269	(1)	(1)
Georgia	21,848	21,848	(1)	(1)	69,586	91,864	(1)	(1)
Idaho	(1)	(1)	14,261	2,312	1,126,972	1,274,540	1,050,282	448,126
Illinois	2,395,886	1,186,085	18,140	8,942	2,958,191	1,692,061	1,137,913	834,510
Indiana	1,227,699	833,182	22,484	6,508	4,818,854	2,498,507	431,179	183,420
Iowa	323,631	243,462	75,798	6,546	1,655,503	819,745	3,163,436	381,256
Kansas	364,267	231,830	10,784	352	950,610	579,389	741,744	366,889
Kentucky	698,981	566,117	27,490	14,803	279,197	252,758	190,446	70,302
Louisiana	1,446,137	1,258,946	164	55	1,174,764	1,217,779	72,605	17,362
Maine	65,106	54,151			737,837	311,154	955,885	233,356
Maryland	(1)	(1)			(1)	(1)	286,560	28,375
Massachusetts	1,354,868	1,143,694	(1)	(1)	1,292,368	610,531	(1)	(1)
Michigan	1,942,612	1,206,131	140,907	20,850	3,927,461	2,144,707	3,141,005	966,640
Minnesota	569,743	496,662	104,989	31,726	892,425	442,283	5,225,847	462,859
Mississippi	707,741	506,903	144,258	81,916	772,097	547,664	370,826	93,268
Missouri	1,128,152	677,162	102	62	445,867	263,035	581,161	317,674
Montana	87,806	77,137	81,776	44,759	2,062,433	1,590,722	1,191,837	567,252
Nebraska	598,791	354,086	10,353	1,885	1,973,104	1,124,584	325,011	113,908
Nevada	45,519	45,288	9,160	15,320	(1)	(1)	1,424,474	722,112
New Hampshire	(1)	(1)			36,739	38,727	899,640	74,830
New Jersey	889,675	656,094			372,477	224,480	13,963	1,034
New Mexico	(1)	(1)	(1)	(1)			(1)	(1)
New York	3,351,941	2,546,872	204,987	287,109	2,684,326	1,897,073	2,003,942	1,439,333
North Carolina	453,003	527,885	12,735	2,419	896,515	989,894	79,126	32,568
North Dakota	18,184	17,043	1,350	10	121,413	107,456	1,803,314	65,915
Ohio	1,979,853	1,349,635	19,361	10,510	3,390,518	2,289,362	406,594	87,655
Oklahoma	207,107	120,272	164	55	474,799	389,369	1,316,069	643,478
Oregon	930,233	631,965	116,788	19,837	2,672,804	1,902,684	1,492,044	905,799
Pennsylvania	2,143,331	2,035,193			2,075,886	1,847,594	112,658	23,841
Puerto Rico			(1)	(1)			(1)	(1)
Rhode Island	53,211	37,631	4,519	3,938	186,975	75,015	123,681	25,738
South Carolina	65,415	64,549	164	55	22,037	21,044	545	273
South Dakota	100,354	35,408	13,998	7,132	1,313,211	958,687	1,501,583	269,544
Tennessee	738,063	610,605	(1)	(1)	1,075,292	831,755	(1)	(1)
Texas	3,505,326	2,798,542	562,498	74,927	4,107,958	3,547,745	3,255,012	1,350,246
Utah	664,508	379,266	5,785	2,826	1,308,266	926,302	853,107	376,669
Vermont	13,570	17,000			38,806	13,612	359,974	122,794
Virginia	1,754,966	2,265,497	31,350	8,742	901,719	1,230,329	319,734	55,837
Washington	1,529,689	893,332	171,826	75,030	1,244,989	1,003,672	2,131,388	796,228
West Virginia	446,486	422,537	7,510	2,920	456,643	421,995	194,346	149,602
Wisconsin	1,288,629	640,721	490,705	83,981	1,468,354	647,400	2,192,510	779,809
Wyoming	281,595	162,947	736	464	365,899	263,220	546,119	422,624
Undistributed [2]	1,353,178	1,575,348	1,181,000	672,000	1,836,713	1,832,734	4,813,000	2,366,000
	46,389,536	35,827,822	8,022,000	3,942,000	60,874,506	43,193,937	54,806,000	21,004,000

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1942, 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)	39,975	$31,278	4,039,335	$2,500,277	620,289	$38,461
Alaska							(1)	(1)
Arizona	11,710	$5,881	7,055	2,577	533,796	491,267	1,077,557	702,336
Arkansas	525,836	293,247	12,025	14,321	3,856,567	2,860,593	1,975,300	1,058,619
California	663,224	160,187	316,409	149,843	23,730,152	16,336,954	11,061,822	5,730,050
Colorado	79,136	14,987	371	456	1,882,954	1,318,817	2,748,988	1,901,889
Connecticut	26,630	6,658	131,613	25,157	2,443,809	1,539,276	516,668	71,307
Delaware					169,267	95,298		
Florida	(1)	(1)			1,834,863	1,339,361	(1)	(1)
Georgia					969,934	732,528	(1)	(1)
Idaho	624,225	74,707	(1)	(1)	1,908,917	1,455,884	1,209,664	527,170
Illinois	2,472,013	1,061,628	95,412	35,965	16,538,916	10,675,579	1,181,427	857,269
Indiana	1,656,968	832,917	841,173	353,065	12,219,004	6,409,242	496,465	200,687
Iowa	246,573	93,189	8,567	19,155	3,439,816	1,800,955	3,260,929	389,497
Kansas	(1)	(1)	23,657	34,583	4,386,182	2,380,064	814,818	393,219
Kentucky	200,162	89,565			2,059,570	1,602,163	344,065	141,532
Louisiana	429,734	269,569	9,580	9,764	4,542,496	3,534,215	72,922	17,535
Maine	124,216	47,237	37,099	31,395	1,147,203	529,499	1,102,051	270,648
Maryland					5,630,760	5,517,370	309,363	30,064
Massachusetts	55,880	21,363	281,917	87,570	5,179,419	3,105,674	(1)	(1)
Michigan	551,688	208,777	38,407	12,382	11,938,226	6,306,901	3,604,715	1,055,330
Minnesota	1,864,356	555,991	523,591	78,392	5,332,428	2,063,883	5,568,065	538,441
Mississippi	408,746	144,506	5,387	3,082	2,703,772	1,588,836	553,779	177,531
Missouri	233,928	133,630	3,667	2,098	3,868,719	2,584,878	621,931	347,046
Montana	1,250,066	383,245	135,080	20,162	3,970,353	2,371,627	1,275,889	614,841
Nebraska	31,306	10,906	(1)	(1)	6,166,840	3,119,463	360,825	122,159
Nevada	608,865	176,165	(1)	(1)	1,290,843	758,720	1,445,016	749,751
New Hampshire					79,718	66,076	1,207,676	92,982
New Jersey	(1)	(1)	16,000	22,167	6,018,200	5,725,586	14,778	1,274
New Mexico	(1)	(1)			261,358	146,866	(1)	(1)
New York	100,836	62,453	114,070	135,723	13,592,399	9,518,598	2,692,968	2,322,647
North Carolina	34,420	27,335	(1)	(1)	3,325,816	2,279,424	954,382	212,396
North Dakota	425,287	111,523	80,945	13,088	695,079	274,520	1,814,605	69,092
Ohio	1,496,896	712,196	197,853	265,048	13,303,442	10,465,498	449,951	105,390
Oklahoma	35,207	10,629	51,469	68,469	1,690,169	1,202,996	1,419,461	743,648
Oregon	304,995	173,164	187,820	87,794	5,019,306	3,562,369	1,641,005	935,145
Pennsylvania			38,303	23,498	10,472,568	10,666,745	141,843	33,998
Puerto Rico							(1)	(1)
Rhode Island			2,823	1,045	415,193	318,292	157,244	43,589
South Carolina	21,605	4,306	289	318	647,483	304,644	82,060	50,526
South Dakota	399,791	83,124	22,959	2,249	1,952,460	1,123,547	1,625,523	320,361
Tennessee	(1)	(1)	7,213	3,599	3,550,427	3,086,499	(1)	(1)
Texas	1,567,766	628,429	30,652	33,843	13,692,698	10,116,046	4,035,273	1,523,366
Utah	506,877	87,058	(1)	(1)	3,012,009	1,697,946	862,832	381,356
Vermont	14,021	2,572			112,756	48,689	363,575	124,569
Virginia	99,227	160,627	(1)	(1)	5,219,534	5,378,848	391,219	81,384
Washington	1,011,548	309,615	280,996	85,168	5,634,676	3,133,486	2,537,874	961,414
West Virginia	62,230	43,442			2,842,547	3,580,973	216,331	166,378
Wisconsin	1,659,965	329,399	180,096	33,872	6,204,730	2,527,413	3,060,782	969,208
Wyoming	2,678,682	687,472	7,276	3,763	3,421,078	1,182,888	557,595	430,519
Undistributed [2]	625,943	360,292	43,077	20,421			6,949,000	3,569,000
	23,110,558	8,377,991	3,772,826	1,711,310	232,947,787	159,427,273	71,399,000	29,073,000

[1] Included under "Undistributed."
[2] Includes items entered as (1).
[3] Includes 422,922 tons of blast sand valued at $1,071,018.
[4] Includes 39,352 tons of ballast sand valued at $8,740, produced by railroads for their own use.
[5] Includes 178,191 tons of sand valued at $27,500, used by railroads for fills and similar purposes.
[6] Includes 10,243,680 tons of ballast gravel valued at $2,031,339, produced by railroads for their own use.
[7] Includes 1,294,861 tons of gravel valued at $141,917, used by railroads for fills and similar purposes.

Government-and-contractor production.—Reflecting the changing pattern of activity in the industry, Government-and-contractor production of sand and gravel in 1942 was 33 percent lower than in 1941. State governmental agencies reported 33 percent of the total, counties 26, municipalities 2, and other agencies (principally Federal organizations) 39 percent. An outstanding development was the continued decrease in direct production by governmental agencies, as indicated by the fact that contractors contributed 48 percent of the total in 1942 compared with 38 percent in 1941 and 27 percent in 1940. State agencies reported that contractors supplied them with 52 percent of their requirements in 1942.

Average value per ton of contractor tonnage increased considerably, but material produced by construction and maintenance crews was valued only slightly higher than in 1940 and 1941. Other details are shown in the following tables.

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1938–42, 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
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	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
1941	5,789,000	1,797,000	12,876,000	4,013,000	8,779,000	3,797,000	79,715,000	22,893,000	107,159,000	32,500,000
1942	3,482,000	2,018,000	5,089,000	2,109,000	8,022,000	3,942,000	54,806,000	21,004,000	71,399,000	29,073,000

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1939–42, by types of producers

Type of producer	1939		1940		1941		1942	
	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	71,934,000	$0.29	78,615,000	$0.28	66,234,000	$0.27	36,911,000	$0.29
Contractors	35,681,000	.39	28,437,000	.37	40,925,000	.36	34,488,000	.53
	107,615,000	.32	107,052,000	.30	107,159,000	.30	71,399,000	.41
States	35,770,000	.29	36,657,000	.26	39,177,000	.26	23,334,000	.31
Counties	16,588,000	.21	21,685,000	.22	22,772,000	.20	18,841,000	.21
Municipalities	2,093,000	.26	1,923,000	.28	1,637,000	.29	1,397,000	.29
Other agencies	53,164,000	.38	46,787,000	.38	43,573,000	.40	27,827,000	.63
	107,615,000	.32	107,052,000	.30	107,159,000	.30	71,399,000	.41

METHOD OF TRANSPORTATION

Despite adverse conditions, such as rubber and gasoline shortages, trucks transported the major part of all sand and gravel produced in 1942. Railroads were second in importance, handling nearly half of the output of commercial operations. Waterways furnished minor but locally important facilities.

Sand and gravel sold or used by commercial producers in the United States, 1941–42, by methods of transportation [1]

Method of transportation	1941		1942	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Truck	74,452,542	44.9	103,777,190	47.4
Rail	69,225,395	41.7	93,456,656	42.7
Waterway	22,201,899	13.4	21,603,759	9.9
Total reported	165,879,836	100.0	218,837,605	100.0
Percent of total commercial production covered		91.0		94.0

[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—1941: Truck 67 percent, rail 25 percent, and waterway 8 percent; 1942: Truck 60 percent, rail 32 percent, and waterway 8 percent.

DEGREE OF PREPARATION

Refinements in the technology of the various consuming industries have advanced to a point that preparation was required for 72 percent of the sand and gravel used in 1942. Part of this high percentage is due to reduced consumption in many public projects that require only bank-run material, but the proportion of prepared material has not been under 59 percent during the past 5 years. As shown in the accompanying table, most of the prepared material is supplied by commercial operations, and this largely explains the fact that the average value per ton reported by commercial producers is appreciably higher than that from Government-and-contractor operations.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1941–42, by commercial and Government-and-contractor operations

	1941			1942		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared	159,784,239	88	$0.67	200,131,369	86	$0.73
Unprepared	21,772,228	12	.33	32,816,418	14	.38
	181,556,467	100	.63	232,947,787	100	.68
Government-and-contractor operations:						
Prepared	22,311,000	21	.49	20,076,000	28	.67
Unprepared	84,848,000	79	.25	51,323,000	72	.30
	107,159,000	100	.30	71,399,000	100	.41
Grand total	288,715,000		.51	304,346,000		.62

SIZE OF PLANTS

The average commercial sand and gravel plant is a comparatively small operation. Approximately half of the plants produce less than 25,000 tons per year, and the average output per plant in this group was about 8,100 tons in 1942. Only 23 percent of the producers reported more than 100,000 tons in 1942 but they supplied 78 percent of the total tonnage. Details of output, by size groups, for 1941 and 1942 are given in the following table.

Comparison of number and output of commercial sand and gravel plants in the United States, 1941–42, by size groups [1]

Size group in short tons	1941				1942			
	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	1,104	48.5	9,404,000	5.5	1,258	49.2	10,225,000	4.6
25,000 and less than 50,000	390	17.1	13,902,000	8.1	366	14.3	13,139,000	5.9
50,000 and less than 100,000	331	14.6	23,168,000	13.4	336	13.1	24,591,000	11.1
100,000 and less than 200,000	227	10.0	31,778,000	18.4	299	11.7	42,193,000	19.1
200,000 and less than 300,000	96	4.2	23,212,000	13.4	132	5.2	32,312,000	14.6
300,000 and less than 400,000	47	2.1	16,642,000	9.6	56	2.2	19,361,000	8.7
400,000 and less than 500,000	29	1.3	12,867,000	7.5	34	1.3	14,981,000	6.8
500,000 and less than 600,000	16	.7	8,880,000	5.1	24	1.0	13,046,000	5.9
600,000 and less than 700,000	8	.4	5,106,000	3.0	14	.5	8,918,000	4.0
700,000 and less than 800,000	10	.4	7,526,000	4.4	12	.5	8,972,000	4.1
800,000 and less than 900,000	5	.2	4,186,000	2.4	5	.2	4,112,000	1.9
900,000 and less than 1,000,000	4	.2	3,734,000	2.2	3	.1	2,819,000	1.3
1,000,000 and over	7	.3	12,068,000	7.0	18	.7	26,523,000	12.0
	2,274	100.0	172,473,000	100.0	2,557	100.0	221,192,000	100.0

[1] Plants operated by or for States, counties, and municipalities are not included; also not included are approximately 187 railroad plants with an output of 9,083,000 tons of sand and gravel in 1941, and 172 plants with an output of 11,756,000 tons in 1942.

[2] Includes a few companies operating more than 1 plant but not submitting separate returns for individual plants.

PRINCIPAL TRENDS

Sand and gravel for construction.—Over 90 percent of the sand and gravel marketed in the United States is absorbed by the construction industries for use in building and paving and as railroad ballast. Figure 2 shows the correlation between total construction activity, concrete-pavement contract awards, sales of sand, and sales of gravel. Production of these commodities has expanded greatly in satisfying the demands of the tremendous military and civilian construction programs of the rearmament period. During the latter part of 1942 the rate slowed down appreciably as many projects reached completion; and with the curtailment of private building, highway construction and maintenance, and public works programs, all signs point to a reduced output of sand and gravel in 1943.

Industrial sands.—Sand has many important uses in the manufacturing industries. Glass and molding sands are practically indispensable in their fields; and others, like filter, engine, and abrasive sands, perform vital functions. Except for filter and grinding and polishing sands, production of all the industrial sands was greater in 1942 than in 1941. Owing to the fact that these sands enter directly into the manufacturing and operational processes, their volume

undoubtedly will be better-maintained throughout the wartime period than will the construction sands. Figures 3 and 4 show graphically details of production of these sands in past years, and their correlation with indexes of industrial production.

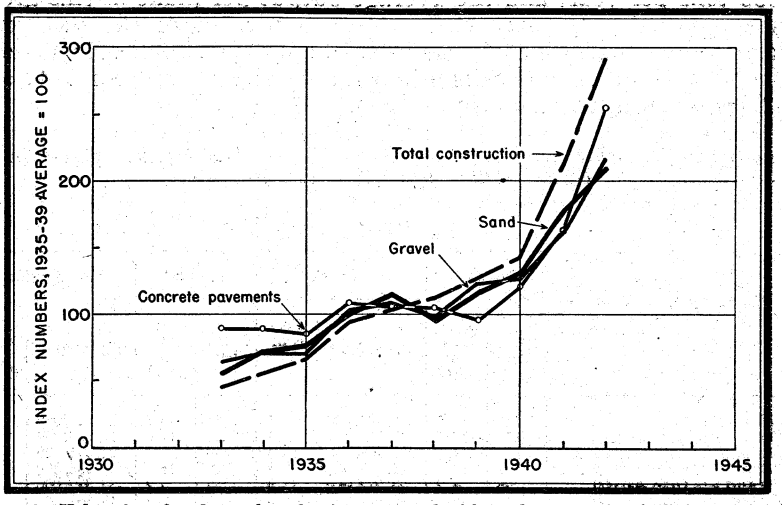

FIGURE 2.—Value of sand and gravel production compared with total construction (value) and concrete pavements (contract awards, thousands of square yards) in the United States, 1933–42. Data on construction and concrete pavements from Bureau of Foreign and Domestic Commerce.

EMPLOYMENT AND PRODUCTIVITY

In 1941 employment in the commercial sand and gravel industry reached the highest level since the Bureau of Mines began recording manpower information in 1933.[2] Operators who produced about four-fifths of the total tonnage reported employment data for 1941, and from this information it is apparent that approximately 25,000 men were employed in the industry in that year. The number and length of the working days increased, and average output per man-hour reached a record high—12 percent above the 1940 performance.

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, 1936-41 [1]

Year	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed		Man-hours		Commercial sand and gravel (short tons)	Average per man (short tons)		
		Average number of days	Total man-shifts	Average per man per day	Total		Per shift	Per hour	
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
1940	16,595	217	3,596,886	8.4	30,263,744	101,143,305	28.1	3.3	77.1
1941	19,909	228	4,530,488	8.6	38,978,128	144,594,925	31.9	3.7	79.6

[1] Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

[2] See Minerals Yearbook: 1935, pp. 941–943; 1936, pp. 843–845; 1940, Review of 1939, pp. 1218–1221; Review of 1940, pp. 1191–1193; and 1941, pp. 1285–1286.

Productivity data for 1941, by regions, are summarized in the accompanying table. Outstanding is the fact that production efficiency improved in every district except one in which the same rate

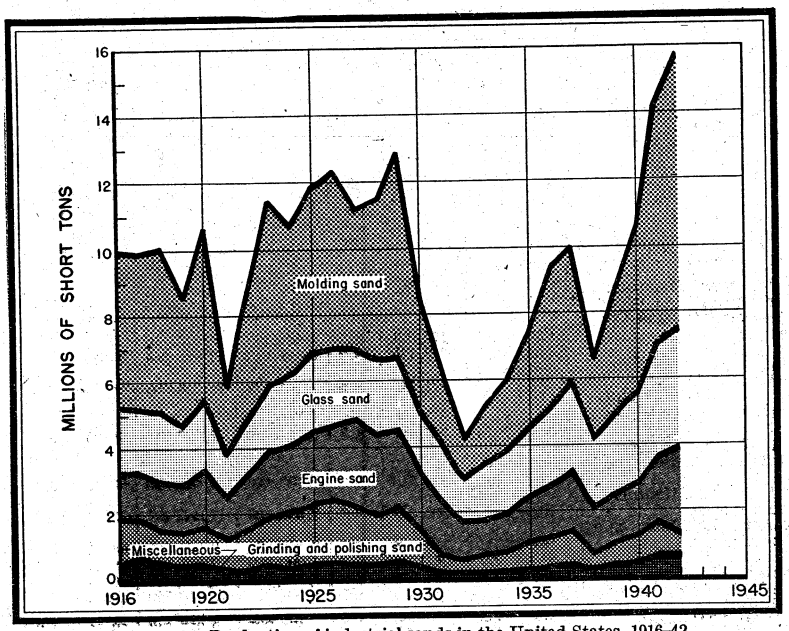

FIGURE 3.—Production of industrial sands in the United States, 1916–42.

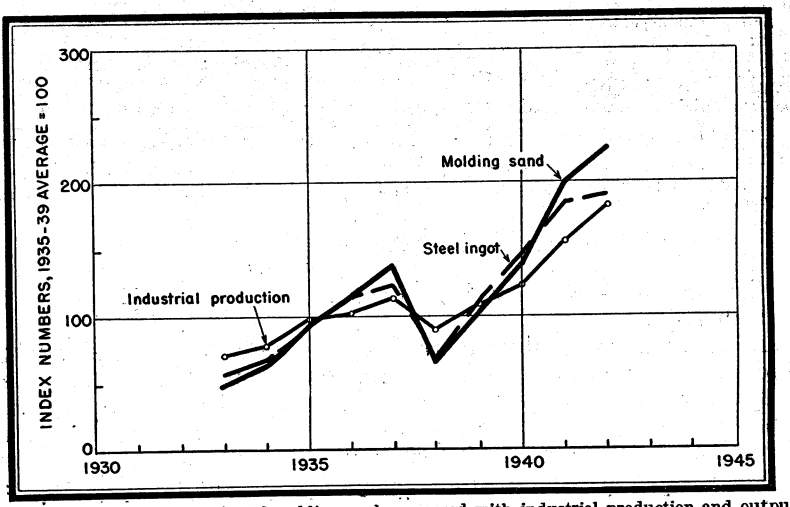

FIGURE 4.—Trends in production of molding sand compared with industrial production and output of steel ingots, 1933–42. Index of industrial production from Federal Reserve Board; statistics of steel-ingot production compiled by American Iron and Steel Institute.

was maintained as in the previous year. Many of the increases were substantial, the average being 0.4 ton per man-hour for the entire country. That this improvement represents a legitimate gain in efficiency is indicated by the fact that the degree of preparation of the material was exactly the same in both years.

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 1941, by regions [1]

Region	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed		Man-hours		Commercial sand and gravel (short tons)	Average per man (short tons)		
		Average number of days	Total man-shifts	Average per man per day	Total		Per shift	Per hour	
Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	871	195	170,001	8.5	1,446,209	6,676,116	39.27	4.6	84.3
New York	1,716	221	378,749	8.2	3,119,059	12,928,933	34.14	4.1	86.6
Pennsylvania, New Jersey, and Delaware	2,652	253	671,446	8.6	5,754,129	16,236,508	24.18	2.8	98.3
West Virginia, Virginia, Maryland, and District of Columbia	1,348	273	367,427	8.8	3,217,086	7,072,345	19.25	2.2	62.5
South Carolina, Georgia, Alabama, Florida, and Mississippi	945	240	226,510	9.3	2,103,546	6,440,520	28.43	3.1	89.3
North Carolina, Kentucky, and Tennessee	1,189	258	306,313	8.6	2,639,469	7,088,487	23.14	2.7	89.6
Arkansas, Louisiana, and Texas	1,561	241	376,645	9.5	3,560,274	9,043,365	24.01	2.5	59.3
Ohio	1,615	227	367,243	8.4	3,090,599	9,684,943	26.37	3.1	81.0
Illinois and Indiana	1,859	211	391,935	8.5	3,318,939	18,193,467	46.42	5.5	83.9
Michigan and Wisconsin	1,288	203	261,359	8.7	2,267,998	12,420,760	47.52	5.5	76.4
North Dakota, South Dakota, and Minnesota	376	149	56,190	8.4	474,087	2,817,243	50.14	5.9	52.8
Nebraska and Iowa	698	176	123,067	9.2	1,137,810	4,446,114	36.13	3.9	80.4
Kansas, Missouri, and Oklahoma	920	228	209,452	8.7	1,813,125	7,101,317	33.90	3.9	92.4
Wyoming, Colorado, New Mexico, Utah, and Arizona	401	172	69,004	8.3	575,288	2,887,650	41.85	5.0	77.4
California and Nevada	1,616	250	403,626	8.1	3,256,232	16,123,634	39.95	5.0	81.1
Montana, Washington, Oregon, and Idaho	854	177	151,521	7.9	1,204,278	5,433,523	35.86	4.5	64.4
Total United States	19,909	228	4,530,488	8.6	38,978,128	144,594,925	31.92	3.7	79.6

[1] Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

PRICES

The ton values of every class of sand and gravel were higher in 1942 than in 1941.

Increases in ton value averaging 54.8 percent for sand and 33.3 percent for gravel were registered for the output of Government-and-contractor operations. Smaller but substantial gains, averaging 7.6 percent for sand and 8.2 percent for gravel, were made by commercial operations. Additional statistical details covering total and ton values of the various classes of sand and gravel are contained in the table accompanying the summary outline at the beginning of this chapter.

Prices of sand and gravel were under the jurisdiction of the Office of Price Administration, and on May 11 the General Maximum Price

Regulation froze prices at the maximum levels existing in March 1942. Subsequently the Office of Price Administration authorized upward revision of prices in a very few individual instances, but no general increases were approved.

NEW DEVELOPMENTS

Although molding-sand technology has been developing for hundreds of years in the metal industries, new attention is being directed to the subject owing to the complex problems of handling magnesium in the molten condition. The great expansion of magnesium-production facilities in 1942 stimulated interest and research, and technical articles explaining modern practice appeared.[3]

Before the war industrial sands from Belgium found a market in the Pacific Northwest, and a substantial tonnage enters this area from California, Illinois, and other distant States. In an attempt to determine the possibilities of developing local supplies of glass and molding sands, silica deposits in the State of Washington were investigated. A report on the subject was published.[4]

During recent peacetime years the Work Projects Administration has been an influential factor in the sand and gravel industry. On December 4, 1942, the President directed that, since increase in private employment had made the work-relief program no longer necessary, liquidation of project operations should be completed as soon as feasible. By taking this action it was expected that no project funds need be provided for the next fiscal year.

In spite of priority restrictions, many new plants were built in 1942, but most of them were comparatively small portable or temporary operations. Many producers whose permanent plants are well located to furnish civilian requirements compensated for a serious drop in this volume by operating temporary plants at other locations to serve war-construction demands.[5]

FOREIGN TRADE[6]

Even in peacetime years only minor quantities of sand and gravel were imported or exported. For example, during the period 1937 to 1939 imports averaged about 0.25 percent of domestic production and exports only about 0.02 percent. Foreign trade statistics for the 10-year period 1932–41 are shown in the accompanying table. Owing to wartime restrictions, no figures on current foreign trade can be published, but it is apparent from the data on sand and gravel recorded herein that their absence will not detract appreciably from the value of the report, particularly in view of the recent rigid restrictions on foreign movement of commodities. Foreign trade figures will be released at the termination of the present war emergency to preserve the continuity of the statistical record.

[3] Cramer, Eugene M., Rapid Methods of Analysis for Sand Control in Magnesium Foundries: Am. Foundryman, vol. 4, No. 12, 1942, pp. 11–12.
[4] Wilson, Hewitt, Skinner, Kenneth G., and Couch, Albert H., Silica Sands of Washington: University of Washington Exp. Sta. Bull. 108, 1942, 80 pp.
[5] Pit and Quarry, Sand and Gravel: Vol. 35, No. 7, January 1943, pp. 77–83.
[6] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Sand and gravel imported for consumption in the United States, 1932–41, by classes

Year	Glass sand [1]		Other sand [2]		Gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932	26,574	$51,016	140,793	$94,728	45,091	$18,717	212,458	$164,461
1933	26,275	57,682	61,597	42,155	32,094	9,707	120,566	109,544
1934	24,516	46,094	36,016	33,635	74,758	18,286	135,290	98,015
1935	44,291	94,966	62,225	51,658	63,189	15,851	169,705	162,475
1936	52,944	117,706	124,013	62,193	201,398	38,142	378,355	218,041
1937	51,090	79,112	319,134	134,430	163,406	36,193	533,630	249,735
1938	33,889	68,315	611,468	157,992	55,619	22,902	700,976	249,209
1939	23,690	33,604	192,106	79,272	60,147	8,399	275,943	121,275
1940	4,337	8,722	264,170	90,350	175,558	25,686	444,065	124,758
1941 [3]			166,228	73,229	98,748	15,387	264,976	88,616

[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] January–September.

Sand and gravel exported from the United States, 1932–41

Year	Short tons	Value	Year	Short tons	Value
1932	96,015	$211,558	1937	67,141	$80,197
1933	82,453	54,557	1938	35,572	30,303
1934	33,550	41,649	1939 [1]	27,746	31,931
1935	37,393	26,369	1940	(2)	(2)
1936	49,906	58,453	1941 (January–September)	(2)	(2)

[1] Classification reads "Gravel and building stone."
[2] Not separately classified.

BLAST-FURNACE SLAG

The National Slag Association, continuing a policy begun in 1938, conducted a canvass of the 31 companies in the United States that prepare iron blast-furnace slag for commercial uses. The total output of air-cooled screened and unscreened and water-granulated slag for 1942 was 19,122,718 short tons, compared with 14,678,266 tons for 1941. Sales of air-cooled slag were 19 percent greater in 1942 than in 1941, and the average value per ton was 1 cent lower.

Air-cooled slag was used principally in the construction and maintenance of highways, access roads, airport runways, defense plant and housing projects, and miscellaneous structures; as railroad ballast; and for sewage trickle filters. Other uses and quantities involved are shown in the accompanying table.

Nearly all the commercial output is produced east of the Mississippi River, chiefly at steel centers in Ohio, Alabama, Pennsylvania, and Illinois. Shipments, however, are made into all States east of the Mississippi, except some of the New England States outside the economic range of sources of supply. Shipments of slag are made by railroad, truck, and waterway. The following tabulation shows the pattern of distribution during the past 3 years.

Shipments of commercial slag in the United States, 1940–42, by methods of transportation [1]

[Percent of total]

Method of transportation	1940	1941	1942
Rail	55	55	52
Truck	44	43	47
Waterway	1	2	1

[1] National Slag Association.

The average shipping range of blast-furnace slag in 1942 was 52 miles by rail, 17 by truck, and 117 by waterway. In most instances shipments did not exceed 140 miles by railroad, 35 by truck, and 160 by waterway.

During the process of crushing and screening blast-furnace slag, particles of metallic iron that escape through the slag notch of the blast furnace are recovered at the slag plant by hand picking and magnetic pulleys. During 1942 the companies surveyed reported 165,679 tons of metallic iron recovered and returned to the furnaces to bolster the supply of metal so vitally needed in the prosecution of the war. The yield slightly exceeds 1.2 percent or approximately 24 pounds of metallic iron per short ton of slag processed.

Not including those assigned to administrative, office, and sales activities, 1,629 plant and yard employees were engaged in producing commercial slag in 1942. The total number of man-hours in production was 4,168,539.

Air-cooled blast-furnace slag sold or used by producers in the United States, 1941–42, by States [1]

State	1941			1942		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama	3,698,379	28.1	$2,528,633	3,936,500	25.1	$2,793,924
Ohio	4,239,924	32.2	4,000,074	4,492,497	28.7	4,080,896
Pennsylvania	1,667,252	12.6	1,564,823	2,522,437	16.1	2,354,024
Other States [2]	3,564,026	27.1	2,730,739	4,714,073	30.1	3,488,004
	13,169,581	100.0	10,824,269	15,665,507	100.0	12,716,848

[1] National Slag Association.
[2] Illinois, New York, Maryland, Michigan, West Virginia, Kentucky, Colorado, Tennessee, and Massachusetts.

Blast-furnace slag sold or used by producers in the United States in 1942, by uses [1]

Use	Air-cooled						Granulated		
	Screened			Unscreened					
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
Concrete (pavements, buildings, bridges, etc.)	2,142,379	$1,867,191	$0.87						
Roads other than concrete	6,591,722	6,096,630	.92	1,254,340	$626,729	$0.50			
Railroad ballast	2,995,045	2,009,260	.67	344,244	125,289	.36			
Mineral wool	205,966	212,547	1.03						
Roofing slag	247,736	331,560	1.34						
Fill and sub-base cushion courses, etc	63,236	45,702	.72	396,930	103,016	.26	2,737,469	$453,156	$0.17
Sewage trickle filter	128,616	147,081	1.14						
Airport runways	995,811	921,838	.93						
Parking lots and private driveways	100,286	97,650	.97	78,097	29,144	.37			
Agricultural purposes	17,901	17,971	1.00				17,890	14,046	.79
Cement manufacture							701,852	119,892	.17
Glass manufacture	11,716	17,257	1.47						
Concrete products	21,285	20,217	.95						
Other uses	70,197	47,766	.68						
Total: 1942	13,591,896	11,832,670	.87	2,073,611	884,178	.43	3,457,211	587,094	.17
1941	12,372,218	10,434,187	.84	797,363	390,082	.49	1,508,685	239,833	.16
1940	8,132,396	7,015,616	.86	1,230,832	507,288	.41	989,814	257,737	.26
1939	7,108,061	5,870,582	.83	812,220	361,554	.45	1,188,094	122,017	.10
1938	6,118,505	5,600,668	.92	1,202,754	567,224	.47	656,807	78,723	.12

[1] National Slag Association.

GYPSUM

By Forrest T. Moyer and M. G. Downey

SUMMARY OUTLINE

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SUMMARY

The complete swing from peacetime to wartime construction in 1942 affected the gypsum industry adversely and general activity declined sharply. The over-all decrease in operations from 1941 may be measured by the 17-percent drop in new crude supply to a total of 5,099,084 short tons and the 24-percent slump in production of calcined gypsum to 3,045,082 tons in 1942. Markets for gypsum products were affected in diverse ways. Sales volumes of most products declined markedly from 1941, but these declines were compensated in part by the strong demand for cement retarder, agricultural gypsum, wallboard, and sheathing, of which sales advanced to record volumes in 1942. In addition, markets for laminated-board products expanded phenomenally after their introduction about the middle of the year. Principally as a result of the brisk demand for certain of the more highly processed, prefabricated products that command a higher price than other gypsum materials, the value of total sales by the industry declined only 9 percent from the record set in 1941 to a total of $63,170,744 in 1942. Although labor and material costs increased, prices of most gypsum products in 1942 were relatively unchanged from the levels that have prevailed in recent years. The General Maximum Price Regulation of the Office of Price Administration, effective May 11, froze prices of gypsum products at the highest selling value, f. o. b. mill, obtained during March 1942. Effective August 1, Maximum Price Regulation 188 of the same agency removed gypsum products from the general regulation and continued the March prices as maximum.

War controls on building construction by the Federal Government were the primary causes of the marked selectivity in demand for gypsum building products. The stoppage of nonessential public and private building by War Production Board Conservation Order L–41 of April 9 had an immediate effect upon the industry, and sales of lath, tiles, and nearly all building plasters slumped sharply after the first quarter of the year. The more restrictive revision of this order on September 7 and the establishment of review committees in War Production Board on October 22 to pass on essentiality of current and proposed construction both had adverse effects on sales of these

products. On the other hand, the joint War Housing Construction Standards of National Housing Agency and War Production Board of October 28 prohibited the use of lumber for housing when suitable substitutes were available and thus enlarged the markets for gypsum wallboard, sheathing, and laminated board.

Salient statistics of the gypsum industry in the United States, 1938–42

	1938	1939	1940	1941	1942
Active establishments [1]	90	92	91	93	92
Crude gypsum [2]—					
Mined short tons	2,684,205	3,226,737	3,699,015	4,788,534	4,697,568
Imported do	789,429	1,308,078	1,405,210	1,347,957	401,516
Apparent supply do	3,473,634	4,534,815	5,104,225	6,136,491	5,099,084
Calcined gypsum produced: [3]					
Short tons	2,252,878	2,881,269	3,307,709	3,980,567	3,045,082
Value	$10,989,626	$14,620,597	$17,254,667	$19,746,914	$16,403,068
Gypsum products sold: [3]					
Uncalcined uses:					
Short tons	756,565	867,782	929,119	1,320,713	1,514,913
Value	$1,681,371	$1,927,415	$2,250,857	$3,138,958	$3,533,607
Industrial uses:					
Short tons	94,248	110,395	123,643	151,960	142,705
Value	$1,154,517	$1,373,564	$1,532,738	$1,885,313	$1,840,927
Building uses:					
Value	$33,420,420	$42,627,260	$49,709,049	$64,734,171	$57,796,210
Total value	$36,256,308	$45,928,239	$53,492,644	$69,758,442	$63,170,744
Gypsum and gypsum products—					
Imported for consumption	$1,002,001	$1,363,967	$1,429,289	$1,282,140	$517,071
Exported	$282,782	$309,453	$264,128	$529,574	$977,863

[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 outstanding feature of the industry in 1942 was the steadily increasing demand for wallboard, sheathing, and the new laminated-board products. All of these are well-adapted to the current types of small, low-cost war and military housing which require prefabricated materials that are not high-priced and are quickly and easily erected with a minimum of labor. Although the advantages of these products would have assured a fair share of the market, the serious shortage of lumber undoubtedly helped increase demand for gypsum boards. Moreover, sheathing and laminated boards entered new fields of application, principally in nonresidential building, and were used widely as exterior siding and roof decks. For exposure to weather these products now are available with a variety of weather-resistant surfacing materials ranging from granule-coated asphalt roofing to a mill-painted finish. Laminated boards reportedly were accepted as satisfactory materials for farm construction work on which war controls were less restrictive than on housing. The effect of these factors was a 38-percent increase over 1941 in square footage of wallboard and a 110-percent gain in area of sheathing sold. The active demand for laminated products after their introduction in May 1942 is shown by sales of 53,170 M square feet (in terms of area of component board and not of finished product) valued at nearly 1½ million dollars.

In marked contrast to the record consumption of finished prefabricated gypsum building products, sales of the built-in materials—lath, tiles, and building plasters—fell sharply. In 1942 the square footage of lath sold was only half the record area sold in 1941, and the

long uptrend in demand for this product that started in 1934 was broken. Tile sales were more than one-fourth below and aggregate tonnage sales of building plasters (including Keene's cement) were 40 percent below 1941 volumes. Sales of "base-coat" and "gauging and molding" plasters, the important tonnage groups, slumped 45 and 39 percent, respectively, from the quantities sold in 1941. Indicated consumption increased only in the "insulating and roof-deck" group of building plasters, and sales were more than double the 1941 tonnage. This sharp gain reflects the high level of industrial building in which roof-deck plasters are used for poured-roof construction.

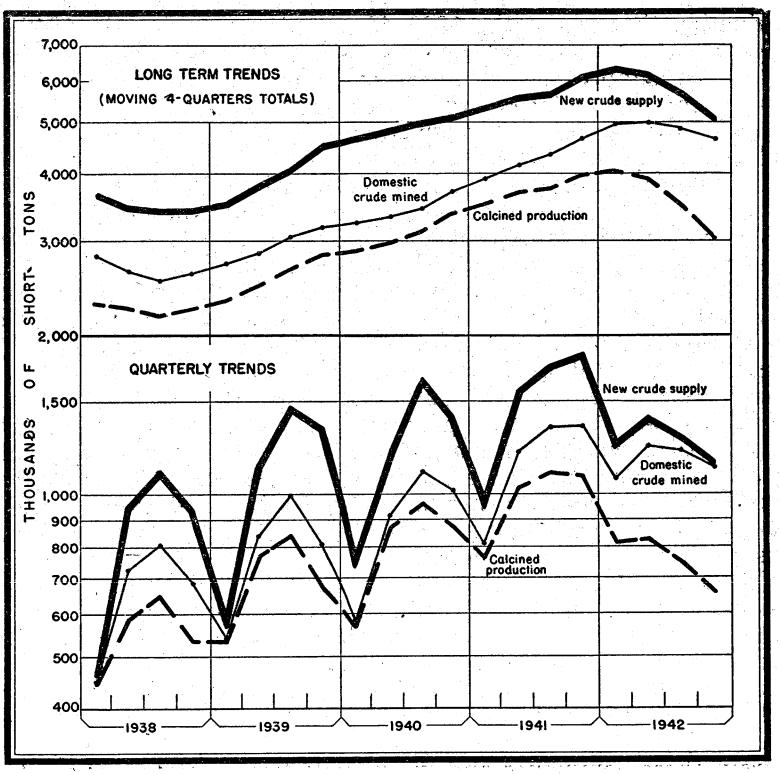

FIGURE 1.—Trends of new crude supply, domestic crude mined, and production of calcined gypsum, 1938-42, by quarters.

The source composition of the new crude supply in 1942 was changed markedly in that only 8 percent was derived from imports whereas in 1941 imported crude gypsum represented 22 percent of the total supply. Throughout 1942 the flow of crude from quarries in Nova Scotia and New Brunswick, Canada, to tidewater processing plants along the Atlantic coast was subject to Government war controls. Gypsum imports were placed on a quota basis, which was lowered drastically on January 21 and April 22. By August all company owned or leased gypsum boats had been requisitioned for other uses by the Federal Government or were lost at sea, and companies had great difficulty

in obtaining shipping space because of the relatively low preference rating assigned to gypsum. As a result crude imports in the last 4 months of 1942 were a mere trickle compared with normal volumes, and the total for the year fell 70 percent below the 1941 tonnage. In figure 1 the long-term trends of new crude supply and domestic crude mined show a marked discordance between the fourth quarters of 1939 and 1942. It is evident that the rate of imports advanced sharply in the October–December period of 1939 and continued at a relatively high level through the fourth quarter of 1941. This advanced rate probably represented efforts by importers to build up stocks in this country after the outbreak of war in Europe in September 1939. The marked parallelism in trends of new supply and calcined production throughout the 1938–42 period is notable. In 1942 convergence of the new-supply and domestic-crude curves and parallelism of the new-supply and calcined-production curves indicate that domestic material replaced imported crude chiefly in the markets for uncalcined products, although there undoubtedly was also some replacement in the calcined-products field.

The critical state of crude supplies at Atlantic tidal plants toward the end of 1942 was mitigated by the fact that the greater demand for gypsum products was in sections of the country not served from these plants. To help relieve the supply problem at importing plants in 1942, some domestic crude was shipped by barge from western New York to the New York City area, calcined gypsum from a domestic operation was moved by rail to a southern tidal plant, and the calcined output of a byproduct-gypsum plant was utilized in the New York City area. Total stocks of crude gypsum in the country on December 31, 1942, aggregated 741,549 short tons, of which 152,581 tons were at Atlantic tidewater plants. The only other recent stock data available are those for December 31, 1935, when there were two less calcining plants on Atlantic tidewater. At that time, stocks in the country totaled 668,927 tons, of which 178,919 tons were on the Atlantic coast.

The Department of Justice in September 1942 nol-prossed its criminal suit against two gypsum companies for illegal control of perforated-lath prices. An earlier criminal action was settled by a directed verdict of acquittal in November 1941. Of the three original actions [1] only the civil suit charging seven gypsum companies and officials with violations of sections 1, 2, and 3 of the Sherman Antitrust Act remains unsettled. Principal objectives of the civil action are to restrain these companies and individuals from violating the act and to have certain patents and agreements declared void.

Wage increases during 1942 were reported by some gypsum operators in New York, Michigan, Iowa, Utah, Nevada, and California. Despite the decline in demand for many products, there was a labor shortage in the industry in nearly all sections of the country. This shortage tended to increase operating costs, as producers were forced to overtime rates of pay to fill orders.

[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 Co. et al.*, No. 66008, in the District Court of the United States for the District of Columbia, April term, 1940, 22 pp.
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.

DOMESTIC PRODUCTION

Total output from domestic gypsum mines in 1942 showed a smaller proportional decline than did other general measures of industry activity and was only 2 percent below the 1941 tonnage owing to the necessity of supplanting imported supplies along the east coast and a strong demand for gypsum products in far Western and some Midwestern States. Of the 17 producing States, production was higher than in 1941 in 6, lower in 10, and was resumed in Arizona after a lapse of 2 years. The ranking States were New York, Michigan, Iowa, and California. Active operations totaled 64, of which 29 were underground mines, 30 open quarries, and 5 mine-quarry combinations.

The average value of run-of-mine gypsum advanced 3 cents over the 1941 figure to $1.45 per ton in 1942. As reported by producers this is a "plant" value, for little crude gypsum enters the open market. Data in the accompanying table relate only to natural gypsum and gypsite and do not include crude byproduct gypsum.

Crude gypsum mined in the United States, 1940–42, by States

State	1940			1941			1942		
	Active mines	Short tons	Value	Active mines	Short tons	Value	Active mines	Short tons	Value
California	6	259,321	$437,504	7	381,951	$618,685	9	426,670	$662,181
Colorado	3	24,641	36,787	(1)	(1)	(1)	(1)	(1)	(1)
Iowa	8	487,379	587,223	8	630,930	736,185	7	514,587	688,211
Michigan	5	746,982	1,017,126	5	805,861	1,090,309	6	891,180	1,286,242
Nevada	4	250,632	618,050	4	284,795	754,294	5	330,333	540,579
New York	9	798,229	1,037,181	9	1,080,320	1,500,307	10	1,012,987	1,605,530
Oklahoma	3	176,166	227,534	3	258,258	344,489	3	243,545	321,652
Texas	7	328,261	368,882	7	446,419	467,087	6	414,196	496,669
Utah	4	45,421	60,055	4	61,813	78,147	4	48,574	60,259
Other States [2]	10	581,983	837,568	13	838,187	1,204,720	14	815,496	1,149,857
	59	3,699,015	5,227,910	60	4,788,534	6,794,223	64	4,697,568	6,811,180

[1] Included under "Other States."

[2] By groups of States as follows—1940: Kansas (2 active mines), Montana (2), South Dakota (1), and Wyoming (1)—197,703 tons valued at $227,025; Ohio (2) and Virginia (2)—384,280 tons, $610,543. 1941: Arkansas (1) and Kansas (2)—174,918 tons, $177,499; Colorado (2), Montana (2), South Dakota (1), and Wyoming (1)—149,848 tons, $222,710; Ohio (2) and Virginia (2)—513,421 tons, $804,511. 1942: Arizona (1), Arkansas (1), and Kansas (2)—142,731 tons, $170,403; Colorado (2), Montana (2), South Dakota (1), and Wyoming (1)—135,588 tons, $202,612; Ohio (2) and Virginia (2)—537,177 tons, $776,842.

CALCINED PRODUCTION AND EQUIPMENT OF PROCESSING PLANTS

Production of calcined gypsum in 1942 dropped nearly one-fourth below kettle-and-kiln output in 1941 because of the slump in demand for building plasters after the first quarter of the year. In the 24 producing States 53 plants were active, of which 42 processed domestic crude, 10 imported crude, and 1 byproduct crude gypsum. Active calcining equipment in these plants comprised 172 kettles, 8 beehive kilns, 12 rotary kilns, and 4 grinding-calcining units. A canvass of the output of calcined gypsum by States was made for the first time for 1942; it showed the following distribution.

Calcined gypsum produced in the United States in 1942, by districts

District	Short tons	Value
New Hampshire, Vermont, Massachusetts, and Connecticut	91,788	$589,055
Eastern New York, New Jersey, Pennsylvania, Georgia, and Florida	500,011	3,390,693
Western New York	529,616	2,439,984
Ohio and Virginia	286,296	1,661,865
Michigan and Indiana	424,283	2,259,095
Iowa	324,387	1,476,107
Kansas and Oklahoma	159,585	853,532
Texas	285,430	1,202,266
Colorado, South Dakota, and Montana	73,893	446,562
Utah	20,695	122,303
California, Nevada, and Arizona	349,098	1,961,606
	3,045,082	16,403,068

Reflecting rising costs of labor, fuel, and materials, the average unit value of calcined gypsum, which is strictly a "transfer" value assigned by producers, increased 43 cents over the 1941 figure to $5.39 per ton.

Active calcining plants and equipment in the United States, 1940–42, by States

State	1940				1941				1942			
	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	4	10	-------	[1] 3	5	13	-------	[2] 4	3	7	-------	[2] 4
Iowa	5	18	-------	-------	5	18	-------	-------	5	18	-------	-------
Michigan	5	21	-------	-------	5	21	-------	-------	5	22	-------	-------
New York	7	22	-------	6	7	23	-------	6	7	22	-------	6
Texas	4	25	-------	-------	4	25	-------	-------	4	26	-------	-------
Utah	4	8	5	-------	4	8	4	-------	4	8	4	-------
Other States [3]	26	65	4	8	27	71	4	7	25	69	4	6
	55	169	9	[1] 17	57	179	8	[2] 17	53	172	8	[2] 16

[1] Includes 3 grinding-calcining units.
[2] Includes 4 grinding-calcining units.
[3] 1940: 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. 1941: 1 calcining plant each in Arizona, Connecticut, Georgia, Indiana, Massachusetts, New Hampshire, Oklahoma, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Florida, Kansas, Montana, Nevada, New Jersey, Ohio, and Virginia. 1942: 1 calcining plant each in Arizona, Connecticut, Florida, Georgia, Indiana, Massachusetts, New Hampshire, Oklahoma, Pennsylvania, South Dakota, and Vermont; 2 each in Colorado, Kansas, Montana, Nevada, New Jersey, Ohio, and Virginia.

The active demand for gypsum board kept the 36 board machines in the country working at a high rate throughout 1942. Results of a monthly survey conducted by the Bureau of Mines for the War Production Board show that the over-all rate of operations of all board machines was 84 percent of capacity in September, 89 percent in October, 80 percent in November, and 75 percent in December. Generally, machines in Atlantic tidewater plants were less active than those in plants processing domestic crude. In the latter group machines were operated at 93 percent of capacity in September, 97 percent in October, 87 percent in November, and 81 percent in December. These capacity data are on a time-utilized basis in which 100 percent equals full operation for 85 percent of the total number of hours in each month.

DISTRIBUTION OF SALES BY USES

The marked changes from 1941 in distribution of total sales value among groups of products are traceable directly to differences in types of materials required for wartime compared with peacetime building. As shown in figure 2 the percentages represented by sales values of lath and building plasters (including Keene's cement) declined sharply from the 1941 distribution, whereas the value of all other boards (wallboard, sheathing, and laminated board) jumped to 50 percent of the total in 1942. Comparison of the distribution for 1928 and 1941 shows long-term changes in composition of sales for peacetime building. Notable differences are the increased percentage represented

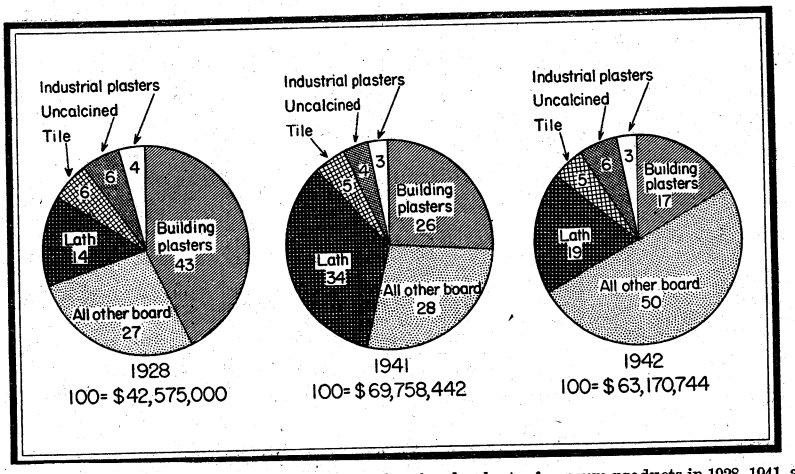

FIGURE 2.—Percentage distribution of total sales value, f. o. b. plant, of gypsum products in 1928, 1941, and 1942, by groups of products.

by value of lath and the decline in importance of the building-plaster group.

As a result of record consumption of portland-cement retarder and agricultural gypsum, total sales of uncalcined products advanced 15 percent over the tonnages sold in 1941. Unprecedented activity in the portland-cement industry raised indicated consumption of gypsum as retarder 8 percent over the record of 1941. Sales of agricultural gypsum increased 69 percent over the 1941 tonnage, a gain due to increased use in both major consuming areas—California and the Virginia-Carolina peanut section. In California, where "land plaster" is used on a large variety of crops to correct sulfate deficiency and to remedy black-alkali soils, consumption[2] has increased phenomenally, from 7,914 tons in 1934 to about 186,000 tons in 1942. In the Virginia-North Carolina area sales totaled approximately 60,000 tons, a 20-percent increase over 1941. A study[3] of markets for agricultural gypsum indicated possible expansion in the "southeast" and "southwest" peanut-growing sections of the country.

[2] California Department of Agriculture, Bureau of Chemistry, Commercial Fertilizers—Agricultural Minerals: Spec. Pub. 188, 1941, p. 94.

[3] Moyer, Forrest T., Expanding Markets for Agricultural Gypsum: Am. Fertilizer, vol. 97, No. 9, October 24, 1942, pp. 5-6.

The aggregate tonnage of industrial plasters sold in 1942 declined 6 percent from 1941 because of the 62-percent slump in the plate-glass and terra-cotta group which was only partly compensated by sharply increased sales of all other types of industrial plasters. The decline in consumption of plate-glass and terra-cotta plasters resulted from the closing of the principal consuming market—polished plate glass for passenger automobiles.

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1941–42, by uses

Use	1941			1942			Percent of change in—	
	Short tons	Value		Short tons	Value			
		Total	Average		Total	Average	Tonnage	Average value
Uncalcined:								
Portland-cement retarder	1,153,443	$2,304,910	$2.00	1,245,277	$2,543,272	$2.04	+8	+2
Agricultural gypsum	149,196	667,342	4.47	251,998	823,645	3.27	+69	−27
Other uses [1]	18,074	166,706	9.22	17,638	166,690	9.45	−2	+2
Total uncalcined uses	1,320,713	3,138,958		1,514,913	3,533,607		+15	
Industrial:								
Plate-glass and terra-cotta plasters	48,214	331,860	6.88	18,096	119,849	6.62	−62	−4
Pottery plasters	26,022	338,708	13.02	30,856	423,927	13.74	+19	+6
Orthopedic and dental plasters	11,568	394,661	34.12	14,319	438,375	30.61	+24	−10
Other industrial uses [2]	66,156	820,084	12.40	79,434	858,776	10.81	+20	−13
Total industrial uses	151,960	1,885,313		142,705	1,840,927		−6	
Building:								
Cementitious:								
Plasters:								
Base-coat	1,532,829	13,505,974	8.81	848,280	7,596,058	8.95	−45	+2
Sanded	132,628	774,465	5.84	101,497	638,388	6.29	−23	+8
To mixing plants	20,878	126,391	6.05	17,527	111,348	6.35	−16	+5
Gauging and molding	171,954	2,125,926	12.36	105,728	1,279,506	12.10	−39	−2
Prepared finishes	12,882	334,040	25.93	8,990	348,818	38.80	−30	+50
Insulating and roof-deck	24,079	200,912	8.34	48,266	385,102	7.98	+100	−4
Other [3]	14,031	520,755	37.11	12,107	485,980	40.14	−14	+8
Keene's cement	29,816	464,219	15.57	14,848	238,467	16.06	−50	+3
Total cementitious	1,939,097	18,052,682		1,157,243	11,083,667		−40	
Prefabricated:								
Lath [4]	1,357,641	23,524,812	[5] 12.76	717,638	12,116,144	[5] 12.63	[6] −48	[5] −1
Wallboard [7]	612,203	16,578,698	[5] 21.88	873,302	23,200,410	[5] 22.18	[6] +38	[5] +1
Sheathing board [8]	179,275	3,287,699	[5] 18.73	374,550	7,016,015	[5] 19.00	[6] +110	[5] +1
Laminated board [9]				55,676	1,464,090	[5] 27.54		
Tile [10]	198,578	3,290,280	[11] 39.53	143,221	2,915,884	[11] 45.81	[6] −29	[11] +16
Total prefabricated	2,347,697	46,681,489		2,164,387	46,712,543		−8	
Total building uses		64,734,171			57,796,210			
Grand total value		69,758,442			63,170,744			

[1] Includes uncalcined gypsum sold for use as filler and rock dust, in paint manufacturing, and for minor purposes.
[2] Includes statuary, industrial casting and molding plasters, dead-burned filler, and miscellaneous sales.
[3] Includes joint filler, patching and painter's plaster, and unclassified building plasters.
[4] 1941: 1,843,648 M square feet; 1942: 959,307 M square feet.
[5] Average value per M square feet.
[6] Percent of change in square footage.
[7] 1941: 757,588 M square feet; 1942: 1,046,025 M square feet.
[8] 1941: 175,496 M square feet; 1942: 369,313 M square feet.
[9] New product first marketed in 1942, when square footage in terms of component board and not of finished product totaled 53,170 M square feet.
[10] Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and planks—1941: 34,877 M square feet; 1942: 24,664 M square feet.
[11] Average value per M square feet of partition tile only.

In the cementitious group of building products only the insulating and roof-deck plasters showed increased sales over 1941; volumes of all other items declined sharply. Although sales of lath and tiles in the prefabricated group of products were markedly lower than in 1941, the loss was fully compensated by the record volumes of wallboard, sheathing, and laminated board sold. The decline in consumption of tiles was due to a decrease of nearly one-half in the square footage of

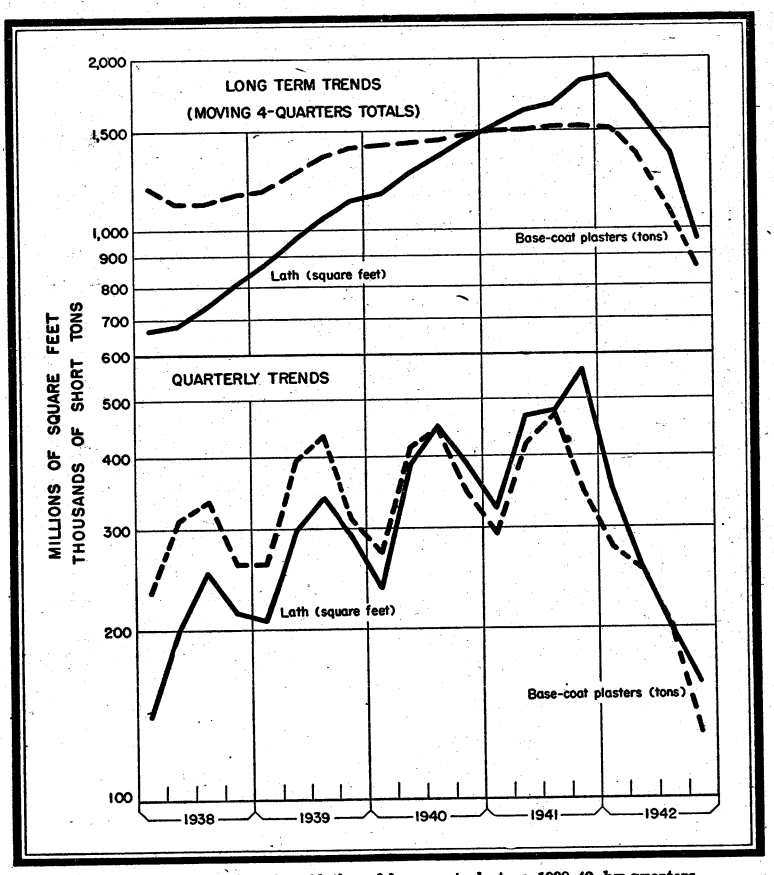

FIGURE 3.—Trends in sales of lath and base-coat plasters, 1938–42, by quarters.

partition tile sold and of approximately one-tenth in sales of all other tile shapes (roof, floor, soffit, plank, etc.).

The sharp change in trends of sales of lath and base-coat plasters early in 1942 is shown in figure 3, which was compiled from data in Bureau of Mines Quarterly Gypsum Reports. The annual volume of lath sold has increased each year since 1933 and after 1935 set new records each year through 1941. After a slight recession in 1938 sales of base-coat plasters also increased through 1941. The change in types of materials required for wartime from peacetime building resulted in a marked decline in demand early in 1942 for these "built-in" products, and sales fell rapidly to a fourth-quarter volume that was well below similar data for any of the years shown.

Gypsum board and tile sold or used in the United States, 1928–42, by types

Year	Lath			Wallboard [1]		
	M square feet	Value		M square feet	Value	
		Total	Average [2]		Total	Average [2]
1928	405,500	$5,775,000	$14.24	[1] 605,500	[1] $11,475,000	[1] $18.95
1929	412,000	5,475,000	13.29	[1] 667,000	[1] 12,275,000	[1] 18.40
1930	341,000	5,625,000	16.50	[1] 449,500	[1] 11,350,000	[1] 25.25
1931	226,500	3,425,000	15.12	[1] 366,500	[1] 9,450,000	[1] 25.78
1932	128,000	2,100,000	16.41	[1] 211,000	[1] 6,050,000	[1] 28.67
1933	117,000	1,675,000	14.32	[1] 208,000	[1] 5,425,000	[1] 26.08
1934	127,000	1,850,000	14.57	[1] 212,000	[1] 5,675,000	[1] 26.77
1935	252,000	3,800,000	15.08	[1] 260,000	[1] 6,875,000	[1] 26.44
1936	479,000	7,325,000	15.29	[1] 344,500	[1] 8,250,000	[1] 23.95
1937	738,929	9,604,372	13.00	[1] 385,307	[1] 8,349,810	[1] 21.67
1938	809,471	10,287,935	12.71	[1] 371,767	[1] 7,921,400	[1] 21.31
1939	1,137,415	14,598,868	12.84	405,655	8,766,184	21.61
1940	1,450,069	18,189,358	12.54	491,291	10,595,245	21.57
1941	1,843,648	23,524,812	12.76	757,588	16,578,698	21.88
1942	959,307	12,116,144	12.63	1,046,025	23,200,410	22.18

Year	Sheathing [1]			Laminated board [3]			Tile [4]		
	M square feet	Value		M square feet	Value		M square feet	Value	
		Total	Average [2]		Total	Average [2]		Total	Average [5]
1928	[1]	[1]	[1]				50,500	$2,400,000	$42.99
1929							54,600	2,400,000	37.74
1930							40,800	1,780,000	36.88
1931							27,300	1,160,000	37.74
1932							10,100	550,000	40.79
1933							7,700	430,000	38.23
1934							9,800	550,000	42.84
1935							12,200	740,000	42.38
1936							22,300	1,380,000	43.19
1937							23,820	1,552,248	42.04
1938							19,942	1,300,830	42.45
1939	5,221	$105,649	$20.24				30,191	2,066,086	43.87
1940	89,631	1,632,688	18.22				30,026	1,962,963	45.58
1941	175,496	3,287,699	18.73				34,877	3,290,280	39.53
1942	369,313	7,016,015	19.00	[6] 53,170	$1,464,090	$27.54	24,664	2,915,884	45.81

[1] Reportedly negligible square footages and values of sheathing are included under "Wallboard," 1928–38, inclusive.
[2] Per M square feet, f. o. b. producing plant.
[3] New product first marketed in 1942.
[4] Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and planks.
[5] Per M square feet, f. o. b. producing plant, of partition tile only.
[6] Reported as area of component board and not of finished product.

In the accompanying table listing annual data of the prefabricated gypsum products, average unit values are presented for the first time. Notable features of the series, not mentioned elsewhere in this chapter, are the over-all declines in average unit value of lath from 1930 to 1942 and in unit value of wallboard from 1932 to 1938, followed by a slight increase to 1942. Average values of wallboard vary more than those for lath because of annual fluctuations in demand for wallboard of different thickness and finish. The annual average values of partition tile likewise vary owing to changes in demand for the different thicknesses available. In studying price trends of gypsum products, it should be remembered that the industry experienced a disastrous price war in 1928–29.

PRICES

Prices of gypsum products as indicated by reported mill values showed a slight upward tendency in 1942, although no significant changes. Average mill values per unit have been remarkably stable in recent years. The decline from 1941 in average value of agricultural gypsum was caused by the increased tonnage of low-priced gypsite sold for such use in California. In 1942 the average mill value was $1.91 per ton for agricultural gypsum in California compared with $6.03 per ton for land plaster in the Virginia-North Carolina area where rock gypsum is used exclusively.

A study [4] of wholesale and retail prices of building materials states that gypsum plasters generally are marketed under a freight equalization system. The average wholesale and retail prices of plaster in September 1939 in the 50 cities surveyed were $13.58 and $17.57 per ton, respectively, a spread of 29.4 percent. Wholesale prices showed a fairly large geographical variation and were lowest in the Middle Atlantic and highest in the East South Central States.

RECENT DEVELOPMENTS

The most notable achievement in 1942 was the development of laminated gypsum-board products which are available at the mill with a wide variety of surfacing materials ranging from those suitable for exposure to weather to those for finished interiors without further decoration. The products are made in thicknesses up to 2 inches and are composed of two, three, or four plies of gypsum boards.

Use of gypsum plaster to make molds and cores for nonferrous metal casting is developing rapidly. A description [5] of the patented Capaco process, which utilizes a mixture of 79 percent calcined gypsum, 20 percent fibrous magnesium silicate, and 1 percent set accelerator, claims marked advantages for gypsum over sand molds. This process already is used in four casting plants, one of which has a daily capacity of 20,000 pounds of nonferrous metals.

In England patterns of gypsum plaster are used more widely than in former years as a means of speeding foundry work. Recent developments in production technique and the advantages of plaster patterns in foundry work have been described.[6]

Press tools of gypsum plaster made by direct molding have been investigated [7] in England for small-quantity production of metal pressings.

A new industrial use for gypsum is the forming of self-sealing liners for bulletproof gasoline tanks over molds of plaster.

Experience [8] has shown that the properties of a high-strength gypsum cement developed recently make it a satisfactory material for certain uses in cementing and shooting oil wells.

Preliminary work [9] on fusion of a mixture of salt, silica, and gypsum produced a glass free of bubbles and specks. Advantages of the

[4] Temporary National Economic Committee, Geographical Differentials in Prices of Building Materials: Mon. 33, 1940, pp. 47–63.
[5] Phair, W. A., Plaster Molds: Iron Age, vol. 148, No. 15, October 9, 1941, pp. 74–78.
[6] Plucknett, Henry, Plaster Patterns: Aircraft Production, vol. 4, No. 37, November 1941, pp. 13–16; Plaster Patterns for Foundry Use: Foundry Trade Jour., vol. 66, January 15, 1942, pp. 35–36.
[7] Plucknett, Henry, Molded Press Tools: Aircraft Production, vol. 4, No. 39, January 1942, p. 139.
[8] Henderson, R. K., New Fast-Setting Cement is Valuable Odd-Job Adjunct: Petrol. Eng., vol. 11, No. 13, 1940, pp. 93–94.
[9] Dertev, N. K., Glass, Sulfuric Acid, and Hydrochloric Acid From Sodium Chloride, Silica, and Gypsum: Jour. App. Chem. (U. S. S. R.), vol. 14, 1941, pp. 703–705.

process are the volatilization of one-fourth of the iron content in the charge, which permits the use of low-grade silica, and the possible recovery of sulfuric and hydrochloric acids as byproducts.

In the late 1930's, practice at the New Caledonia nickel smelter was changed by substitution of gypsum for sulfur in the process as an economic measure. Approximately 6 tons of gypsum does the work of 1 ton of sulfur. At capacity operation monthly requirements [10] of gypsum by the smelter are 2,500 short tons, of which nearly all is obtained from local sources.

FOREIGN TRADE [11]

Nearly all the foreign trade of the United States in gypsum consists of crude gypsum imported from Nova Scotia and New Brunswick, Canada, to processing plants along the east coast as far south as Florida. Developments in 1942 in the flow of crude supplies are discussed earlier in this chapter.

Imports and exports of gypsum products are negligible in quantity and value in contrast with the volume of domestic business. Imports in the classes "Alabaster manufactures" and "Other manufactures" have declined sharply in recent years; they virtually ceased in 1942 because of the stoppage of trade with Italy, the principal source. In export trade the only significant change from 1941 was the trebling in square footage of exports of gypsum board owing doubtless to offshore construction activities of the Federal Government and to demand for board to repair bombed buildings in England.

Gypsum and gypsum products imported for consumption in the United States, 1938–42

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			
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	71,143	36,138	1,429,289
1941	1,347,957	1,225,152	1,631	30,499	242	6,416	34	945	3,232	15,896	1,282,140
1942	401,516	486,894	1,048	20,427	309	8,205	20	484	227	834	517,071

[1] Includes imports of jet manufactures, which are reported to be negligible.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1940–42, by countries

Country	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	1,368,194	$1,260,076	1,345,681	$1,220,761	397,511	$476,900
China			2	88		
Dominican Republic					3,053	9,076
Hong Kong			6	240		
Italy	184	4,495				
Mexico	32,134	29,056				
United Kingdom [1]	4,698	6,823	2,268	4,063	952	918
	1,405,210	1,300,450	1,347,957	1,225,152	401,516	486,894

[1] United Kingdom of Great Britain and Northern Ireland.

[10] Bureau of Mines, Mineral Trade Notes: Confidential Ser., No. 10, April 1943, pp. 23–24.

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

Gypsum and gypsum products exported from the United States, 1938–42

Year	Crude, crushed, or ground		Plasterboard and wallboard		Calcined		Other manufactures, n. e. s.	Total value
	Short tons	Value	Square feet	Value	Short tons	Value		
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
1941	15,491	72,877	13,560,482	296,848	3,041	90,397	69,452	529,574
1942	595	14,543	39,489,186	772,989	1,859	84,784	105,547	977,863

WORLD PRODUCTION

World production of gypsum in 1942, based upon the meager data available, is estimated at approximately 9½ million metric tons.

Since the outbreak of war in 1939, output of gypsum in nearly all European countries that are large producers—France, United Kingdom, Russia, and Germany—undoubtedly has slumped because of the stoppage of residential building. The industries of those countries, unlike the United States, have not developed the manufacture of gypsum boards for which demand in 1942 has been so large in this country as to cushion the decline in plaster consumption. In European countries demand for gypsum as cement retarder probably is greater because of the increased activities of the portland-cement industries to fill needs for fortifications and other military purposes and for industrial and bombproof construction. Compensating in part for the decline due to cessation of building, consumption of gypsum and anhydrite as raw materials for the manufacture of sulfuric acid and sulfide and sulfate chemicals doubtless has gained appreciably in the past few years because of difficulties in obtaining supplies of sulfur and pyrite. After the World War of 1914–18 the processes utilizing gypsum and anhydrite were developed to economic feasibility in the laboratory, and commercial plants [12] employing them were in operation in the United Kingdom, France, and Germany at the outbreak of the present war.

In Spain, the only other European country with sizable production, output of gypsum probably has increased in recent years because of the necessary rehabilitation of buildings destroyed during the Civil War of 1936–39.

Activity of the gypsum industry in Canada during 1942, in terms of crude output, was only about one-third that in 1941. The decline was caused by the severe curtailment of crude exports to the United States and the halting by the Dominion Government of all building not essential to the war effort.

[12] Bureau of Mines Minerals Yearbook, 1938, p. 1091; 1940, p. 1235.

World production of gypsum, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Algeria	46,175	33,325	(2)	(2)	(2)	(2)
Anglo-Egyptian Sudan				(2)	(2)	(2)
Argentina [3]	68,220	70,813	87,328	103,157	86,076	(2)
Australia:						
New South Wales	9,300	12,712	(2)	(2)	(2)	(2)
South Australia	117,985	148,943	147,266	155,901	115,323	(2)
Victoria	21,197	13,596	11,966	(2)	(2)	(2)
Western Australia	9,219	13,645	14,570	13,020	(2)	(2)
Belgian Congo	(2)	1,000	(2)	500	(2)	(2)
Brazil [4]	2,000	2,000	2,000	2,000	(2)	(2)
Canada	1,044,222	915,169	1,289,950	1,314,311	1,445,506	526,686
Chile	24,980	24,551	22,209	25,865	23,125	(2)
China:	(2)	(2)	(2)	75,000	(2)	(2)
Cuba	15,028	7,257	6,270	12,000	12,000	(2)
Cyprus	[5] 13,576	[5] 9,729	[5] 5,058	[4] 1,400	(2)	(2)
Egypt	253,641	212,088	700,166	169,723	130,942	(2)
Eire	11,647	13,364	16,168	21,662	24,660	(2)
Estonia	12,748	13,915	(2)	(2)	(2)	(2)
France	1,320,400	(2)	(2)	(2)	(2)	(2)
Germany	(2)	(2)	(2)	(2)	(2)	(2)
Austria [6]	47,000	(2)	(2)	(2)	(2)	(2)
Greece	17,924	16,609	15,219	(2)	(2)	(2)
India, British	46,830	70,944	69,786	(2)	(2)	(2)
Iraq			69,545	34,879	(2)	(2)
Italy	416,198	425,299	(2)	(2)	(2)	(2)
Latvia	[5] 196,911	220,000	245,035	(2)	(2)	(2)
Luxemburg	19,722	19,901	(2)	(2)	(2)	(2)
New Caledonia	984	1,070	(2)	3,000	(2)	(2)
Palestine	3,934	3,984	4,524	4,403	(2)	(2)
Peru	12,895	14,026	15,655	21,478	25,000	(2)
Portugal	11,390	9,036	(2)	(2)	(2)	(2)
Rumania	70,620	69,079	(2)	(2)	(2)	(2)
Sweden	108	95	102	(2)	(2)	(2)
Switzerland	35,000	35,000	38,000	30,000	(2)	(2)
Tunisia	22,800	(2)	(2)	(2)	(2)	(2)
Union of South Africa	33,186	38,849	40,782	(2)	(2)	(2)
United Kingdom	1,111,669	1,109,928	(2)	(2)	(2)	(2)
United States	2,774,307	2,435,057	2,927,231	3,355,672	4,344,062	4,261,540

[1] In addition to the countries listed gypsum is produced in Chosen, Japan, French Morocco, Mexico, Poland, Spain, 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 Forrest T. Moyer and F. D. Gradijan

SUMMARY OUTLINE

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SUMMARY

The net effect of the change from peacetime to wartime economy in 1942 benefited the lime industry, and total sales of "open-market" lime advanced slightly over 1941 to a new record of 6,103,791 short tons. However, not all branches of the industry shared in the increased business. Sales of agricultural, chemical, and refractory (dead-burned dolomite) lime were well above the volumes sold in 1941, but sales of building lime slumped sharply from the 1941 tonnage. The first year of war also effected a marked change in demand for the two types of lime, as shown by the 7-percent gain in total quantity of quicklime sold and the 19-percent decrease in sales of hydrated lime from 1941. Although labor, fuel, and material costs rose sharply in 1942, prices of lime increased only slightly and remained in the narrow range of fluctuation that has prevailed for the past 10 years. The average value, f. o. b. plant, advanced 21 cents over 1941 to $7.27 per ton.

Although increases in hourly rates of pay were reported by producers in nearly all States, a serious labor shortage prevailed throughout the lime industry during 1942. Also, a high turn-over rate left many plants with an inefficient labor force. These factors increased production costs markedly, as operators were forced to pay overtime rates to meet the demand for lime. As selling prices showed little change from 1941, the increased costs and the short labor supply compelled many plants (mostly small producers) to close during 1942.

Other than price freezing, no direct war controls were imposed on the lime industry during 1942. The General Maximum Price Regulation of the Office of Price Administration, effective May 11, froze all lime prices at the highest selling value, f. o. b. plant, obtained during March 1942. Effective August 1, Maximum Price Regulation 188 of the same agency removed lime from the general order and continued the March prices as maximum. The stoppage of nonessen-

tial public and private construction by War Production Board Conservation Order L–41 of April 9 and its more restrictive revision of September 7 had direct adverse effect on sales of building lime.

The demand for chemical lime increased steadily throughout 1942 in nearly all sections of the country, and total sales for this classification advanced 6 percent over the former record tonnage sold during 1941. At the year's end, shortages had developed in several localities in which war plants with large lime requirements had been built or expanded, and supplies had to be brought in from relatively distant lime plants. Consumption of chemical lime by the various industries showed diverse effects of the war, and the quantities sold for many of the chemical uses declined in 1942 from 1941. However, most of the decreased requirements were in industries with relatively small consumption, whereas nearly all the large consuming industries, notably metallurgical, carbide, glass, and water-purification, purchased more lime in 1942.

Salient statistics of the lime industry in the United States, 1925–29 (average), 1935–39 (average), and 1940–42

	1925–29 (average)	1935–39 (average)	1940	1941	1942
Active plants	419	310	314	309	270
Sold or used by producers:					
By types:					
Quicklime, short tons	2,871,236	2,488,269	3,501,104	4,489,257	4,810,452
Hydrated, do	1,585,631	1,204,128	1,385,825	1,590,159	1,293,339
Total lime:					
Short tons	4,456,867	3,692,397	4,886,929	6,079,416	6,103,791
Value [1]	$38,548,498	$26,592,115	$33,956,385	$42,941,162	$44,367,441
Per ton	$8.65	$7.20	$6.95	$7.06	$7.27
By uses:					
Agricultural, short tons	318,224	350,535	364,823	382,727	400,631
Building, do	2,096,744	870,335	1,010,435	1,065,599	697,677
Chemical and industrial, do	1,623,885	1,929,947	2,643,762	3,561,203	3,776,126
Refractory (dead-burned dolomite), do	418,014	541,580	867,909	1,069,887	1,229,357
Imported for consumption:					
Short tons	18,683	14,108	9,205	[2] 9,165	[3]
Value	$344,887	$240,909	$81,888	[2] $78,860	[3]
Exported:					
Short tons	15,752	10,905	31,912	[2] 32,444	[3]
Value	$221,177	$123,167	$311,619	[2] $318,541	[3]

[1] Selling value, f. o. b. plant, excluding cost of containers.
[2] Figures cover January–September, inclusive.
[3] Data not available.

The high rate of operations and the installation of new open-hearth and electric-furnace capacities in the steel industry, the coming into production of new or expanded magnesium and Bayer alumina plants, and the increased quantities of metallic ores floated during 1942 raised the total demand for metallurgical lime 15 percent above 1941. The only reduced market for metallurgical purposes was for cyanidation of gold ores. The demand for lime in the Bayer alumina process doubtless will increase, because lime requirements per ton of ore rise rapidly as lower-grade bauxites are used. Owing to greatly increased requirements for acetylene in welding and synthetic rubber, consumption of lime for carbide manufacture advanced 49 percent over 1941. Demand for lime in glass manufacture and water purification also increased in 1942. The only chemical uses that annually consume large quantities of lime to show decreased consumption from 1941 were in the insecticide and disinfectant, paper, and tanning industries.

Sales of refractory lime reached a new high volume in 1942 and surpassed the 1941 tonnage by 15 percent—a greater proportional gain than was shown by output of steel. This increased demand resulted in part from the quantities needed for bottoms in new open-hearth furnaces and indicates continued substitution of dead-burned and stabilized dolomites for other higher-priced or less available refractories as well as wider acceptance of the enriched dolomitic-base materials.

War controls on the construction industry and the changes in types of materials required in wartime compared with peacetime building resulted in a sharp decline in total sales of building lime from 1941. As speed of erection was the first requisite of all wartime construction, the automatically reduced volume of masonry work caused a slump in consumption of lime for masonry purposes. Also, the demand for finishing lime declined markedly from 1941, because most of the war and military housing in 1942 consisted of small, low-cost units designed for the use of prefabricated rather than "built-in" materials.

Despite record farm income in 1942 and growing recognition of the importance of calcium as a plant food, consumption of agricultural lime increased only 5 percent over 1941. This increase compares unfavorably with the 38-percent gain in cash farm income from crops and Government subsidies in 1942 over 1941.

A notable feature of figure 1, which shows trends in major uses of lime from 1922 to 1942, is the rapid rate of recovery in sales of chemical and refractory lime from the low volumes of 1932. Consumption in these uses after 1935 set new annual records in each year through 1942, except in 1938, when sales declined. The building-lime curve

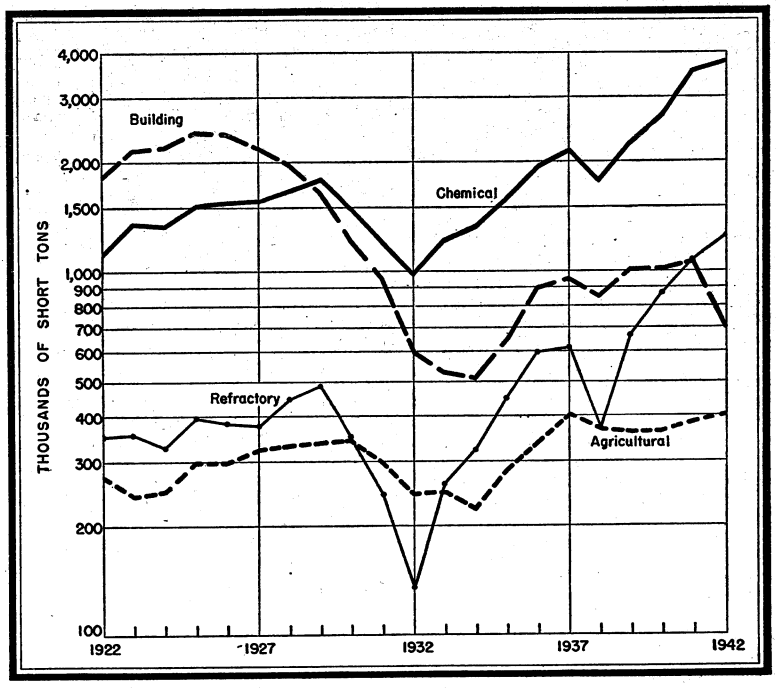

FIGURE 1.—Trends in major uses of lime, 1922–42.

shows the longest decline, extending from 1925 through 1934, with only partial recovery since that time. The demand for agricultural lime is more stable than for other uses, and annual sales show comparatively small fluctuations as well as the lowest rates of gain or loss. In contrast, sales of refractory lime have the greatest proportional fluctuation and also the most rapid rates of increase or decrease, as shown by the slope of the curve from year to year.

PRODUCTION

As quicklime is a semiperishable commodity and most plants have only small storage facilities, stocks of lime in the hands of producers are never large. Hence, in this chapter, the tonnages of "open-market" lime sold or used are considered equivalent to production and are used interchangeably.

Production of all classes of lime, by major uses, increased over 1941 except building lime, for which a decline of 35 percent was recorded. The largest proportional gain was shown in the output of refractory lime (dead-burned dolomite). It is noteworthy that the production of hydrated lime declined in all of the major use categories and that the decline in total output of this type from 1941 was 19 percent. The production of quicklime increased in all principal uses except for building purposes, for which output slumped 38 percent below 1941.

Lime sold or used by producers in the United States, 1941–42, by types and major uses

	1941				1942				Percent of change in—	
	Quantity		Value [1]		Quantity		Value [1]			
	Short tons	Percent of total	Total	Average	Short tons	Percent of total	Total	Average	Tonnage	Average value
By types:										
Quicklime	4,489,257	74	$30,586,364	$6.81	4,810,452	79	$34,077,137	$7.08	+7	+4
Hydrated lime	1,590,159	26	12,354,798	7.77	1,293,339	21	10,290,304	7.96	−19	+2
Total lime [2]	6,079,416	100	42,941,162	7.06	6,103,791	100	44,367,441	7.27	-----	+3
By uses:										
Agricultural:										
Quicklime	161,063	3	866,721	5.38	184,678	3	950,374	5.15	+15	−4
Hydrated lime	221,664	3	1,520,324	6.86	215,953	4	1,568,579	7.26	−3	+6
	382,727	6	2,387,045	6.24	400,631	7	2,518,953	6.29	+5	+1
Building:										
Quicklime	285,271	4	2,593,799	9.09	175,643	3	1,644,316	9.36	−38	+3
Hydrated lime	780,328	13	6,665,319	8.54	522,034	8	4,528,889	8.68	−33	+2
	1,065,599	17	9,259,118	8.69	697,677	11	6,173,205	8.85	−35	+2
Chemical and industrial:										
Quicklime	2,973,036	49	18,014,672	6.06	3,220,774	53	20,664,813	6.42	+8	+6
Hydrated lime	588,167	10	4,169,155	7.09	555,352	9	4,192,836	7.55	−6	+6
	3,561,203	59	22,183,827	6.23	3,776,126	62	24,857,649	6.58	+6	+6
Refractory (dead-burned dolomite)	1,069,887	18	9,111,172	8.52	1,229,357	20	10,817,634	8.80	+15	+3

[1] Selling value, f. o. b. plant, excluding cost of containers.
[2] Includes lime used by producers (captive tonnage) as follows—1941: 499,062 short tons valued at $2,556,240; 1942: 427,635 tons, $2,239,152.

Lime sold or used by producers in the United States, 1941–42, by States

State	1941			1942		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	9	306,836	$1,705,558	9	330,552	$1,916,985
Arizona	3	58,146	413,095	4	59,033	439,817
Arkansas	2	(1)	(1)	2	(1)	(1)
California	9	122,375	1,168,767	9	83,399	905,923
Colorado	3	(1)	(1)	3	(1)	(1)
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	4	23,265	216,254	4	21,510	212,291
Georgia	1	12,515	85,325	1	10,824	68,323
Hawaii	1	8,681	137,195	1	8,863	140,762
Idaho	1	120	2,160			
Illinois	9	246,574	1,702,129	9	314,078	2,269,743
Indiana	3	106,407	588,879	3	102,757	608,656
Louisiana	2	(1)	(1)	1	(1)	(1)
Maine	2	(1)	(1)	2	(1)	(1)
Maryland	13	65,624	431,200	11	62,871	371,189
Massachusetts	6	106,336	1,007,773	6	87,537	757,109
Michigan	4	55,447	388,104	5	58,283	420,523
Minnesota	2	(1)	(1)	2	(1)	(1)
Missouri	11	736,200	4,106,468	10	853,020	4,915,784
Montana	2	(1)	(1)	2	(1)	(1)
Nevada	3	(1)	(1)	2	(1)	(1)
New Jersey	4	(1)	(1)	3	(1)	(1)
New Mexico	2	(1)	(1)	1	(1)	(1)
New York	5	62,339	463,230	4	68,443	552,411
North Carolina	1	(1)	(1)	1	(1)	(1)
Ohio	22	1,549,246	12,482,106	23	1,418,161	11,739,547
Oklahoma	3	(1)	(1)	3	(1)	(1)
Oregon	1	3,940	21,524	1	(1)	(1)
Pennsylvania	89	1,003,039	7,263,779	62	1,030,156	7,708,095
Puerto Rico	6	8,159	114,728	7	10,178	162,796
Rhode Island	1	(1)	(1)	1	(1)	(1)
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	10	239,528	1,354,642	10	269,566	1,620,585
Texas	9	77,783	632,099	8	67,377	559,279
Utah	9	56,221	352,306	6	57,609	392,912
Vermont	5	67,824	479,219	5	71,642	462,908
Virginia	25	224,293	1,359,281	25	206,420	1,367,043
Washington	4	62,309	656,363	3	55,864	623,766
West Virginia	10	372,677	2,350,362	8	422,481	2,879,509
Wisconsin	10	79,077	659,324	10	63,801	499,279
Undistributed [2]		424,455	2,799,292		369,366	2,772,206
	309	6,079,416	42,941,162	270	6,103,791	44,367,441

[1] Included under "Undistributed."

[2] By groups of States as follows—1941: Maine, Rhode Island, Connecticut, and New Jersey, 79,962 short tons valued at $639,559; North Carolina, Louisiana, Arkansas, and Oklahoma, 189,058 tons, $1,086,601; Minnesota and South Dakota, 63,655 tons, $486,436; Colorado, New Mexico, Montana, and Nevada, 91,780 tons, $586,696. 1942: Maine, Rhode Island, Connecticut, and New Jersey, 77,039 tons, $601,068; North Carolina, Louisiana, Arkansas, and Oklahoma, 102,282 tons, $802,873; Minnesota and South Dakota, 64,963 tons, $495,562; Colorado, New Mexico, Montana, Nevada, and Oregon, 125,082 tons, $872,703.

CAPTIVE TONNAGE

The lime industry, as defined by Bureau of Mines statistics, is limited as far as possible to operators who produce lime for sale to consumers. Captive tonnage of companies that produce lime for internal consumption is excluded with only a few exceptions. Hence the annual review figures are confined largely to "open-market" lime sold under competitive conditions. However, to obtain complete data on quantities of lime consumed for certain uses that are not covered by other Bureau of Mines statistics, it is necessary to include some captive tonnage. In 1942 the captive tonnage contained in the lime figures totaled 427,635 short tons valued at $2,239,152. This total comprised 11,429 tons of lime for making prepared masonry mortars, 312,557 tons for metallurgical uses (of which approximately half was for steel manufacture and half for ore concentration), 16,864 tons for miscellaneous chemical uses, and 86,785 tons of refractory lime. The

approximate total consumption of lime in alkali, carbide, glass, magnesia (85 percent), paper, and sugar manufacture may be ascertained by combining the "open-market" lime figures for these uses with the statistics (after allowances for calcining loss) on similar uses for limestone in the Stone chapter of Minerals Yearbook. The figures in the Stone chapter include limestone used to make captive lime but exclude the stone used to produce "open-market" lime.

PRODUCTION BY STATES

The first year of war effected sharp changes in the location of production of lime from 1941. The record output of 1942 was obtained from 270 plants in 37 States and 2 Territories; production increased in 16 States and 2 Territories and declined in 21 States from 1941. No production was reported for Idaho in 1942. The ranking producing States, in order of tonnage, were Ohio, Pennsylvania, Missouri, and West Virginia, which together supplied 61 percent of the total. Although the slump in building lime had a marked effect on production in Ohio, the strong demand for refractory and chemical lime offset the loss in part, and output declined only 8 percent from 1941. Production in the other 3 ranking States that are large producers of chemical lime was greater than in 1941.

In 1942 only 270 plants were active compared with 309 in 1941. Nearly all the plants forced to close by labor, price, or other reasons directly attributable to the war were small producers. The greatest number closed in Pennsylvania, in which 27 plants ceased operating either temporarily or permanently.

PRODUCTION BY USES

In 1942 the largest gains over 1941 in tonnages of lime consumed in the principal uses were recorded for metallurgical and refractory (dead-burned dolomite) purposes and for the manufacture of calcium carbide.

In this chapter, data on the production of lime for its many uses are presented in one table, whereas in former annual reviews the figures were listed in two tables, one for the major uses and a second for miscellaneous uses of chemical and industrial lime.

Lime and other liming materials used in agriculture.—Although production of lime for agricultural purposes gained 5 percent over 1941, the increase was in much smaller proportion than that reported for cash farm income. The output in Pennsylvania, the State with the largest production for agriculture, declined 3 percent from 1941, owing doubtless to closing of a large number of the small plants because of labor shortages.

In the markets for liming materials, lime lost further ground to ground limestone or "agstone," production of which increased 15 percent over 1941. Of the other materials, the output in 1942 of crushed oyster shells declined slightly and that of marl increased somewhat compared with 1941.

Lime sold or used by producers in the United States, 1941–42, by uses

Use	1941			1942		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	382,727	$2,387,045	$6.24	400,631	$2,518,953	$6.29
Building:						
Finishing lime	452,522	4,205,669	9.29	281,227	2,688,734	9.56
Mason's lime	464,564	3,808,074	8.20	295,037	2,536,952	8.60
Prepared masonry mortars	64,572	416,829	6.46	51,303	362,745	7.07
Unspecified	83,941	828,546	9.87	70,110	584,774	8.34
	1,065,599	9,259,118	8.69	697,677	6,173,205	8.85
Chemical and industrial:						
Acid neutralization	1,739	14,222	8.18	5,181	30,124	5.81
Alkalies (ammonium, potassium, and sodium compounds)	(1)	(1)	(1)	7,336	51,198	6.98
Asphalts and other bitumens	2,743	23,112	8.43	706	5,592	7.92
Bleach, liquid and powder [2]	14,687	100,579	6.85	13,161	97,810	7.43
Brick, sand-lime and slag	21,503	156,081	7.26	20,550	166,779	8.12
Brick, silica (refractory)	24,966	168,819	6.76	17,507	135,537	7.74
Calcium carbide and cyanamide	[3] 136,238	[3] 705,333	[3] 5.18	202,518	1,114,447	5.50
Calcium carbonate, precipitated	[3] 5,790	[3] 48,071	[3] 8.30	(1)	(1)	(1)
Chromates and bichromates	18,277	108,649	5.94	20,538	130,902	6.37
Coke and gas (gas purification and plant by-products)	22,011	139,499	6.34	17,629	112,355	6.37
Food products:						
Creameries and dairies	1,171	19,877	16.97	1,427	19,721	13.82
Gelatin	4,846	32,718	6.75	7,223	56,083	7.76
Other [4]	887	7,658	8.63	8,952	80,852	9.03
Glasswork	184,559	1,253,700	6.79	190,580	1,402,674	7.36
Glue	12,005	83,580	6.96	7,886	52,224	6.62
Grease, lubricating	4,001	34,787	8.69	4,996	43,309	8.67
Insecticides, fungicides, and disinfectants	81,955	587,567	7.17	66,332	507,730	7.65
Magnesia (85 percent)	51,256	373,999	7.30	24,635	166,663	6.77
Medicines and drugs	(1)	(1)	(1)	6,021	35,479	5.89
Metallurgy:						
Nonferrous smelter flux	[3] 4,998	[3] 41,114	[3] 8.23	3,956	39,842	10.07
Steel (open-hearth and electric furnace flux)	1,051,851	6,179,270	5.87	1,171,082	7,508,445	6.41
Ore concentration [5]	[3] 230,748	[3] 1,332,808	[3] 5.78	318,436	1,942,098	6.10
Wire drawing	7,025	54,355	7.74	9,065	70,274	7.75
Other [6]	72,277	462,633	6.40	74,058	529,664	7.15
Paints	45,513	258,298	5.68	14,281	107,429	7.52
Paper mills [7]	677,116	4,234,772	6.25	606,440	4,049,884	6.68
Petroleum refining	34,696	252,010	7.26	30,944	267,120	8.63
Polishing compounds	3,922	97,987	24.98	758	20,836	27.49
Rubber manufacture	3,058	22,346	7.31	1,381	10,049	7.28
Salt refining	1,956	12,593	6.44	4,113	25,604	6.23
Sewage and trade-wastes treatment	38,256	245,115	6.41	25,758	177,651	6.90
Soap and fat	(1)	(1)	(1)	6,673	34,676	5.20
Sugar refining	23,169	248,602	10.73	27,655	315,127	11.39
Tanneries	93,157	649,002	6.97	78,746	549,828	6.98
Textiles	1,091	8,210	7.53	871	7,352	8.44
Tobacco	(1)	(1)	(1)	6,858	38,865	5.67
Varnish	864	5,888	6.81	311	2,689	8.65
Water purification	319,244	2,072,807	6.49	335,877	2,327,177	6.93
Wood distillation	2,557	24,106	9.43	2,901	28,622	9.87
Undistributed [8]	156,119	777,442	4.98	31,709	221,665	6.99
Unspecified	204,952	1,346,218	6.57	401,075	2,373,273	5.92
	3,561,203	22,183,827	6.23	3,776,126	24,857,649	6.58
Refractory lime (dead-burned dolomite)	1,069,887	9,111,172	8.52	1,229,357	10,817,634	8.80
Total lime [9]	6,079,416	42,941,162	7.06	6,103,791	44,367,441	7.27
Hydrated lime included in above distribution	1,590,159	12,354,798	7.77	1,293,339	10,290,304	7.96

[1] Included under "Undistributed."
[2] Excludes bleach used in paper mills.
[3] Revised figures.
[4] Includes chocolate, cocoa, fruit juices, phosphate baking powders, and unspecified food products.
[5] Includes flotation, cyanidation, bauxite purification, and magnesium manufacture.
[6] Includes mold coating and unspecified.
[7] Includes bleach used in paper mills.
[8] Includes acids (unspecified), alcohol, bromine, calcium phosphate, cement manufacture, chloropicrin, explosives, glycerin, nicotine, photographic supplies, poultry feed, retarder, rock wool, Spanish whiting, starfish control, sulfur, and wool pullers.
[9] Includes lime used by producers (captive tonnage) as follows—1941: 499,062 tons, valued at $2,556,240; 1942: 427,635 tons, $2,239,152.

Lime sold or used by producers in the United States in 1942, by States and uses

State or Territory	Agricultural		Building		Chemical and industrial										Refractory		Total	
					Metallurgical		Paper mills		Tanneries		Water purification		Other					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	41,261	$273,358	175,026	$940,521	82,377	$488,388	(1)	(1)	6,206	$52,469	(1)	(1)	(1)	(1)	330,552	$1,916,985
Arizona	(1)	(1)	(1)	(1)	50,965	348,618					(1)	(1)	(1)	(1)			59,033	439,817
Arkansas			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
California	526	$4,751	20,467	249,556	29,941	300,212	(1)	(1)	(1)	(1)	5,743	52,027	23,768	$267,661			83,399	905,923
Colorado	(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Connecticut	(1)	(1)	(1)	(1)			(1)	(1)									(1)	(1)
Florida	(1)	(1)	4,713	46,734			(1)	(1)			7,770	73,998	8,641	88,591			21,510	212,291
Georgia	3,864	19,167	6,960	49,156													10,824	68,323
Hawaii			871	14,888									7,992	125,874			8,863	140,762
Illinois	439	2,877	13,032	124,521	133,190	799,665	13,314	76,989	11,700	$82,550	23,894	168,934	(1)	(1)	(1)	(1)	314,078	2,269,743
Indiana	(1)	(1)	6,155	42,345	(1)	(1)	12,782	74,353	(1)	(1)	14,584	89,431	49,016	273,019			102,757	608,656
Louisiana			(1)	(1)			(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
Maine	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Maryland	52,012	299,484	(1)	(1)							(1)	(1)	(1)	(1)			62,871	371,189
Massachusetts	7,682	54,787	29,481	291,383	(1)	(1)	9,878	78,781	9,670	73,737	4,233	33,447	(1)	(1)			87,537	757,109
Michigan	(1)	(1)	1,023	8,263	(1)	(1)	(1)	(1)	(1)	(1)	4,868	37,230	13,082	100,196			58,283	420,523
Minnesota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Missouri			41,130	273,498	151,139	793,904	(1)	(1)	(1)	(1)	89,488	529,257	427,139	2,264,495	(1)	(1)	853,020	4,915,784
Montana			(1)	(1)	(1)	(1)							(1)	(1)			(1)	(1)
Nevada	(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)			(1)	(1)
New Jersey	(1)	(1)	(1)	(1)									(1)	(1)			(1)	(1)
New Mexico			(1)	(1)													(1)	(1)
New York	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			68,443	552,411
North Carolina	(1)	(1)	(1)	(1)													(1)	(1)
Ohio	27,416	184,864	291,951	2,548,711	107,677	649,995	35,437	214,463			(1)	(1)	(1)	(1)	691,823	$6,289,116	1,418,161	11,739,547
Oklahoma	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
Oregon	(1)	(1)	(1)	(1)													(1)	(1)
Pennsylvania	184,663	1,242,281	59,918	538,979	415,901	2,908,349	75,277	542,524	(1)	(1)	23,324	189,952	(1)	(1)	(1)	(1)	1,030,156	7,708,095
Puerto Rico	(1)	(1)	5,284	84,548							(1)	(1)	4,836	77,148			10,178	162,796
Rhode Island	(1)	(1)	(1)	(1)									(1)	(1)			(1)	(1)
South Dakota			(1)	(1)	(1)	(1)											(1)	(1)
Tennessee	(1)	(1)	20,960	166,740	48,750	265,205	110,059	622,937	(1)	(1)	14,861	93,814	67,546	423,738			269,566	1,620,585
Texas	(1)	(1)	21,189	191,958	8,277	58,604	7,166	47,531	(1)	(1)	19,955	161,105	10,470	96,729	(1)	(1)	67,377	559,279
Utah			6,199	73,479	(1)	(1)					329	4,664	(1)	(1)			57,609	392,912
Vermont	(1)	(1)	(1)	(1)	1,837	13,718	20,430	166,623	(1)	(1)	(1)	(1)	(1)	(1)			71,642	462,908
Virginia	27,883	186,190	19,973	139,908	60,861	389,286	18,943	124,693	1,399	8,812	22,770	167,068	54,591	351,086			206,420	1,367,043
Washington	(1)	(1)	(1)	(1)	(1)	(1)	21,943	231,308			(1)	(1)	(1)	(1)			55,864	623,766
West Virginia	27,687	114,555	4,415	30,067	164,102	1,062,110	(1)	(1)	(1)	(1)	7,099	44,522	(1)	(1)	(1)	(1)	422,481	2,879,509
Wisconsin	(1)	(1)	18,372	154,680	133	1,330	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			63,801	499,279
Undistributed [2]	68,459	409,997	84,323	870,433	228,798	1,556,806	198,834	1,381,294	55,977	384,729	90,753	629,259	511,385	3,771,900	537,534	4,528,518	369,366	2,772,206
	400,631	2,518,953	697,677	6,173,205	1,576,597	10,090,323	606,440	4,049,884	78,746	549,828	335,877	2,327,177	1,178,466	7,840,437	1,229,357	10,817,634	6,103,791	44,367,441

[1] Included under "Undistributed."

[2] Includes items entered as (1).

Agricultural lime and other liming materials sold or used by producers in the United States, 1941–42, by kinds

Kind	1941				1942			
	Short tons		Value		Short tons		Value	
	Gross	Effective lime content [1]	Total	Average	Gross	Effective lime content [1]	Total	Average
Lime:								
Quicklime	161,063	136,900	$866,721	$5.38	184,678	156,980	$950,374	$5.15
Hydrated lime	221,664	155,170	1,520,324	6.86	215,953	151,170	1,568,579	7.26
Oyster shells (crushed) [2]	119,079	55,970	424,096	3.56	[3] 111,350	[3] 52,340	[3] 474,119	[3] 4.26
Limestone	11,909,640	5,597,530	14,395,831	1.21	13,745,400	6,460,340	16,993,254	1.24
Calcareous marl	183,009	76,860	175,393	.96	194,878	81,850	135,046	.69

[1] Effective lime contents as follows: Quicklime, 85 percent; hydrated lime, 70 percent; limestone and oyster shells, 47 percent; calcareous marl, 42 percent.
[2] Figures supplied by Fish and Wildlife Service.
[3] Preliminary figure.

Building lime.—Production of lime for all building purposes declined sharply from 1941. The degree of slump, however, was more marked for finishing and mason's lime than in lime used to make prepared masonry mortars.

Chemical and industrial lime.—Of the principal chemical uses of lime, only the paper, tannery, and insecticide, fungicide, and disinfectant uses required less lime than in 1941. In paper, the decline resulted from reduced activity in that industry owing primarily to a shortage of wood for pulping.

HYDRATED LIME

Production of hydrated lime had increased each year from 1938 through 1941, but the output in 1942 was sharply lower than in 1941. The degree of change was much more severe than that customarily shown in year-to-year fluctuations in demand for hydrated lime.

The 1942 output of hydrated lime was obtained from 165 active plants in 35 States and 2 Territories; production increased over 1941 in 10 States and 2 Territories, decreased in 20 States, and was relatively unchanged in 3 States. In 1942 no production was reported in South Dakota, and the manufacture of the hydrate was started in Louisiana and Oregon. Ranking States, in order of tonnage, were Ohio, Pennsylvania, and Missouri, which together supplied 58 percent of the total.

Uses.—Consumption of hydrated lime was lower in all its principal uses except water purification.

TRENDS IN PRINCIPAL USES

Trends in major uses of lime in the 1922–42 period are shown in figure 1 and discussed earlier in this chapter. Figure 2 illustrates clearly the marked changes effected by the war on the percentage distribution of lime in its major uses in 1942 from 1941 and also the more pronounced long-term changes from the 1925–29 period.

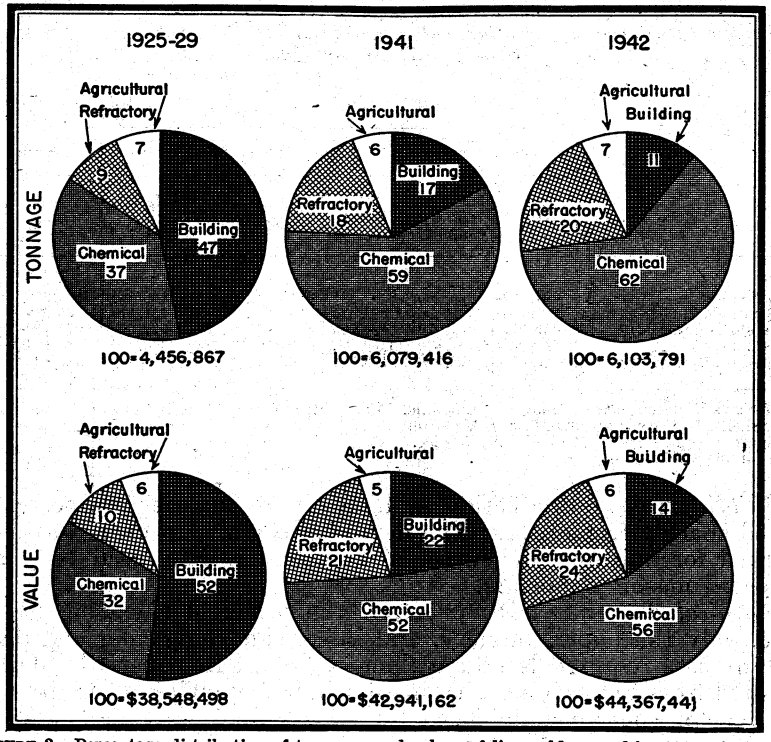

FIGURE 2.—Percentage distribution of tonnages and values of lime sold or used in 1925-29 (averages), 1941, and 1942, by major uses.

Hydrated lime sold or used by producers in the United States, 1941–42, by States

State	1941			1942		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	7	31,370	$224,609	8	25,575	$209,270
California	7	25,540	261,622	8	30,367	333,578
Florida	4	12,214	119,713	4	11,295	120,044
Georgia	1	9,748	70,755	1	7,420	52,810
Hawaii	1	8,665	136,475	1	8,823	138,962
Illinois	6	39,496	282,634	6	31,366	234,242
Indiana	3	24,645	158,618	3	21,419	145,486
Maryland	5	24,826	169,349	5	28,767	181,602
Massachusetts	5	41,166	321,515	5	41,154	322,626
Michigan	4	14,464	107,493	3	7,835	59,762
Missouri	10	179,425	1,054,833	9	184,866	1,134,640
New York	3	16,784	112,176	3	17,686	132,596
Ohio	16	539,939	4,661,687	16	356,265	2,979,928
Pennsylvania	23	250,733	1,955,757	19	213,475	1,744,061
Puerto Rico	(1)	(1)	(1)	4	5,248	81,557
South Dakota	1	698	7,393			
Tennessee	8	45,304	348,539	8	42,434	322,088
Texas	6	27,415	262,349	6	23,355	225,039
Virginia	16	74,810	486,488	16	62,453	443,049
Washington	3	10,803	96,474	(1)	(1)	(1)
West Virginia	6	48,028	254,156	5	34,473	213,452
Other States [2]	31	164,086	1,262,163	35	139,063	1,215,512
	166	1,590,159	12,354,798	165	1,293,339	10,290,304

[1] Included under "Other States."

[2] By groups of States as follows—1941: Maine (2 active plants), Vermont (2), Rhode Island (1), Connecticut (1), and New Jersey (2), 57,663 short tons valued at $407,308; North Carolina, (1), Puerto Rico (1), Arkansas (2), and Oklahoma (3), 28,195 tons, $255,568; Wisconsin (6) and Minnesota (2), 24,912 tons, $192,551; and Colorado (1), Utah (2), Arizona (2), Nevada (2), and Montana (1), 53,316 tons, $406,736. 1942: Maine (2), Vermont (2), Rhode Island (1), Connecticut (1), and New Jersey (3), 53,086 tons, $381,529; North Carolina (1), Louisiana (1), Arkansas (2), and Oklahoma (3), 31,374 tons, $294,885; Wisconsin (7) and Minnesota (2), 22,776 tons, $173,587; Colorado (1), Utah (2), and Arizona (2), 12,130 tons, $157,508; and Nevada (1), Montana (1), Washington (2), and Oregon (1), 19,697 tons, $208,003.

Hydrated lime sold or used by producers in the United States, 1941–42, by uses

Use	1941			1942		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	221,664	$1,520,324	$6.86	215,953	$1,568,579	$7.26
Building	780,328	6,665,319	8.54	522,034	4,528,889	8.68
Chemical and industrial:						
Brick, sand-lime and slag	(1)	(1)	(1)	4,220	35,158	8.33
Brick, silica	(1)	(1)	(1)	9,368	78,608	8.39
Food products	(1)	(1)	(1)	10,133	94,663	9.34
Glass	2,501	16,163	6.46	3,869	27,432	7.09
Insecticides	(1)	(1)	(1)	48,489	379,919	7.84
Metallurgy	61,174	392,203	6.41	27,619	250,957	9.09
Paints	(1)	(1)	(1)	4,369	36,857	8.44
Paper mills	47,098	312,470	6.63	26,581	186,012	7.00
Petroleum	(1)	(1)	(1)	25,669	234,865	9.15
Sewage	(1)	(1)	(1)	9,898	70,252	7.10
Sugar	17,611	199,186	11.31	15,355	193,740	12.62
Tanneries	44,484	324,048	7.28	42,892	304,901	7.11
Water purification	158,560	1,108,885	6.99	170,164	1,267,167	7.45
Other uses	256,739	1,816,200	7.07	156,726	1,032,305	6.59
	588,167	4,169,155	7.09	555,352	4,192,836	7.55
Total hydrated lime	1,590,159	12,354,798	7.77	1,293,339	10,290,304	7.96

[1] Included under "Other uses."

The fairly close correlation of refractory lime with steel-ingot production in the 1932–42 period is presented in figure 3. The discordance in recent years between the metallurgical-lime and steel-production curves results partly from increased consumption of lime in the Bayer alumina process and partly from increasing requirements per ton of steel owing to the lower quality of scrap used and the wider use of ore in place of scrap.

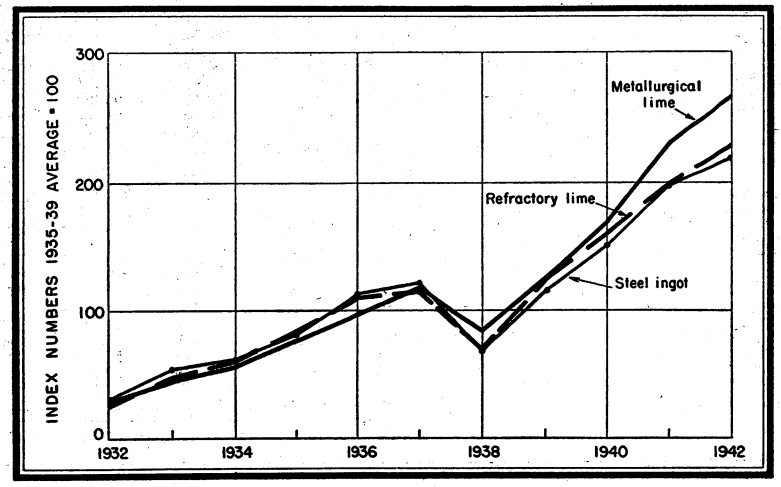

FIGURE 3.—Indicated annual consumption of metallurgical and refractory lime compared with steel production, 1932–42. (Index numbers of steel production by Federal Reserve Board.)

SHIPMENTS

TOTAL SHIPMENTS

The accompanying tables show supplies of lime available, by States and shipments, from and into groups of States that comprise approximate freight-rate zones.

HYDRATED LIME

Distribution of hydrated lime into groups of States from all producing plants and from all Ohio plants are listed in the adjoining table.

Lime supplies available in continental United States in 1942, by States, in short tons

State	Sales by producers	Shipments from State [1]	Shipments into State	Supply		
				Quicklime	Hydrated lime	Total
Alabama	330,552	80,376	49,771	288,383	11,564	299,947
Arizona	59,033	15,577	1,418	41,971	2,903	44,874
Arkansas	(2)	(2)	(2)	36,823	5,253	42,076
California	83,399	10,781	26,854	66,651	32,821	99,472
Colorado	(2)	(2)	(2)	40,564	4,179	44,743
Connecticut	(2)	(2)	(2)	21,347	14,859	36,206
Delaware			52,887	37,349	15,538	52,887
District of Columbia			15,814	5,741	10,073	15,814
Florida	21,510		36,650	38,809	19,351	58,160
Georgia	10,824	1,312	67,256	53,880	22,888	76,768
Idaho			2,134	557	1,577	2,134
Illinois	314,078	127,568	253,011	361,594	77,927	439,521
Indiana	102,757	81,515	183,017	172,161	32,098	204,259
Idaho			54,107	41,080	13,027	54,107
Kansas			30,733	14,499	16,234	30,733
Kentucky			163,391	150,213	13,178	163,391
Louisiana	(2)	(2)	(2)	82,270	16,801	99,071
Maine	(2)	(2)	(2)	64,768	10,659	75,427
Maryland	62,871	16,246	123,740	117,632	52,733	170,365
Massachusetts	87,537	56,912	53,626	48,634	35,617	84,251
Michigan	58,283	22,632	167,334	151,497	51,488	202,985
Minnesota	(2)	(2)	(2)	84,516	11,811	96,327
Mississippi			10,520	5,864	4,656	10,520
Missouri	853,020	562,124	13,363	214,463	89,796	304,259
Montana	(2)	(2)	(2)	26,600	2,753	29,353
Nebraska			8,215	2,140	6,075	8,215
Nevada	(2)	(2)	(2)	33,926	1,087	35,013
New Hampshire			8,518	6,099	2,419	8,518
New Jersey	(2)	(2)	(2)	56,148	92,002	148,150
New Mexico	(2)	(2)	(2)	13,699	1,569	15,268
New York	68,443	9,469	331,087	293,980	96,081	390,061
North Carolina	(2)	(2)	(2)	60,657	28,668	89,325
North Dakota			12,878	436	12,442	12,878
Ohio	1,418,161	895,741	139,638	567,154	94,904	662,058
Oklahoma	(2)	(2)	(2)	26,588	17,097	43,685
Oregon	(2)	(2)	(2)	16,332	5,592	21,924
Pennsylvania	1,030,156	387,904	512,720	974,894	180,078	1,154,972
Rhode Island	(2)	(2)	(2)	6,039	5,323	11,362
South Carolina			23,763	14,364	9,399	23,763
South Dakota	(2)	(2)	(2)	3,233	1,723	4,956
Tennessee	269,566	234,058	8,665	23,735	20,438	44,173
Texas	67,377	12,836	8,519	39,974	23,086	63,060
Utah	57,609	940	1,820	51,669	6,820	58,489
Vermont	71,642	40,509	393	30,771	755	31,526
Virginia	206,420	141,299	72,048	94,357	42,812	137,169
Washington	55,864	17,887	2,428	34,509	5,896	40,405
West Virginia	422,481	387,456	183,325	202,244	16,106	218,350
Wisconsin	63,801	29,331	59,400	67,649	26,221	93,870
Wyoming			1,078	131	947	1,078
Undistributed [3]	369,366	95,501	519,021			
	6,084,750	3,227,974	3,199,142	4,788,594	1,267,324	6,055,918

[1] Includes 28,832 tons unclassified as to destination.
[2] Included under "Undistributed."
[3] Includes items entered as "(2)."

Lime shipped (supply) in continental United States in 1942, by origin and destination of shipments, in short tons

Destination	Origin														
	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Rhode Island, Vermont			Florida, Georgia, North Carolina, Virginia			Alabama, Louisiana, Tennessee		
	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total
Illinois, Indiana, Michigan, Ohio	949, 587	200. 022	1, 149, 609	47, 355	6, 128	53, 483	132	1	133	10, 623	1, 747	12, 370	704	1, 329	2, 033
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	370, 808	117, 141	487, 949	1, 152, 755	301, 961	1, 454, 716	26, 057	16, 449	42, 506	89, 895	21, 793	111, 688	23, 052	1, 195	24, 247
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	9, 359	17, 742	27, 101	55, 319	4, 988	60, 307	112, 630	46, 343	158, 973	350	264	614	-------	-------	-------
Florida, Georgia, North Carolina, South Carolina, Virginia	6, 481	29, 661	36, 142	28, 362	9, 897	38, 259	200	18	218	57, 181	55, 098	112, 279	157, 027	27, 288	184, 315
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	61, 018	15, 626	76, 644	37	187	224	-------	7	7	-------	1, 186	1, 186	351, 928	35, 575	387, 503
Arkansas, Kansas, Nebraska, Oklahoma, Texas	1, 125	2, 414	3, 539	-------	50	50	-------	-------	-------	-------	-------	-------	87	-------	87
Iowa, Minnesota, Missouri, Wisconsin	68, 663	25, 184	93, 847	-------	5	5	-------	-------	-------	-------	43	43	-------	-------	-------
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	3, 559	8, 721	12, 280	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Lime shipped (supply) in continental United States in 1942, by origin and destination of shipments, in short tons—Continued

Destination	Origin											
	Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington			United States		
	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total
Illinois, Indiana, Michigan, Ohio	----------	132	132	244,005	47,058	291,063	----------	----------	----------	1,252,406	256,417	1,508,823
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	----------	12	12	25,421	4,060	29,481	----------	----------	----------	1,687,988	462,611	2,150,599
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	----------	----------	----------	----------	295	295	----------	----------	----------	177,658	69,632	247,290
Florida, Georgia, North Carolina, South Carolina, Virginia	----------	520	520	12,816	636	13,452	----------	----------	----------	262,067	123,118	385,185
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	28,435	5,931	34,366	109,047	8,125	117,172	----------	----------	----------	550,465	66,637	617,102
Arkansas, Kansas, Nebraska, Oklahoma, Texas	83,569	41,403	124,972	35,243	23,878	59,121	----------	----------	----------	120,024	67,745	187,769
Iowa, Minnesota, Missouri, Wisconsin	687	662	1,349	338,358	114,961	453,319	----------	----------	----------	407,708	140,855	548,563
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	1,087	1,644	2,731	5,128	8,629	13,757	320,504	61,315	381,819	330,278	80,309	410,587

Shipments of hydrated lime from plants in continental United States and in Ohio in 1942, 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	256,417	20	156,412	44	61
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	462,611	36	116,224	33	25
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	69,632	6	17,742	5	25
Florida, Georgia, North Carolina, South Carolina, Virginia	123,118	10	29,661	8	24
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	66,637	5	11,552	3	17
Arkansas, Kansas, Nebraska, Oklahoma, Texas	67,745	5	2,414	1	4
Iowa, Minnesota, Missouri, Wisconsin	140,855	11	13,464	4	10
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	80,309	6	8,602	2	11
Undistributed	11,944	1	194	(1)	2
	1,279,268	100	356,265	100	28

[1] Less than 0.1 percent.

PRICES

Average values for total sales of building quicklime are higher than for building hydrate, an anomalous condition compared with values of types of agricultural and chemical lime. This condition results principally from the rather widespread use of the relatively higher-priced pulverized quicklime in building. It also is noteworthy that some producers in nearly all sections of the country generally obtain a higher price for bulk quicklime than for bulk hydrate for all uses, although the most common practice is to set a higher value on the hydrate.

NEW DEVELOPMENTS

A new type [1] of limekiln designed to calcine small sizes of stone was introduced in 1942.

Descriptions [2] of the properties and methods of manufacture of dead-burned, stabilized, and enriched dolomite-base refractories were published.

PLANT CAPACITY

In 1942 about 72 percent of total capacity (based upon a 300-operating-day year) was used in the country. Data on capacities of calcining equipment (excluding obsolete units) are listed in the following table, by types and districts.

[1] Ellerbeck, T. R., Vertical Kiln of New Design Calcines Smaller Sizes of Crushed Limestone: Pit and Quarry, vol. 34, No. 11, May 1942, pp. 55–58.

[2] Schallis, Alvin, Dolomite-Base Refractories: Bureau of Mines Inf. Circ. 7227, 1942, 11 pp.

Capacities and number of kilns in active lime plants in the United States in 1942, by types and status of kilns and by districts

District	Active plants	Pot kilns				Shaft kilns				Rotary kilns				Total capacity per 24-hour day		
		Active		Inactive		Active		Inactive		Active		Inactive				
		Number	Capacity [1] (short tons)	Number	Capacity [1] (short tons)	Number	Capacity [1] (short tons)	Number	Capacity [1] (short tons)	Number	Capacity [1] (short tons)	Number	Capacity [1] (short tons)	Active (short tons)	Inactive (short tons)	Total (short tons)
Maine, Rhode Island, and Connecticut	4					18	281	10	122					281	122	403
Massachusetts, Vermont, and New York	14	(2)	(2)	(3)	(3)	[4] 50	[4] 557	[5] 23	[5] 262	10	620			1,177	262	1,439
Pennsylvania and New Jersey	65	154	687	18	76	99	1,156	12	127	[6] 17	[6] 1,817			3,660	203	3,863
Maryland	11	[7] 62	[7] 584	12	92	(8)	(8)							584	92	676
Virginia	25	20	218	(3)	(3)	71	729	[5] 18	[5] 301					947	301	1,248
North Carolina, Georgia, and Florida	6					21	132	7	54					132	54	186
Alabama	9					[9] 56	[9] 1,245	6	[10] 115	(2)	(2)	(3)	(3)	1,245	115	1,360
Tennessee and West Virginia	18	23	319	(3)	(3)	67	936	[5] 13	[5] 179	9	982			2,237	179	2,416
Ohio	23					275	2,969	100	945	21	2,465			5,434	945	6,379
Michigan, Indiana, and Illinois	17					41	736	16	285	10	715			1,451	285	1,736
Wisconsin, Minnesota, and South Dakota	14	(2)	(2)	(3)	(3)	[4] [9] 32	[4] [9] 554	[5] 31	[5] 369	(2)	(2)			554	369	923
Missouri	10					61	1,385	[10] 5	[10] 165	8	1,260	(3)	(3)	2,645	165	2,810
Arkansas, Oklahoma, Louisiana, and Texas	14					[9] 40	[9] 1,108	12	195	(2)	(2)			1,108	195	1,303
Colorado, New Mexico, Arizona, Utah, Nevada, and Montana	18	5	36			49	549	8	80	7	415			1,000	80	1,080
California, Oregon, and Washington	[11] 13	8	64			28	280	8	132	7	436			780	132	912
Hawaii and Puerto Rico	8	(2)	(2)			[4] 16	[4] 178							178		178
Summary	[11] 269	280	1,953	60	608	902	11,763	[10] 239	[10] 2,891	103	9,697	(3)	(3)	23,413	3,499	26,912

[1] Expressed as output of quicklime per 24-hour day.
[2] Included with data on active shaft kilns.
[3] Included with data on inactive shaft kilns.
[4] Includes data on active pot kilns.
[5] Includes data on inactive pot kilns.
[6] Includes data on active sintering machines.
[7] Includes data on active shaft kilns.
[8] Included with data on active pot kilns.
[9] Includes data on active rotary kilns.
[10] Includes data on inactive rotary kilns.
[11] A plant in California with only hydrating equipment is not included in this total

SIZE OF PLANTS

There has been a strong trend toward larger lime plants, as is shown by comparison of data on size groups in 1942, the year of record production, with those in 1925, the preak production year of the 1920's. In all groups under 25,000 tons, both the number of plants and the percentage of total output from each group declined sharply. The number of plants in all groups over 25,000 tons increased, and the percentage of total output increased for each group except the group 50,000 and less than 100,000 tons. The largest gain in percentage of total production was in the group over 100,000. The marked decline in total number of plants from 1925 took place entirely in the groups under 25,000 tons. These data on size of lime plants are not comparable with those on companies and plants published in these chapters in recent years. The earlier studies are based only upon size of companies.

Distribution of lime (including refractory) plants in 1925 and 1942, according to size of production

Size group (short tons)	1925			1942		
	Plants	Production		Plants	Production	
		Short tons	Percent of total		Short tons	Percent of total
Less than 1,000	172	40,054	1	48	17,844	
1,000 and less than 5,000	86	246,433	5	72	195,265	3
5,000 and less than 10,000	65	478,336	10	28	192,497	3
10,000 and less than 25,000	81	1,230,411	27	49	802,353	13
25,000 and less than 50,000	24	805,807	18	39	1,383,782	23
50,000 and less than 100,000	19	1,398,246	31	21	1,441,995	24
100,000 and over	3	381,536	8	13	2,070,055	34
	450	4,580,823	100	270	6,103,791	100

FOREIGN TRADE

Because of wartime restrictions, no figures on imports and exports can be published. However, foreign trade of the United States in lime has a negligible effect on the domestic industry.

Imports.—During the 1935–39 period, annual imports of lime (including dead-burned dolomite) averaged 14,108 short tons valued at $240,909. This represents only 0.4 percent of average annual domestic production of 3,692,397 tons during 1935–39. In 1940, the last year for which data are complete, 9,205 tons of lime valued at $81,888 were imported or only 0.2 percent of domestic output. The principal volume of imports is from British Columbia, Canada, into the the Pacific Coast States, a flow in 1940 that comprised 98 percent of the total. Imports increased in 1941 and for the January-September period were at a monthly rate of 1,018 tons, which was 33 percent above the rate (767 tons) of 1940. Imports doubtless increased in 1942 over 1941, owing to shortages of lime on the West Coast, which were overcome by bringing in Canadian material.

Exports.—Annual exports of lime in the 1935–39 period averaged 10,905 tons valued at $123,167—a volume that represented only 0.3 percent of the average annual domestic production of 3,692,397

tons during the same period. During 1940 a new record of 31,912 tons (0.7 percent of domestic output of lime) was exported. The volume of exports increased further in 1941 and for the January-September period was at a monthly rate of 3,605 tons—a 36-percent gain over the monthly rate (2,659 tons) of 1940. Exports in 1942 undoubtedly advanced over 1941 owing to expanding markets in the Latin American countries and in eastern Canada.

CLAYS

By G. W. Josephson and A. Linn [1]

SUMMARY OUTLINE

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GENERAL SUMMARY

The reaction of the various segments of the clay industry to wartime conditions emphasizes the fact that, although there is considerable overlapping in many fields, the physical properties of the various clays have enabled each clay to dominate one or more specialized markets. Production of some clays increased while others decreased, depending on the extent to which each contributed to an increasingly military economy. Shipments of fire clay have nearly doubled since 1940, and even those clays that declined from 1941 held at levels comparing favorably with recent peacetime years. Over-all, 4 percent more merchant clay was shipped in 1942 than in 1941.

As clays are available in more than ample quantities, no restrictions in their use were imposed by the War Production Board; in fact, their application as substitute materials was encouraged. Many examples of such substitute products appeared, but the total consumption of clay in them was insignificant.

The restrictions felt by the clay industry were those that developed from wartime shortages in such things as metals, equipment, and labor. Only fire clay was regarded as critical enough to warrant granting special priority ratings for repair and expansion programs. As time went on, labor became increasingly scarce. In isolated instances plants reported that they could not maintain sufficient production to fill all orders; but, in general, reduced crews met the sales demand. Shortages of hardware, plumbing, and lumber led to allocations of available supplies to war construction and discouraged a general private-building program. Transportation was a problem in many areas. Under the stress of accumulated difficulties, a few plants suspended operation for the duration of the war; but the great majority, although granted no advantages, found ways of solving their problems and maintained production.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce. Domestic figures for fuller's earth compiled by R. W. Metcalf, of the Bureau of Mines.

Prices of all clays were under the jurisdiction of the Office of Price Administration. The General Maximum Price Regulation froze prices at the maximum levels of March 1942. Many producers complained that various expenses, such as costs of labor, transportation, and repair parts, had risen since their prices were established, and a few petitioned the Office of Price Administration for relief. Some of the cases were under consideration at the end of the year, but none had been approved.

Foreign trade in clays was reduced materially during 1942. Imports consisted principally of kaolin and ball clay from the United Kingdom, and exports (which totaled 193,199 tons) were 61 percent fire clays.

Interest in clay as an ore of aluminum reached a point at which large sums of money were expended by both private concerns and Government agencies in research and exploration programs. This development may prove to have primary importance in the future, although many obstacles must be overcome before clays will be able to compete with bauxite upon an equal basis.

Bureau of Mines statistics reported in this chapter are limited to those tonnages of clay that are sold or shipped raw by the producer. Any departures from this rule are clarified in the text. The tonnages do not include the much greater quantity of clay mined by manufacturers of brick and other clay products at integrated plants at mine or pit.

Salient statistics of the clay industry in the United States, 1925–42

	1925–29 (average)	1930–34 (average)	1935–39 (average)	1940	1941	1942
Domestic clay sold or used by producers:						
Kaolin, china clay....short tons	453,618	431,932	654,147	833,450	1,087,848	946,588
Ball clay....do	116,127	70,299	108,525	140,707	198,445	162,293
Fire clay [1] (including stoneware clay)....short tons	2,898,576	1,487,364	2,175,309	2,765,247	4,167,567	4,839,332
Bentonite....do	[2]	84,762	188,385	251,032	354,028	374,967
Fuller's earth....do	261,640	259,354	204,529	146,568	207,446	204,244
Miscellaneous clays [1]....do	[2] 575,708	305,973	360,602	710,515	1,210,168	1,019,663
Total domestic:						
Quantity....do	4,305,669	2,639,684	3,691,497	4,847,519	7,225,502	7,547,087
Value	$17,568,812	$10,977,776	$15,455,392	$19,633,568	[3]$27,037,391	$26,662,897
Imports:						
Kaolin or china clay....short tons	339,014	140,888	122,232	105,567	85,141	63,278
Common blue and Gross-Almerode....short tons	12,130	11,306	27,108	32,141	26,825	19,790
Fuller's earth....do	8,118	4,708	2,256	474	342	287
Other clay....do	61,048	24,713	16,922	2,267	154	169
Total imports:						
Quantity....do	420,310	181,615	168,518	140,449	112,462	83,524
Value	$3,841,462	$1,595,101	$1,608,395	$1,159,790	$1,152,915	$862,907
Exports:						
Fire clay....short tons	55,316	39,709	61,247	96,501	91,732	118,101
Other clay (including fuller's earth)....short tons	54,028	68,978	87,824	87,667	116,120	75,098
Total exports:						
Quantity....do	109,344	108,687	149,071	184,168	207,852	193,199
Value	$1,217,769	$1,323,744	$1,819,242	$2,071,336	$2,537,763	$2,042,940

[1] Does not include clay burned into clay products in integrated plants at mine or pit.
[2] Sales of bentonite included under "Miscellaneous clay" before 1930.
[3] Revised figures.

CONSUMPTION AND USES

The accompanying table gives sales of specified domestic clays by kinds and uses in 1942, continuing a series begun in 1921. Of particular interest in 1941 and 1942 have been the sharp increase in refractory and foundry clays, the apparent recovery in fuller's earth, and the decrease in rubber clay.

Figure 1 shows the contributions of the clays to refractory uses during the past 10 years.

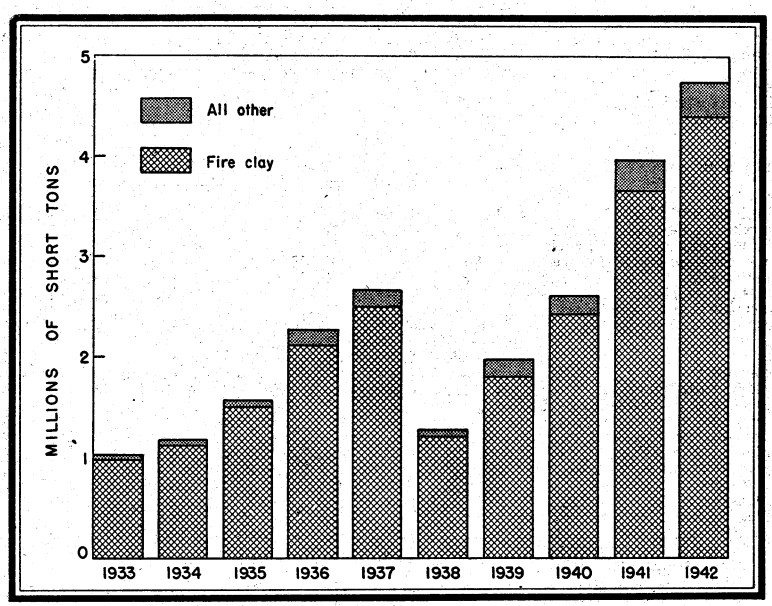

FIGURE 1.—Trends in sales of clay by domestic producers for use in refractories, 1933-42.

Clay sold or used by producers in the United States in 1942, by kinds and uses, in short tons

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Miscellaneous clay, including slip clay	Fuller's earth	Total
Pottery and stoneware:							
Whiteware, etc.	86,029	136,181	10,215				232,425
Stoneware, including chemical stoneware		957	42,067				43,024
Art pottery, flowerpots, etc.		894	4,649		5,381		10,924
Slip for glazing		300			506		806
	86,029	138,332	56,931		5,887		287,179
Tile, high-grade	12,313	9,793	3,051		60		25,217
Kiln furniture, etc.:							
Saggers, pins, stilts	2,348	1,357	46,170				49,875
Wads		239	9,816				10,055
	2,348	1,596	55,986				59,930
Architectural terra cotta		75	10,390				10,465

Clay sold or used by producers in the United States in 1942, by kinds and uses, in short tons—Continued

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Miscellaneous clay, including slip clay	Fuller's earth	Total
Paper:							
Filler	364,154	1,200	583				365,937
Coating	192,819						192,819
	556,973	1,200	583				558,756
Rubber	51,334		5,000				56,334
Linoleum and oilcloth	6,304	6,000	11,434				23,738
Paints:							
Filler or extender	15,289	238	122				15,649
Calcimine	1,403						1,403
	16,692	238	122				17,052
Cement manufacture	12,315		2,259	3,614	287,639		305,827
Refractories:							
Fire brick and block	149,996	1,000	3,105,621		8,605		3,265,222
Bauxite, high-alumina brick			77,478				77,478
Fire-clay mortar, including clay processed for laying fire brick	2,832		309,732		33		312,597
Clay crucibles	396	500	1,203				2,099
Glass refractories	475	175	21,996				22,646
Zinc retorts and condensers		500	45,351				45,851
Foundries and steelworks	6,187	100	815,026	149,384	24,847	297	995,841
	159,886	2,275	4,376,407	149,384	33,485	297	4,721,734
Miscellaneous:							
Rotary-drilling mud			763	48,912	118,423	2,049	170,147
Filtering and decolorizing oils (raw and activated earths)				116,814		[1] 193,846	310,660
Other filtering and clarifying						7,730	7,730
Artificial abrasives	290	282	1,377		4,206		6,155
Asbestos products	677	500	256				1,433
Chemicals	5,130		20,423				25,553
Enameling		1,000					1,000
Filler (other than paper or paint)	596			3,562	18,070	98	22,326
Plaster and plaster products	250						250
Concrete admixture, sealing dams, etc				3,013			3,013
Heavy clay products			287,520		527,276		814,796
Other uses	35,451	1,002	6,830	49,668	24,617	224	117,792
	42,394	2,784	317,169	221,969	692,592	203,947	1,480,855
Grand total:							
1942	946,588	162,293	4,839,332	374,967	1,019,663	204,244	7,547,087
1941	1,087,848	198,445	4,167,567	354,028	1,210,168	207,446	7,225,502

[1] Comprises following: Mineral oils, 172,518 short tons; vegetable oils, 21,328 short tons.

CHINA CLAY OR KAOLIN

Shipments of kaolin or china clay by domestic producers were 13 percent lower in both quantity and value in 1942 than in the record year 1941. Although this might be interpreted as indicating a period of recession, further comparisons show that activity was high. More domestic kaolin was shipped in 1942 than in any previous year except 1941, 14 percent more than in 1940, and 45 percent more than the average in the years 1935–39.

Mine shipments were reported in 14 States, but most of the tonnage came from Georgia and South Carolina. Georgia, furnishing 79 percent, contributed an even greater portion of the national total than usual, and South Carolina ranked second with 12 percent.

Outstanding changes in kaolin consumption compared with 1941 were the 60-percent reduction in its use in rubber, 16-percent in pottery, and 8-percent in paper and the 30-percent increase in refractories. The drastic decline in sales to the rubber industry was a direct result of the rubber shortage, but recovery in this use is to be expected if synthetic rubber technology does not require the use of materials that will displace clay. Although pottery requirements were not as great as in 1941, shipments in 1942 compare favorably with those in previous years. As paper clays constitute approximately 60 percent of the total kaolin tonnage, even the 8-percent reduction resulting in part from a paper-production curtailment order by the War Production Board constituted a serious loss. However, comparisons show that kaolin sales to the paper industry were greater in 1942 than in any prior year except 1941. Wartime expansion of the high-temperature manufacturing processes sharply stimulated consumption of kaolin in refractories.

In addition to shipments of raw kaolin, producers reported to the Bureau of Mines that 194,234 tons were burned into clay products at the mine or pit.

Although kaolin is not yet a commercial source of aluminum metal, many deposits were investigated as possible sources.

Kaolin beneficiation plants equipped to recover mica as a byproduct of clay production enjoyed a very active market during 1942. During the latter part of the year a shortage of ground mica developed, and a movement was initiated to obtain price concessions from the Office of Price Administration to stimulate production.

Crude undried kaolin sold as low as $2.50 per ton for refractory uses, and processed grades sold all the way up to $20 for air-floated enamel quality. Specialties were listed at $20 to $40 per ton. Most paper clays ranged from $7.50 to $15 and rubber clays from $8.50 to $20 per ton. The national average value, as reported by producers to the Bureau of Mines, was $8.49 per ton, or slightly higher than the $8.46 in 1941 and $8.39 in 1940.

Kaolin sold or used by producers in the United States, 1940–42, by States

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	(1)	(1)	(1)	(1)
California	14,407	$118,481	20,810	$164,110	10,237	$119,004
Delaware	(1)	(1)	(1)	(1)	(1)	(1)
Florida	(1)	(1)	(1)	(1)	(1)	(1)
Georgia	570,010	4,834,826	787,013	6,573,605	744,408	6,136,231
Illinois			(1)	(1)	(1)	(1)
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	14,602	202,642	(1)	(1)	(1)	(1)
Pennsylvania	49,541	169,981	44,277	172,783	19,862	125,774
South Carolina	152,227	1,302,812	177,276	1,596,471	115,679	974,950
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Vermont	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed [2]	32,663	365,364	58,472	698,923	56,402	681,274
	833,450	6,994,106	1,087,848	9,205,892	946,588	8,037,233

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)" above.

Imports of china clay in 1942 totaled 63,278 tons valued at $671,081, 26 percent less than the 85,141 tons valued at $901,973 received in 1941; the United Kingdom supplied 62,774 tons, and the remainder (504 tons) came from Canada. The English clay was valued at $10.59 per short ton, approximately the same as in 1941, but transportation added materially to the delivered price in this country. Trade journals quoted lump clay, f. o. b. American ports, c. i. f., at $19 to $28 and air-floated at $40 to $60 per long ton.

Kaolin exports are not recorded separately by the Department of Commerce, but producers reported to the Bureau of Mines that in 1942 they exported a total of 2,128 tons valued at $19,216 to Canada, Mexico, and South America.

Georgia kaolin sold or used by producers, 1938–42, 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
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
1941	669,978	6,216,087	9.28	117,035	357,518	3.05	787,013	6,573,605	8.35
1942	594,780	5,645,760	9.49	149,628	490,471	3.28	744,408	6,136,231	8.24

BALL CLAY

Compared with 1941, total sales of ball clay decreased 18 percent in 1942 in both tonnage and value, but in spite of this reduction they were the second highest on record. Approximately 49 percent of the total in 1942 was mined in Kentucky and 43 percent in Tennessee; the remainder came principally from Maryland and New Jersey. Mississippi and Missouri reported minor quantities and Nevada none.

Imports of "common blue and ball clays, unwrought and unmanufactured" from the United Kingdom fell to 19,648 short tons in 1942, or 27 percent from the 26,817-ton total for the previous year. The average value was $9.21 per ton compared with $9.06 in 1941. Thirty-four tons valued at $885 were received from Brazil and 102 tons valued at $903 from Canada.

During recent years domestic producers have improved and standardized the quality of their product to a degree that has gained its acceptance in the field formerly held by foreign ball clays. In prewar years domestic ball clay could be laid down at consumers' plants at a lower price than imported; this advantage was an even greater factor in 1942, when ocean freight rates were excessively high. Displacement of the entire foreign tonnage is unlikely, however, as strenuous efforts are being made by English clay producers to retain their position in the American market.

The average value of domestic ball clay as reported to the Bureau of Mines by producers was $8.49 per ton, slightly higher than the $8.45 of 1941 and substantially more than the $7.57 realized in 1940. Prices were limited by the General Maximum Price Regulation, and

trade-journal quotations listed bulk, shredded, at $3 to $8.25 and air-floated, in bags, at $10 to $18.25.

War conditions stimulated consumption in refractories, kiln furniture, and paint filler. Decreased amounts were required for products devoted principally to the needs of the civilian economy, such as pottery, paper filler, and linoleum, but these requirements compared favorably with consumption in the same categories in most pre-war years. Eighty-five percent of the domestic ball clay shipped in 1942 was used in whiteware or cream-color ware and 6 percent in high-grade tile.

Ball clay sold by producers in the United States, 1940–42, by States

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Kentucky	75,933	$600,264	105,586	$944,705	80,259	$696,788
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Mississippi			(1)	(1)	(1)	(1)
Missouri	(1)	(1)	(1)	(1)	(1)	(1)
Nevada	(1)	(1)	(1)	(1)		
New Jersey	(1)	(1)	(1)	(1)	(1)	(1)
Tennessee	53,871	414,602	80,506	664,906	70,573	606,118
Undistributed [2]	10,903	50,566	12,353	67,989	11,461	75,599
	140,707	1,065,432	198,445	1,677,600	162,293	1,378,505

[1] Included under "Undistributed." [2] Includes States indicated by "(1)."

FIRE CLAY

Intense wartime activity in the metal-working and other high-temperature process industries continued to absorb increasing quantities of refractories. Shipments of domestic fire clay were 16 percent greater in 1942 than in 1941, establishing a new record for that portion of the fire-clay tonnage that is sold or shipped raw to distant plants for further processing or ultimate consumption. In addition to this merchant clay, producers reported that 3,457,413 tons of fire clay were burned into firebrick or other clay products in integrated plants at the mine or pit, 6 percent more than the 3,275,021 tons burned in 1941.

At the beginning of the rearmament program, the fire-clay refractories producers, who for years had been operating at less than 50 percent of capacity,[2] had enough active equipment to handle immediate demands. In addition, obsolete and inactive plants and facilities represented a considerable capacity. As the tremendous construction and modernization programs in the steel, coke, magnesium, aluminum, power, glass, and other industries got under way, refractories were supplied as needed with few delays in delivery. The War Production Board gave close attention to the situation, but the establishment of rigid controls did not become necessary. Virtually all that was required was an occasional meeting of a committee representing members of the industry and the War Production Board to relieve some local shortage. As demand increased, more and more obsolete facilities were rehabilitated and improved to meet requirements without construction of new plants. It has been esti-

[2] Ramsay, John D., Refractories the Backbone of Industry: Penton Press, Cleveland, Ohio, 1941, p. 78.

mated that, in contrast to the mushroom growth of the consuming industries, only about 10 percent of new capacity in the form of new plants and expansion or modernization of old ones has been added to the refractories industry.[3] Although there is some minor amount of unused additional facilities, the industry was considered to be operating at close to capacity at the end of 1942. It is expected that, barring major production interruptions, all demands can be met.

Shipments of fire clay were reported from 29 States in 1942. Although production is widely distributed, the major tonnages are concentrated in relatively few States owing to market and quality factors. Pennsylvania supplied 26 percent of the total, Missouri 23, Ohio 16, California 9, and Kentucky 9; thus, these five States shipped 83 percent. A map showing location of fire-clay mines in the United States was published in the chapter on Clays in Minerals Yearbook, 1941.

Fire clay has a wide variety of uses, many of which in normal times consume substantial quantities, but in 1942 over 90 percent went into refractories.

According to the records of the Department of Commerce, 118,101 tons of fire clay valued at $709,455 were exported in 1942, principally to Canada, England, and Mexico, compared with 91,732 tons valued at $721,627 in 1941. This 29-percent increase in fire-clay exports contrasts sharply with the 35-percent reduction in exports of all other clay. It is apparent from these figures that substantial quantities of American clay bolstered the munitions production of our allies.

Fire clay, including stoneware clay, sold or used by producers in the United States, 1940–42, by States [1]

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	42,843	$74,868	52,509	$108,703	96,567	$158,150
California	193,713	459,680	316,226	714,779	433,571	999,901
Colorado	52,695	89,206	84,986	143,398	92,804	195,468
Illinois	147,148	308,711	201,139	448,002	180,994	329,212
Indiana	69,144	82,962	111,551	142,329	77,597	95,072
Kentucky	269,090	728,380	395,524	[2] 1,020,490	416,870	1,165,600
Maryland	12,582	67,479	17,790	99,229	15,213	75,590
Missouri [3]	487,650	1,391,045	794,705	1,782,139	1,110,962	2,450,752
New Jersey	91,325	512,546	133,126	714,925	112,041	639,794
New Mexico	3,263	10,928	(4)	(4)	4,634	11,349
Ohio	470,101	1,039,228	689,187	1,689,308	790,489	1,627,800
Pennsylvania	794,702	1,984,272	1,130,525	2,848,049	1,242,058	3,082,851
South Carolina	(4)	(4)	4,046	7,576	(4)	(4)
Tennessee	(4)	(4)	38,120	117,168	44,260	166,046
Texas	12,498	22,686	31,646	45,880	45,791	61,499
Utah	20,113	40,107	15,473	31,150	16,525	32,667
Washington	21,108	36,097	65,521	91,604	70,468	108,674
West Virginia	55,853	103,989	70,885	133,300	74,141	146,245
Other States [5]	21,419	94,562	14,608	49,704	14,347	34,836
	2,765,247	7,046,746	4,167,567	[2] 10,187,733	4,839,332	11,381,506

[1] Does not include clay burned into clay products in integrated plants at mine or pit.
[2] Revised figures.
[3] Includes diaspore and burley clay as follows—1940: 34,359 tons valued at $156,603; 1941: 79,897 tons, $405,673; 1942: 119,357 tons, $591,124.
[4] Included under "Other States."
[5] Includes States indicated by "(4)" above, and Arkansas, Connecticut (1940), Idaho, Iowa, Massachusetts, Minnesota, Mississippi (1941), Montana (1942), Nebraska, Nevada, North Carolina (1940–41), North Dakota, Oregon, Vermont (1941), and Virginia.

[3] Information supplied by personnel of War Production Board.

Imports of fire clay have not been an important factor in recent years. Facing competition from American fire clays, Gross-Almerode had even in pre-war years declined to a few hundred tons per year. Klingenberg clay was prized by American graphite crucible makers, but it has been largely replaced by American clays.[4] Obviously neither of these German clays was imported in 1942, but suitable domestic substitutes are available.

In 1942 the average value of merchant fire clays—$2.35 per ton—was somewhat lower than the $2.44 reported for 1941. Prices were frozen at March 1942 levels by the General Maximum Price Regulation.

BENTONITE

Bentonite enjoyed a good market in 1942; output, which increased 6 percent over 1941, reached a new record. Wyoming produced slightly less than in 1941 but was still the leading producer, with 37 percent of the total. South Dakota increased shipments by 54 percent and supplied 24 percent of the total. In 5 years South Dakota has more than quadrupled its bentonite output. Reflecting the high quality of the bentonite from the Wyoming-South Dakota district, its 61 percent of the national tonnage commanded 76 percent of the value. For the entire United States the average value in 1942 was $6.80 per ton, which compares with $6.93 in 1941 and $7.65 in 1940.

Of the 1942 shipments, 40 percent was used in foundries and steel works, 31 percent for filtering and decolorizing oils, 13 percent in oil-well drilling muds, and the remaining 16 percent in a wide variety of applications. Foundry consumption was higher, in line with metal activity. The use of bentonite in foundries, where its bonding properties are valuable, increased from 53,872 tons in 1939 to 149,384 tons in 1942. The decrease in oil-well drilling reduced that market, but requirements for oil filtering held close to the level of 1941.

Some of the principal firms increased their production capacity substantially over that in 1941, but this probably was not a strong factor in reduction of the average value, which likely resulted from the increased proportion of material sold for foundry work—a comparatively low-priced grade.

Although some mine-run material is sold as low as about $2 per ton, in general prices ranged from about $4 for unprocessed material through various pulverized grades, mainly in the $7 to $20 span, to a maximum of about $35 per ton for extremely finely divided products.[5]

In oil refining, bentonite is directly competitive with fuller's earth, as well as with other materials discussed in the fuller's earth section of this chapter. Usually the bentonites and sub-bentonites used for this purpose have little natural bleaching capacity, but when acid-treated or activated they are converted into very effective bleaching agents. As it is often difficult to distinguish between these two clays there has been some reclassification by producers in past years. Although the Bureau of Mines as a rule accepts the producer's classification of his commodity, this type of discrepancy is held to a minimum wherever feasible.

[4] Information furnished by Mica-Graphite Division, War Production Board.
[5] Information supplied by Office of Price Administration.

The same is often true of those clays used as rotary-drilling muds. For this use, clays having bentonitic characteristics have particular value for suspending cuttings and maintaining a desirable specific gravity. The boundary between bentonite and other clays of somewhat similar properties is sometimes hazy, and drilling muds that are not obviously bentonite are classed among the miscellaneous clays.

Exports, as reported by producers to the Bureau of Mines and excluding foreign shipments made by dealers and a large tonnage of acid-treated bentonite used for oil refining, totaled over 10,000 tons. Destinations listed were Australia, England, Mexico, and various South American countries.

Bentonite sold or used by producers in the United States, 1940–42, by States

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	7,867	$99,840	6,981	$69,776	4,745	$48,522
Colorado	(1)	(1)				
Mississippi	(1)	(1)	(1)	(1)	(1)	(1)
Nevada	(1)	(1)				
Oklahoma	(1)	(1)				
South Dakota	40,481	274,714	57,139	401,758	88,149	664,449
Texas	14,399	127,949	11,593	105,312	17,651	127,941
Utah	(1)	(1)			(1)	(1)
Wyoming	91,714	976,844	145,574	1,369,057	139,410	1,259,863
Undistributed [2]	96,571	440,114	132,741	505,997	125,012	447,734
	251,032	1,919,461	354,028	2,451,900	374,967	2,548,509

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

FULLER'S EARTH

Shipments of fuller's earth were only 2 percent less in 1942 than in 1941, in spite of a considerably greater reduction in oil-refining activity. The mineral-oil refining industry consumed 84 percent and the vegetable-oils 10 percent of total shipments.

Although during the past 20 years fuller's earth has depended largely on the petroleum industry, it has not participated fully in that industry's expansion. As illustrated in figure 2, during the 1920's consumption of fuller's earth increased in direct proportion to petroleum output, but in the 1930's it lost ground almost continuously. The decline in use of fuller's earth was due to the increased popularity of colored fuels, to improvements in refining methods, and even more directly to the fact that it was forced to meet the competition of materials like bauxite and synthetics that have properties desirable in refining oils. Although the first cost of the competitive products is not low, their greater durability makes them economical. Activated earths have also made deep inroads into the market for natural bleaching clays.

The same active competition has carried over into catalytic petroleum cracking, which developed rapidly during the 1930's. Fuller's earth has had a somewhat varied acceptance as a catalyst, but research has developed a specially treated product that is to be used in some of the new high-octane plants.[6]

[6] Information furnished by Petroleum Administration for War.

The decline in consumption of fuller's earth was arrested in 1941 and, when compared with petroleum refining, relatively more was used in 1942. People in the industry believe that although this may have resulted from some tonnage being absorbed into plants under construction and not yet operating, it is more likely that in some refineries the pressures of wartime production have led to somewhat earlier rejection of fouled earth, thus increasing the clay used per unit of petroleum product.

Only part of the recovery in 1941 can be attributed to reclassification of borderline material and no additional reclassification took place in 1942, so the evidence indicates that the long downward trend may have run its course.

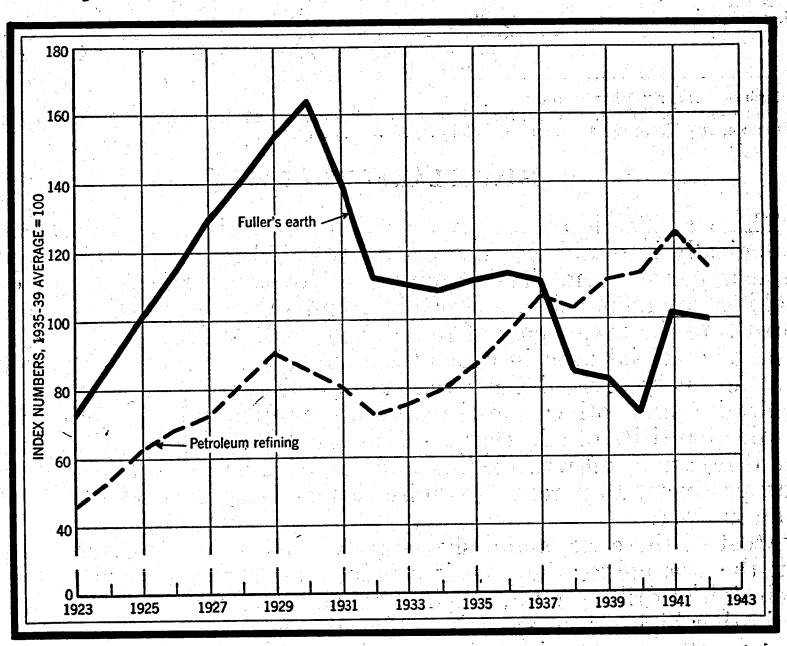

FIGURE 2.—Mine shipments of fuller's earth compared with petroleum-refining activity (Federal Reserve Board Index), 1923–42.

Texas was the leading fuller's earth-producing State in 1942, with 42 percent of the total; the Florida-Georgia district contributed 41 and Illinois 15 percent. The average value of Texas clay, however, was only $8.38 per ton as compared with $8.70 for Illinois and $13.14 for Florida-Georgia. Fuller's earth has many grades, and some have relatively rigid specifications; thus, prices usually range from $5.50 to $16 per ton in most areas, depending on the mesh size and degree of preparation.

In recent peacetime years imports of fuller's earth have been limited to relatively expensive materials equivalent to 1 or 2 percent of domestic production. By 1942, imports had shrunk to an insignificant 287 tons, all from the United Kingdom and valued at $4,716 ($16.43 per ton); in 1941, 342 tons valued at $5,042 entered the country.

Exports reported by producers to the Bureau of Mines were more substantial—6,052 tons valued at $50,080 in 1942. Shipping shortages took their toll, however, as these totals are much less than the 10,722 tons valued at $98,847 reported for 1941.

Fuller's earth sold or used by producers in the United States, 1940–42, by States

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	79,898	$917,365	91,925	$1,075,318	83,007	$1,091,062
Illinois	(1)	(1)	26,676	209,577	30,421	264,611
Texas	34,039	277,229	77,033	713,085	85,012	712,303
Other States [2]	32,631	276,489	11,812	113,694	5,804	71,694
	146,568	1,471,083	207,446	2,111,674	204,244	2,139,670

[1] Included under "Other States."
[2] 1940: Colorado, Illinois, Nevada, New Mexico, and Tennessee; 1941: California, Nevada, New Mexico, Tennessee, and Utah; 1942: California, Colorado, Nevada, and Utah.

MISCELLANEOUS CLAYS

This classification is simply a grouping of various clays that do not fit logically into any of the types discussed elsewhere in this chapter. As is apparent from the foregoing table of uses, the clays utilized in making common brick, sewer pipe, and other heavy-clay products constitute the major part of the tonnage, followed by much the same type of material used in cement manufacture. Third in importance are the finely divided clays that are applied alone or admixed with bentonite and other constituents to produce rotary-drilling mud. Small quantities of slip clay are also included. Owing principally to the decrease in oil-well drilling and the declining demand for heavy-clay products, 16 percent less miscellaneous clay was shipped in 1942 than in 1941.

Most of these clays and shales are valued at less than $1 per ton; but the average for the class is usually somewhat higher owing to the inclusion of drilling mud, much of which sells for around $10 per ton, and other high-priced specialties like slip clay.

It must be emphasized that merchant clay is only a small part of the clay and shale used in heavy-clay-products manufacture. Usually such products are made in plants at or very near the mine. Producers canvassed by the Bureau of Mines reported that in 1942 they burned over 8,500,000 tons into clay products at the mine or pit, but additional large quantities were made into heavy-clay products at the mine or pit by firms not canvassed by the Bureau of Mines. A more complete coverage of the industry is in prospect. The Bureau of the Census reported that 16,062,000 short tons of clay were produced in 1939 by the common-clay and shale industry. Although only fragmentary information is available since that time, owing to suspension of the canvass by the Census of Manufactures, it is estimated that the quantity was about 10 percent greater in 1941. Further information on this part of the industry appears in the following section on Clay Products.

Similarly, clay marketed for cement manufacture is only a small percentage of the total clay so used. In 1942, 287,639 tons of mis-

cellaneous clay were reported sold to cement companies, but the cement industry reported to the Bureau that it used 5,181,582 tons of clay and shale in 1942, nearly all of which was mined by the cement companies on their own properties.

As most of the miscellaneous clays are cheap and abundant throughout the world, foreign trade in them is limited to higher-priced specialties. Official Department of Commerce figures do not reveal the exact total for 1942, but it is known to be small, as exports of only a few hundred tons were reported by producers to the Bureau of Mines.

Miscellaneous clay, including slip clay [1] and shale, sold or used by producers in the United States, 1940–42, by States [2]

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	100,522	$60,583	125,563	$70,273	97,169	$55,470
Arkansas	24,421	10,533	(3)	(3)	(3)	(3)
California	127,539	248,632	186,123	473,846	130,698	346,535
Colorado	62,803	64,842	79,458	83,246	40,954	45,356
Illinois	(3)	(3)	73,468	66,408	60,118	60,463
Indiana	20,086	9,750	106,362	34,038	97,390	32,890
Iowa	9,548	47,566	9,690	46,759	8,049	37,085
Louisiana	10,189	96,314	(3)	(3)	(3)	(3)
Nebraska	10,406	5,516	11,949	5,748	15,953	13,691
Ohio	44,156	18,788	52,468	21,760	17,416	23,176
Pennsylvania	54,930	35,256	59,565	24,856	17,478	14,547
Texas	65,822	257,238	94,698	180,681	139,913	212,064
Washington	14,807	11,256	(3)	(3)	(3)	(3)
Other States [4]	165,286	270,466	410,824	394,977	394,525	336,197
	710,515	1,136,740	1,210,168	1,402,592	1,019,663	1,177,474

[1] Includes slip clay as follows—1940: 4,365 tons, valued at $29,268, from Michigan, New York, and Ohio; 1941: 5,649 tons, $40,797, from Kentucky, Michigan, New York, Ohio, and Pennsylvania; 1942: 5,164 tons, $41,856, from Michigan and New York.

[2] Does not include clay burned into clay products in integrated plants at mine or pit.

[3] Included under "Other States."

[4] Includes States indicated by "(3)" above, and Connecticut, Georgia, Kansas, Kentucky (1941–42), Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nevada (1940–41), New Jersey, New Mexico, New York, Oklahoma, Oregon (1941–42), Tennessee, Utah, and Wisconsin (1941–42).

CLAY PRODUCTS

Although the demand for structural clay products was active during the early part of 1942, it declined with the downward trend in building activity. According to figures gathered from various sources and issued by the Statistics Division, Materials Branch, War Production Board, covering glazed and unglazed common and face brick, unglazed hollow facing tile, and unglazed structural clay tile, production of brick or brick equivalent was 25 percent less in 1942 than in 1941. This group of producers has operated at far less than capacity for years and operated at only 36 percent of capacity in 1942.

Consumption of these materials was encouraged by the War Production Board for both permanent and temporary structures, because a minimum of critical materials was involved, and production has been mechanized so that of 33,000 men employed in the brick and tile industry, 28,000 were either unskilled or semiskilled. In addition, transportation can be saved as the War Production Board claims there is a clay-products plant within 100 miles of every likely building-construction site in the United States.

Imports are negligible. Exports are not big factors in the industry, but appreciable tonnages are shipped as follows: 81 percent to Canada, 11 percent to South and Central America, and 8 percent to other destinations.

Data on building brick and clay tile in the United States, 1940–42 [1] [2]

[Millions of brick or brick equivalent]

	1940	1941	1942
Production	6,000	6,211	4,634
Estimated capacity	(3)	(3)	12,933
Stocks—January 1	1,112	1,149	1,000
Exports	36	37	29

[1] Abstracted from reports issued by Statistics Division, Materials Branch, War Production Board.
[2] Includes glazed and unglazed common and face brick, unglazed hollow facing tile, and unglazed structural clay tile. Sewer pipe and paving brick not included.
[3] Figures not available.

TECHNOLOGIC DEVELOPMENTS

During the past few years there has been a steadily increasing interest in the possibility of utilizing clay as a source of aluminum. Up to the present the United States has depended on high-grade bauxite, because its alumina is comparatively easily available through the Bayer process and large reserves in Surinam bolster the limited quantities known to exist in this country. By comparison, clay as a class has been a leaner and more refractory source of aluminum, and although many methods of extraction have been developed none has achieved commercial success.

Into this situation the war has injected some new considerations that are acting as a powerful stimulant. From the early days of the war it was evident that the element of airpower was to become a crucial and possibly overwhelming factor in battles of the future. As today's combat aircraft is built principally of the light metals a tremendous expansion in aluminum production has taken place, bringing with it an acute realization of the slender supplies of bauxite available within the United States. The point became even clearer as the German submarine campaign along the East coast and in the Caribbean during 1942 made delivery of Surinam bauxite more difficult and costly.

Although a large body of opinion still is doubtful of the commercial prospects of clay as an aluminum ore in the postwar period if it must meet bauxite competition on an equal basis, even the most skeptical are impelled to concede that in the interest of national security the clay processes must be developed to a point that will make the country independent of foreign ore if the need should arise in the future. As to whether this may lead to the creation of a fully developed industry or be limited to small-scale plants sufficient to prove and develop the technique, only the future can reveal. In any case, both private organizations and Government agencies are actively investigating clays. During 1942 the Bureau of Mines conducted extensive clay-drilling programs.

Naturally all groups active in this movement have tended to look first for clays containing a high available alumina content, as they

offer the most immediate promise of success. The fire clays of Missouri are most attractive from that standpoint, but they are not sufficiently extensive. The high-alumina clays of Pennsylvania have the advantage of location near high-calcium limestone and coal that would be required if they were to be treated by the lime-soda process. Lower-quality clays, however, are also receiving attention, for they are much more abundant and widely distributed.

At the request of the War Production Board, a committee of the National Academy of Sciences surveyed domestic aluminum sources, and their findings were embodied in a report submitted June 9, 1942.[7] Their investigations led the committee to conclude that although bauxite was the best raw material for producing aluminum, the clays, red muds, and alunite should not be neglected. They found that the acid-process pilot plant operated by the Tennessee Valley Authority was not producing alumina pure enough to be used in the manufacture of aluminum, but they did encourage further progress by offering suggestions as to methods of purification. The following are selected quotations from the report pertaining to clay:

As a matter of insurance in the production of alumina, the War Production Board should consider the construction of lime-soda sintering plants in connection with the Bayer process plants. This would enable each Bayer process plant in the United States to operate on high-silica bauxite and it would also make possible the production of a portion of the alumina, in these combination plants, from clay.

The Committee considers a modified Pedersen process for the production of alumina from clay as the most promising process that will be independent of the Bayer process. This process consists essentially of sintering clay with lime and subsequently leaching with soda. There are many ramifications in the details and in the treatment of the liquors which need test plant study. It is therefore recommended, that the War Production Board allocate to the War Metallurgy Committee a maximum of $100,000 for the construction and operation of a test plant to study the modified Pedersen process for the production of alumina from clay. It is suggested also that the War Production Board facilitate the acquisition of equipment for this test plant. A "Project Priority" is suggested.

It is recommended, that the Aluminum Co. of America be asked to prosecute vigorously pilot plant work on the lime-soda treatment of clay. To facilitate this work, it is suggested that the War Production Board assist the Aluminum Co. of America in obtaining either pilot plant equipment for work on clay or, preferably, a larger pilot plant for the treatment of red mud, thus making available the present pilot plant for work on clay.

It is recommended, that the work now in progress on alumina at the College Park Experiment Station of the Bureau of Mines be continued, and that the War Production Board assist the Bureau in obtaining equipment for this work. A "Project Priority" for this alumina work is suggested.

It is suggested that large quantities of bauxite could be conserved by restricting its use in the manufacture of aluminum sulfate. Calcined kaolin clay apparently can be substituted for the production of aluminum sulfate.

As a means of acquiring a fundamental understanding of the physical structures of the various clays the X-ray and electron microscope are powerful research tools. The progress of the past 15 years is summarized in a report by Grim.[8] Although the electron microscope is still too new to have developed a large body of information on the clays, micrographs have shown that: [9]

The montmorillonites show structures ranging from a fluffy amorphous-appearing material to well-defined, extremely thin plates. Nontronite has flat, frayed

[7] Advisory Committee on Metals and Minerals (Zay Jeffries, chairman), National Academy of Sciences, Alumina from Domestic Sources.

[8] Grim, Ralph E., Modern Concepts of Clay Materials: Jour. Geol., vol. 50, No. 3, April–May 1942, pp. 225–275.

[9] Shaw, B. T., and Humbert, R. P., Electron Micrographs of Clay Minerals: Proc., Soil Science Soc. America, vol. 6, 1941, pp. 146–149.

fibers; kaolinite and dickite both have hexagonal plate-shaped crystals, and halloysite has long split rods. Dickite crystals are much thicker than most kaolinitic crystals.

With a view to suggesting a series of the more important tests recognized by the various industries, whereby any given clay can be classified according to its possible uses, a group in the Bureau of Mines working under the supervision of Oliver C. Ralston prepared a syllabus of clay testing that should prove to be very useful.[10]

[10] Klinefelter, Theron A., O'Meara, Robert G., Gottlieb, Sidney, and Truesdell, Glenn C., Syllabus of Clay Testing, part I, Bureau of Mines Bull. 451, 1943, 35 pp.

ABRASIVE MATERIALS

By Robert W. Metcalf

SUMMARY OUTLINE

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GENERAL CONDITIONS

The total value of the products of the natural abrasives industries rose about 9 percent in 1942 compared with 1941. All classes of abrasives shown except tripoli, millstones, garnet, and grindstones made sizable gains in value of products. The value of sales of quartz and of ground sand and sandstone was at a high level; in fact, the value of ground sand and sandstone established a new record. The value of pumice and pumicite sales also was the highest yet recorded. The sales value of tube-mill liners and grinding pebbles in 1942 increased moderately over 1941.

Salient statistics of the abrasives industries in the United States, 1941–42

	1941	1942	Percent of change in 1942
Domestic production (sold or used by producers):			
Natural silica abrasives:			
Diatomite	[1]	[1]	
Tripoli	$421,746	$272,428	−35
Quartz	228,587	331,494	+45
Ground sand and sandstone	3,073,730	3,646,643	+19
Special silica-stone products:			
Grindstones and pulpstones	545,556	539,739	−1
Oilstones and related products	[1]	[1]	
Millstones	15,579	10,391	−33
Flint lining and grinding pebbles	276,042	295,761	+7
Natural silicate abrasives:			
Pumice and pumicite	669,514	706,199	+5
Garnet	371,752	299,904	−19
Natural alumina abrasives:			
Emery	42,484	49,413	+16
Total natural abrasives [2]	[2] 5,644,990	[2] 6,151,972	[2] +9
Total artificial abrasives [3]	16,444,319	23,856,488	+45
Foreign trade:			
Imports	15,470,148	22,696,338	+47
Exports	3,219,642	6,684,352	+108

[1] Bureau of Mines not at liberty to publish figures. Average for diatomite for 1939–41 was $1,915,405.
[2] Excludes value of diatomite and oilstones and related products, which the Bureau of Mines is not at liberty to publish.
[3] Includes material produced in Canada; Bureau of Mines not at liberty to publish United States data separately.

Paced by the enormously increased demand for abrasives caused by the war, the production of crude manufactured (artificial) abrasives surpassed all previous records by substantial margins for the third successive year. The combined total output reached by aluminum oxide, silicon carbide, and metallic abrasives in 1942 rose to 370,578 short tons valued at $23,856,488, 33 percent more in tonnage and 45 percent more in value than the figures reported for the former record year (1941). With aluminum oxide and silicon carbide production operating at full capacity and metallic abrasives production at nearly 75 percent of capacity, all three classes of manufactured abrasives for which data are shown achieved record outputs in both quantity and value. The percentages of increase in tonnage in 1942 compared with 1941 were: Silicon carbide, 37 percent; aluminum oxide, 24 percent; and metallic abrasives (steel shot and grit), 45 percent.

The total value of imports of natural abrasive materials into the United States rose to $22,696,338 in 1942, 47 percent greater than in 1941, when the total value reached $15,470,148. In both 1941 and 1942, imports of smaller diamonds ("glaziers' and engravers', unset, and miners' ") into the United States continued at a record-breaking rate, increasing to 6,882,248 carats in 1941 and 11,203,704 carats in 1942, compared with 3,809,071 carats in 1940. Imports of bort in 1942 rose sharply compared with 1941 and were the highest reported since 1937. Imports of corundum ore, which doubled in quantity from 1940 to 1941, declined somewhat in 1942. As in 1941, there were no receipts of emery ore, and pumice imports were very small. The combined value of exports of domestic abrasives and abrasive products in 1942 was twice that in 1941 and higher than in any year since 1920. A very large increase compared with 1941 in the export value of emery and corundum abrasive wheels brought the 1942 total of these products almost to the 1918 figure of $3,862,531. The value of exports of grindstones rose 20 percent, whereas the value of all other natural abrasives, whetstones, hones, etc., dropped slightly.

This chapter includes data for most of the materials used chiefly as abrasives, although certain clays, oxides, and substances mentioned later under "Miscellaneous mineral abrasive materials" are not included in the statistics presented herein. On the other hand, certain of the "abrasive materials" for which figures are included also have important nonabrasive uses.

NATURAL SILICA ABRASIVES

Diatomite.—The Bureau of Mines has not been at liberty to publish annual production data for diatomite since 1926. Total output (sales) for 3-year periods, however, may be shown. Total sales for the three most recent of such periods were as follows—1939–41: 360,502 short tons valued at $5,746,216; 1936–38: 279,645 tons valued at $4,377,353; and 1933–35: 244,342 tons valued at $3,618,428. Sales of diatomite in 1942 were somewhat higher in quantity and value than for 1941.

As in other recent years, California and Oregon were the chief producing States. Other States in which diatomite was produced in 1942 were Florida, Idaho, Nevada, and Washington.

About half of the diatomaceous earth marketed in the United States in 1942 was used in filtration, about one-quarter in various types of insulation, another one-sixth as fillers or admixtures, and the remainder for other miscellaneous uses, including small amounts for abrasives.

Prices at the beginning of 1942, according to E&MJ Metal and Mineral Markets, were as follows: Crude dried diatomite f. o. b. mines (Nevada), in bulk, $7, in bags, $12; 40-mesh, $18; 200-mesh, $22.50; low-temperature insulation, $19; and high-temperature, $40. On April 30 and throughout the year, quotations were: Crude dried diatomite f. o. b. mines (Nevada), in bulk, $7 (nominal); 98–100 mesh, $20; low-temperature insulation, $19; high-temperature insulation, $30; fine abrasives, 2 cents a pound (all bags are extra).

Several applications of diatomite were reported in the literature. Its employment as a decolorizing filter aid,[1] the advantages of its use as an ingredient of paint,[2] and in the manufacture of paper,[3] and its utilization in the construction of small homes [4] were described.

A flow sheet giving a simplified description of the mining and processing of diatomite at the operations of the Johns-Manville Products Corporation, Lompoc, Calif., accompanied by photographs of mines and refining plants, was published.[5] Japanese deposits of diatomite and their uses were described during 1942.[6]

Tripoli.—Both the quantity and value of tripoli (including Pennsylvania rottenstone) dropped sharply to 17,536 tons, worth $272,428, the lowest point in tonnage since 1932. This decline was due largely to the lack of output reported in 1942 for Oklahoma and Texas. Production in 1942 was obtained from Arkansas, Illinois, Missouri, and Pennsylvania (rottenstone).

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1938–42

Year	Illinois		Other States [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	13,833	200,700	15,468	221,046	29,301	421,746
1942	12,575	203,390	4,961	69,038	17,536	272,428

[1] 1938: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1939: Arkansas, California, Missouri, Oklahoma, Pennsylvania, Tennessee, and Texas; 1940–41: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Texas; 1942: Arkansas, Missouri, and Pennsylvania.

[1] Boyd, R., and Schmidt, R. W., Decolorizing Filter Aids, Kyrite and Dicalite M–23: Ind. and Eng. Chem., ind. ed., vol. 34, No. 6, June 1942, pp. 744–748.

[2] Hall, H. W., Diatomaceous Silica and Its Application in the Paint Industry: Paint, Oil and Chem. Rev., vol. 104, No. 7, March 26, 1942, pp. 12, 14, 16, 18.

[3] Hall, H. W., Diatoms in Paper Manufacture: Paper Trade Jour., vol. 115, No. 14, October 1, 1942, pp. 107–109.

[4] Architectural Forum, Diatalum Dwellings: Vol. 77, No. 3, September 1942, pp. 108–111.

[5] Chemical and Metallurgical Engineering, Mining and Refining of Diatomite—Flow Sheet: Vol. 49, No. 8, August 1942, pp. 110–113.

[6] Kawasima, T., and Siraki, Y., Japanese Diatomaceous Earths and Their Industrial Application (abst); Jour. Am. Ceram. Soc., vol. 25 (Ceram. Abs., vol. 21), April 1, 1942, pp. 89–90.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1940–42, by uses

Use	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasives	10,279	$119,609	13,407	$198,252	5,447	$85,013
Concrete admixture	1,683	15,895	1,179	15,168	754	8,895
Filler	8,451	113,862	10,020	145,063	8,887	144,055
Oil-well drilling	1,840	16,949	1,925	22,835	(1)	(1)
Other uses [2]	7,959	100,254	2,770	40,428	2,448	34,465
	30,212	366,569	29,301	421,746	17,536	272,428

[1] Included under "Other uses."
[2] 1940: Filter block, foundry facing, and unspecified; 1941: Foundry facing and unspecified; 1942: Foundry facing, drilling mud, and unspecified.

Fillers and abrasives continued to be the largest markets for tripoli in 1942, as in 1941, absorbing 51 and 31 percent of the total sold. Other uses in 1942 were concrete admixture, oil-well drilling, foundry facing, and uses not specified.

Quotations on tripoli, as reported by E&MJ Metal and Mineral Markets, remained unchanged during 1942, as follows (prices per ton, f. o. b. Missouri, in paper-lined burlap bags, minimum carload, 30 tons): Once-ground through 40-mesh, rose or cream colored, $14.50; double-ground through 110-mesh, rose or cream, $16; air-floated through 200-mesh, $26.

Quartz.—The output of crude, crushed, and ground quartz from pegmatite veins or dikes and from quartzite in 1942 rose to 65,878 short tons worth $331,494, a gain of 58 percent in quantity and 45 percent in value compared with 1941. This was the largest tonnage reported since 1918 and the highest value since 1914. Sales of ground quartz in 1942 more than doubled compared with 1941, and sales of crushed material were 90 percent more than in 1941, but quartz sold or used without preparation decreased sharply.

Quartz (crude, crushed, and ground) [1] sold or used by producers in the United States, 1938–42

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	8,977	39,247	24,101	94,913	8,607	94,427	41,685	228,587
1942	2,043	7,937	45,747	144,808	18,088	178,749	65,878	331,494

[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.

In 1942, output of quartz was reported from 15 States, the same number that produced in 1941; however, no output was reported from Oregon in 1942 and none from Virginia in 1941.

Quartz (crude, crushed, and ground) [1] *sold or used by producers in the United States, 1940–42, by States*

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona, California	2,141	$25,548	3,974	$50,243	(2)	(2)
Oregon	1,600	10,000			(2)	(2)
Maine	160	538	202	722	364	$922
Massachusetts	786	4,716	850	5,525	1,029	8,137
New Jersey	(2)	(2)				
Pennsylvania	(2)	(2)	778	7,181	975	8,649
Ohio						
North Carolina, Virginia	3,842	25,063	(2)	(2)	(2)	(2)
Texas			1,485	14,345	(2) 319	(2) 3,190
Other States [3]	23,336	110,525	34,396	150,571	63,191	310,596
	31,865	176,390	41,685	228,587	65,878	331,494

[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] 1940: Maryland, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin; 1941: Maryland, New Hampshire, New York, North Carolina, Tennessee, and Wisconsin; 1942: Arizona, California, Maryland, New York, North Carolina, Tennessee, Virginia, Washington, and Wisconsin.

The production and grinding of "flint"—apparently sugar quartz or vein quartz—by the United Feldspar & Minerals Corporation, Spruce Pine, N. C., for use in sandpaper and abrasives was described.[7] Deposits of quartz and quartzite suitable for commercial development in New Hampshire were described and analyses of quartzites given by Meyers.[8]

Ground sand and sandstone.—Sales of ground sand and sandstone in 1942 rose to 527,886 short tons, only 1 percent less than the record year (1917—532,454 tons) and 8 percent greater than in 1941. The value of sales, however, reached $3,646,643, 205 percent more than in 1917 and 19 percent higher than the former record reported in 1941. Output in all States or groups of States for which comparative totals are shown was substantially higher in 1942 than in 1941, except for Ohio-Virginia-West Virginia, in which production (sales) only slightly exceeded that for 1941. States producing sizable tonnages of ground material were Illinois, New Jersey, Ohio, and Pennsylvania.

Ground sand and sandstone sold or used by producers in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	237,167	$1,425,445	1941	487,665	$3,073,730
1939	310,512	1,930,301	1942	527,886	3,646,643
1940	342,218	2,088,314			

[7] Engineering and Mining Journal, "Flint" Ground for Abrasives: Vol. 143, No. 11, November 1942, p. 55.
[8] Meyers, T. R., Some New Hampshire Quartz Deposits: New Hampshire State Planning Development Commission Mineral Resources Survey VI; Chem. Abs., vol. 37, No. 6, March 20, 1943, p. 1353.

Ground sand and sandstone sold or used by producers in the United States, 1940–42, by States

State	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
California	5,505	$39,080	(1)	(1)	8,371	$68,324
Washington						
Illinois	106,397	628,488	131,581	$808,402	158,853	1,087,481
Massachusetts	1,425	6,240	1,352	6,327	2,761	13,948
New Jersey and Pennsylvania	122,304	641,021	174,305	954,929	188,598	1,143,746
Ohio, Virginia, and West Virginia	96,133	688,321	149,542	1,092,784	149,625	1,167,207
Other States[2]	10,454	85,164	30,885	211,288	19,678	165,937
	342,218	2,088,314	487,665	3,073,730	527,886	3,646,643

[1] Included under "Other States."
[2] 1940: Missouri, North Carolina, and Wisconsin; 1941: California, Missouri, and Wisconsin; 1942: Georgia, Missouri, and Wisconsin.

The three chief uses for ground sand and sandstone in 1942 were foundries (34 percent of the total); pottery, porcelain, and tile (26 percent); and abrasives (22 percent). Other important outlets are for fillers and in the glass and enamel trades.

Ground sand and sandstone sold or used by producers in the United States in 1942, by uses

Use	Short tons	Value	
		Total	Average per ton
Abrasive:			
Cleansing and scouring compound	87,317	$507,669	$5.81
Other	28,106	200,905	7.15
Enamel	22,043	141,305	6.41
Filler	25,419	190,852	7.51
Foundry	177,269	1,179,327	6.65
Glass	15,959	110,114	6.90
Pottery, porcelain, and tile	138,995	1,100,185	7.92
Other uses	32,778	216,286	6.60
	527,886	3,646,643	6.91

Abrasive sands.—Production of natural sands with a high silica content, employed for sand blasting, scouring stone, grinding glass, sand paper, and other abrasive uses, rose in 1941—the latest year for which data are at present available—to 1,001,814 short tons valued at $1,388,966, compared with 856,309 tons valued at $915,925 in 1940, an increase of 17 percent in tonnage and 52 percent in value. The 1941 total includes 371,049 tons of blast sand valued at $912,626—45 percent more in quantity and 53 percent more in value than that reported in 1940. See chapter on Sand and Gravel for 1942 figures.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and pulpstones.—Total sales of pulpstones and grindstones in 1942 totaled 14,681 short tons valued at $539,739, a decrease of 6 percent in tonnage and a slight decrease in value compared with 1941. In spite of heavy competition from manufactured stones, the tonnage of grindstones sold in 1942 was but 6 percent less than in 1941, and the value only slightly less than in 1941 although consider-

ably above that in 1940. Output of natural pulpstones in 1942 decreased about 2 percent in tonnage to 1,918 tons, although the value rose 5 percent to $116,976. Grindstones were quarried in 1942 in Ohio and West Virginia and pulpstones in Washington and West Virginia.

Grindstones and pulpstones sold by producers in the United States, 1938–42

Year	Grindstones		Pulpstones		
			Quantity		Value
	Short tons	Value	Pieces	Equivalent short tons	
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
1941	13,573	434,208	685	1,963	111,348
1942	12,763	422,763	528	1,918	116,976

The production of grindstones by the Constitution Stone Co., Constitution, Ohio, in its quarries and finishing mills in Ohio and West Virginia was described by Random.[9] The circular, rough blocks of stone coming from the quarry weigh up to 5 or 6 tons and may measure 7 feet in diameter, but grindstones completed at the company finishing mills range from 6 to 84 inches in diameter and from 1 to 20 inches in thickness. The stones produced are a medium-coarse, hard grit and are shipped largely to manufacturers of saws, millworking equipment, machine knives, and similar products. Although competition from artificial stones has been severe in recent years, the war has aided in maintaining a fairly active market for the natural product.

The development of pulpstones during the present century was traced by Dupuis.[10] Different patterns of the working face of sandstone and artificial pulpstones were illustrated in a paper-trade journal [11] to suggest methods of obtaining increased grinding surfaces. Characteristics and structure of foreign (Finnish) artificial pulpstones were discussed.[12]

Oilstones and related products.—Sales of natural sharpening stones, including oilstones, whetstones, scythestones, and rubbing stones, were somewhat higher in 1942 than in 1941. The Bureau of Mines, however, is not at liberty to publish the figures. States in which production was made in 1942 and the type of stone reported from each were as follows: Arkansas, oilstones and whetstones; Indiana, scythestones, whetstones, and rubbing stones; New Hampshire, scythestones; and Ohio, scythestones, whetstones, and lathestones.

[9] Random, Bill, Grindstones Come Back: Compressed Air Mag., vol. 47, No. 9, September 1942, pp. 6837–6840.
[10] Dupuis, D. E., Forty Years Progress in Pulpstones and Burrs: Pulp and Paper of Canada, vol. 43, No. 8, July 1942, pp. 578–581.
[11] Paper Industry and Paper World, Case Studies of Various Pulpstone Dressings: Vol. 24, No. 7, October 1942, pp. 702–703.
[12] Pellinen, H., Pulpstone Structure: Finnish Timber Jour., vol. 23, No. 10, May 31, 1941, p. 192; through Bull. Inst. Paper Chem., vol. 12, 1942, p. 224; abs. Paper Ind. and Paper World, vol. 24, No. 1, April 1942, p. 97.

Oilstones, whetstones, scythestones, and other sharpening stones sold by producers in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	511	$130,277	1941	(1)	(1)
1939	620	115,805	1942	(1)	(1)
1940	(1)	(1)			

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

Millstones.—The value of millstones in 1942 decreased to $10,391—33 percent less than in 1941 and 6 percent less than in 1939. In 1942 millstones were produced in Ulster County, N. Y.; Rowan County N. C.; and Montgomery County, Va. Output of chasers also was reported from New York State.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1938–42

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
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
1941	5	3,558	3	12,021	8	15,579
1942	2	(2)	3	(2)	5	10,391

[1] 1938: Virginia; 1939–40 and 1942: North Carolina and Virginia; 1941: North Carolina, Virginia, and West Virginia.
[2] Bureau of Mines not at liberty to publish figures.

Grinding pebbles and tube-mill liners.—Total sales of grinding pebbles and tube-mill liners in 1942 increased to 18,063 short tons valued at $295,761, a gain of 6 percent in tonnage and 7 percent in value compared with 1941. Of the total for 1942, grinding pebbles totaled 15,487 tons worth $245,794 and tube-mill liners 2,576 tons valued at $49,967. Similar figures for 1941 were: Grinding pebbles, 13,561 tons, $221,826; tube-mill liners, 3,411 tons, $54,216.

In 1942, grinding pebbles or tube-mill liners, or both, were produced in six States—Alabama, California, Minnesota, North Carolina, Texas, and Wisconsin. In Alabama, the Great Lakes Foundry Sand Co., Detroit, Mich., marketed grinding pebbles produced near Elmore. John C. Momand, Carlsbad, Calif., sold small quantities of beach pebbles.

Jasper Stone Co., Sioux City, Iowa, in 1942 continued production and sales of both liners and mechanically rounded pebbles from its Jasper (Minn.) quartzite deposits. The Southern Products & Silica Co., Lilesville, N. C., owned by Charlotte Chemical Laboratories Inc., Charlotte, N. C., and the W. R. Bonsal Co., Hamlet, N. C., produced silica pebbles near Lilesville, N. C. This firm also marketed flint pebbles produced in Texas. Harris Granite Quarries Co., Salisbury, N. C., produced rounded granite cubes and granite liners.

True flint pebbles were shipped from various points in four counties in south central Texas by Philip S. Hoyt, Van Horn, Tex. The Arley Mining Co., Pearsall, Tex., owned by the Richard L. Cawood Co., East Liverpool, Ohio, produced flint pebbles, as did also the

Dezendorf Marble Co., Austin, Tex. The Baraboo Quartzite Co., Baraboo, Wis., marketed quartzite pebbles and liners.

Genuine nodular amorphous flint pebbles, of good shape and said to have similar wearing qualities, purity, and the appearance and color of French pebbles, are being marketed by the Richard L. Cawood Co., East Liverpool, Ohio, according to the trade press.[13] The pebbles occur in the so-called Edwards chalk in south central Texas in beds of a red claylike matrix. Some of this matrix remains attached to the pebbles as a thin coating which, for certain uses, must be removed by ball milling. All pebbles, however, are not of equal quality, and many must be discarded.

Grinding mediums and mill liners made of Salisbury granite, quarried near Salisbury, Rowan County, N. C., were described.[14] Sizes of liners and pebbles, with recently quoted prices for each size and degree of preparation, are given. A domestic burrstone lining material has been developed, after careful tests, to replace the product formerly imported from Belgium. The new-type burrstone differs in structure from the Belgian product, does not have soft spots, and withstands impact and abrasion tests satisfactorily.[15]

Quartzite pebbles are abundant in certain areas of southwestern Saskatchewan, according to the Department of Natural Resources of the Province. A reconnaissance survey of three areas in the Province has disclosed large supplies.[16] Careful hand sorting would be necessary, as other rocks of similar size, shape, and color occur with the quartzite. Tests to determine their suitability for use as grinding mediums have been undertaken.

NATURAL SILICATE ABRASIVES

Pumice and pumicite.—Sales of pumice and pumicite in 1942 topped those in the previous record year (1941) by 8 percent in tonnage and 5 percent in value, rising to 126,522 short tons valued at $706,199, compared with 117,310 tons worth $669,514 in 1941.

Output of pumice or pumicite in 1942 was reported from seven States—California, Kansas, Nebraska, New Mexico, Oklahoma, Oregon, and Texas. The leading producing States in 1942 were California, Kansas, New Mexico, and Nebraska.

Pumice and pumicite sold or used by producers in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	65,742	$312,886	1941	117,310	$669,514
1939	89,159	424,780	1942	126,522	706,199
1940	82,407	449,914			

Pumice and pumicite used for abrasive purposes increased 11 percent in 1942 over 1941. Sales or use in concrete admixture and aggregate continued at a high level. Consumption for acoustic

[13] Pit and Quarry, vol. 35, No. 1, July 1942, p. 124; Chem. and Met. Eng., vol. 49, No. 7, July 1942, p. 134; Ceram. Ind., vol. 39, No. 4, October 1942, pp. 39–40.

[14] Engineering and Mining Journal, Grinding Media from Salisbury Granite: Vol. 143, No. 11, November 1942, p. 61.

[15] Grindings and Mixings, Two-Year Test Proves Superiority of Domestic Burrstone Linings: March 1943, p. 1; pub. by Paul O. Abbe, Little Falls, N. J.

[16] Engineering and Mining Journal, Quartz Pebbles for Ball-Mill Grinding in Saskatchewan: Vol. 144, No. 4, April 1943, p. 71; Canadian Min. and Met. Bull., No. 372, April 1943, p. 137.

plaster decreased 7 percent in tonnage, although showing a substantial increase in value. The decline in quantity sold or used for acoustic purposes and for concrete may be more apparent than real, however, since two or three firms producing moderate-size tonnages did not report their figures broken down by uses. In the absence of information by means of which estimates as to possible uses might be made, the amounts in question necessarily were placed under "Other uses."

Pumice and pumicite sold or used by producers in the United States, 1940–42, by uses

Use	1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps	49,359	$234,768	36,246	$265,361	50,324	$353,788
Other abrasive uses	836	7,563	12,785	127,003	4,084	90,286
Acoustic plaster	3,712	67,906	4,885	78,538	4,552	121,551
Concrete admixture and concrete aggregate	22,045	48,204	56,159	72,242	46,163	57,219
Other uses [1]	6,455	91,473	7,235	126,370	21,399	83,355
	82,407	449,914	117,310	669,514	126,522	706,199

[1] 1940: Asphalt, heat or cold insulation, insecticide, stucco, lime mortar, and unspecified uses; 1941: Asphalt, insulating mediums, insecticide, paint products, and unspecified; 1942: Asphalt, insulation, insecticide, paint products, filtration, and unspecified.

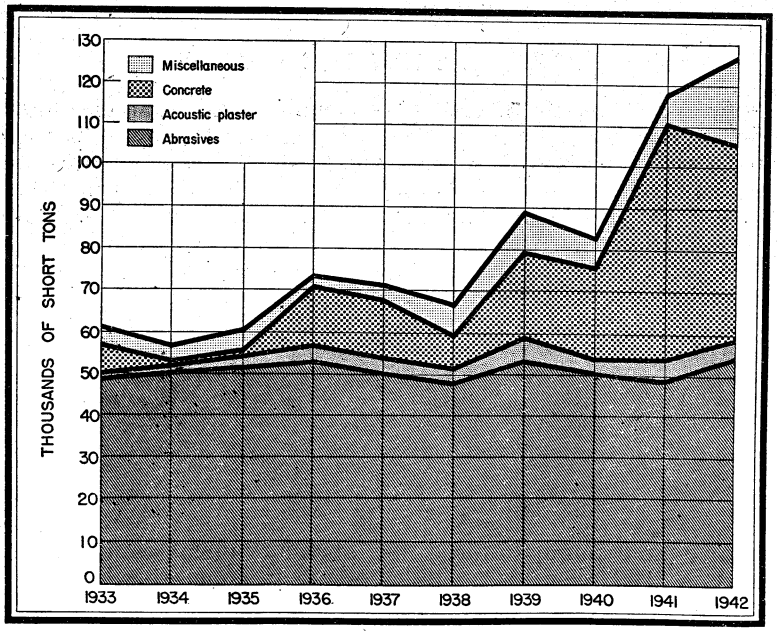

FIGURE 1.—Trends, by uses, of pumice and pumicite sold or used by producers in the United States, 1933–42.

Although volcanic ash is cheap and widely distributed in certain areas, its iron content has greatly restricted its use in ceramic applications.[17] Attempts to remove the iron by various means, including concentration, magnetic separation, and leaching, have been unsuccessful, as the iron is in the form of a complex silicate. Decolorizers, such as selenium and selenium combined with arsenic trioxide, gave promising results. The plasticity, dry strength, and glaze fit of hotel chinaware bodies are improved by substituting substantial quantities of volcanic ash for ball clay and feldspar. Potential applications are the use of volcanic ash as a glaze component and in low-cost glass. Iron oxide, however, usually gives a yellow or ivory tint to the fired ware.

The manufacture of a fire-resistant concrete masonry unit using pumice is described in the trade press.[18] Volcanic ash deposits in Texas, in Grimes County,[19] in Polk and adjoining counties,[20] and in the Rio Grande area,[21] were described. In the last-named study, the chemical and physical compositions of volcanic ash in that area were analyzed. When mixed with plastic clays, the resulting brick is said to be far superior to ordinary brick.

Garnet.—Although sales of garnet reported to the Bureau of Mines in 1942 decreased 21 percent in quantity and 19 percent in value, they were still somewhat above the levels of 1939, and the period 1931 to 1936. (See fig. 2.) The output of garnet produced for sale in 1942

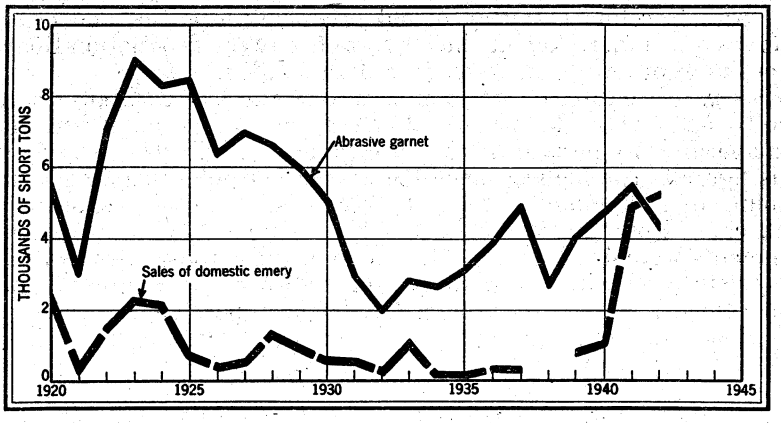

FIGURE 2.—Marketed production of abrasive garnet and domestic emery in the United States, 1920–42.

came from New York, North Carolina, and Idaho. Mas-Celo Mines, Inc., Burnsville, N. C., ceased business in June 1942, and the property remained idle the rest of the year. Yancey Cyanite Co. was to reopen the plant early in 1943. Recovery of garnet concentrates of probable

[17] American Ceramic Society, American Ceramic Society Committee on Research Reports on Enamel, Glass, Refractories, Ceramics (Structural), Whiteware, Materials: Bull., vol. 21, No. 6, June 1942, pp. 92-101 (see esp. p. 99).

[18] Lenhart, Walter B., Making a Porous Concrete Pipe: Rock Products, vol. 45, No. 4, April 1942, pp. 64–66.

[19] Ramsay, George D., Report on Volcanic Ash, Building Stone, and Gravel Deposits of Grimes County as a Part of the Mineral Resource Survey of Grimes County: Univ. of Texas, Bureau of Econ. Geol., Min. Res. Survey No. 14, 1936, 7 pp.

[20] Shafer, George H., Rice Sands in Polk and Adjoining Counties, with Notes on Volcanic Ash and Bentonitic Clays: Univ. of Texas, Bureau of Econ. Geol., Min. Res. Survey 41, 1942, 5 pp.

[21] Ryan, J. J., Field Findings on Rio Grande Volcanic Ash: Paper presented before Ceramic Society of the Southwest, at Univ. of Texas, October 17, 1942; reported in abs. in Brick and Clay Record, vol. 101, No. 5, November 1942, p. 8.

commercial value from Oregon beach sands was reported by Dasher, Fraas, and Gabriel.[22]

Abrasive garnet sold or used by producers in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	2,669	$191,658	1941	5,501	$371,752
1939	4,056	278,534	1942	4,357	299,904
1940	4,716	259,345			

Garnet prices, as quoted by E&MJ Metal and Mineral Markets, remained constant during 1942, as follows: New Hampshire, f. o. b. mines, per ton, concentrate, $35; grain, $80 to $140; New York Adirondack garnet concentrates, grain, $85; Spanish grades, c. i. f. port of entry, $70 (nominal).

NATURAL ALUMINA ABRASIVES

Corundum.—Practically all of the natural corundum used in this country in recent years has been imported from South Africa, although small receipts from other countries have been reported occasionally. The need of using it for war purposes and the uncertainties of a long ocean haul have led to intensive investigation of known or potential deposits, in order to develop domestic sources of supply if possible. In North Carolina a survey of old producing localities and existing reserves was undertaken at the request of the War Production Board.[23] Deposits in other regions also have been studied.

Emery.—The sales of emery produced in the United States in 1942 rose to 5,277 short tons worth $49,413, an increase of 8 percent in tonnage and 16 percent in value compared with 1941 (see fig. 2). This figure is the highest since 1918, when output (including a small amount of corundum) totaled 10,422 tons. The entire output in 1942 came from the Peekskill (N. Y.) region. Producers reporting shipments were Joe DeLuca, Di Rubbo & Ellis, and Scalzo & Pisano. Floors surfaced with a top coating of graded emery aggregate, portland cement, and water are rendered nonslippery, even when wet, give good traction, and have increased load-bearing properties and high resistance to wear.[24]

Emery sold or used by producers in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938			1941	4,876	$42,484
1939	765	$6,828	1942	5,277	49,413
1940	1,046	9,349			

NATURAL CARBON ABRASIVES[25]

Abrasive or industrial diamonds.—Given new impetus by the war, the development of the harder metal alloys and the need for greater

[22] Dasher, John, Fraas, Foster, and Gabriel, Alton, Mineral Dressing of Oregon Beach Sands, 1. Concentration of Chromite, Zircon, Garnet, and Ilmenite: Bureau of Mines Rept. of Investigations 3668, 1942, 19 pp.

[23] American Ceramic Society Bull., vol. 31, No. 11, November 15, 1942, p. 302; Manufacturers Record, vol. 112, No. 1, January 1943, p. 29.

[24] Chemical and Metallurgical Engineering, vol. 49, No. 10, October 1942, p. 148.

[25] See also chapter on Gem Stones of this volume.

accuracy and higher working speeds, have enlarged the scope of usefulness of diamonds. For many years diamonds have been essential in glass cutting and in rock drilling. Diamonds and diamond dust embedded in various matrices, such as powdered metal, plastics, and ceramic bonds, used in almost all manufacturing processes, are now much more important, quantitatively. In addition to their abrasive uses, diamonds are vitally needed because of their abrasion-resistant qualities, which make them especially suitable for use as dies in drawing copper, tungsten, brass, and other wires or filaments and as atomizers in oil-burning equipment.

Although there have been reports in the trade press of the possible reopening of the long idle Arkansas diamond properties,[26] by far the chief sources of abrasive or industrial diamonds now are Brazil and Belgian Congo. Other areas in Africa and South America also produce significant quantities of industrial diamonds. Imports of diamond dust into the United States in 1942 declined in value. Imports of bort increased over fourfold but were considerably under the 1937 figure. Diamonds for industrial use ("glaziers' and engravers', unset, and miners' diamonds") rose to 6,882,248 carats in 1941 and 11,203,704 carats in 1942 compared with 3,809,071 in 1940, a 194 percent increase within only 2 years. The average value per carat continued to decline, reflecting the greater use of smaller stones. The average values for 1942 and the 2 previous years were: 1942, $1.98; 1941, $2.17; and 1940, $2.89.

The world production of diamonds in 1942 probably approximated that of 1941, when slightly less than 9,350,000 carats were produced. The 1941 figure was over one-third (34 percent) less than in 1940, when production reached 14,250,000 carats. In normal years about two-thirds of the annual world production of diamonds consists of industrial stones, although their value scarcely exceeds one-fifth of the total annual diamond output. Unlike gem diamonds, industrial diamonds are actually consumed. In normal times, over half the diamonds used in industry were destroyed after 12 months' continuous employment.[27] Today the average life of industrial diamonds should be shorter, owing to the present intensity of work and the hardness of the alloys used for armament purposes.

The largest producing areas are in Africa—Belgian Congo, Gold Coast, Sierra Leone, and Angola together supplied 94 percent, by weight, of the total world output in 1941; South Africa and South-West Africa only 2 percent; and South America (Brazil, Venezuela, and British Guiana) 4 percent.[28] Of the 94 percent produced in Equatorial Africa, the output of the Gold Coast, Sierra Leone, and Angola represented 11, 9, and 8 percent of the world production.[29] Most of the Belgian Congo output came from the famous Beceka mines. Sinclair[30] described mining and market conditions leading to the shut-down of the large South African diamond mines and the possible effect of the heavy demand for stones of industrial grade.

[26] Engineering and Mining Journal, vol. 143, No. 11, November 1942, p. 96.
[27] Economist, Industrial Diamonds: Vol. 143, No. 5160, July 18, 1942, pp. 88–89.
[28] Ball, Sydney H., Diamond Production, In Symposium on Diamonds: Am. Mineral., vol. 23, No. 3, March 1943, pp. 141–150. (See esp. pp. 141–143.)
[29] National Jeweler, August 1942, pp. 92, 163.
[30] Sinclair, W. E., Diamond Mining in South Africa: Mining Mag. (London), vol. 66. No. 6, June 1942, pp. 251–256.

A new source of alluvial diamonds in the Ural Mountain region, U. S. S. R., was noted.[31]

Total sales of diamonds in 1942, according to market estimates, reached nearly £10,000,000 compared with £7,000,000 in 1941 and nearly £4,050,000 in 1938.[32] A considerable shift in the relative positions of gem and industrial diamonds has occurred in the last year or two. Gem sales have been smaller but prices much higher than heretofore. The prices of industrial diamonds, however, by agreement, have remained unchanged since the start of the war. Indications therefore point to an appreciable advance in the sale of industrial stones.[33] Factors in this increased importance of working diamonds, as above noted, are the volume and speed of war production, the greater hardness of armament alloys, with its attendant increase in replacement requirements, and the rapidly expanding range of its usefulness.[34]

A group of papers covering changes and progress in the diamond industry during 1942 was published in the early part of 1943.[35] World output, which is concentrated largely in the United Nations countries, and stocks were discussed by Ball.[36] After the Low Countries were invaded, the diamond-cutting industry was widely dispersed. Cutting industries have been established in Transvaal, Palestine, Brazil, Cuba, Puerto Rico, Great Britain, and the United States. Many gem-cutting establishments also have been producing specially shaped diamonds for tools or other industrial use.[37] Photomicrographic studies and the use of specially designed machines have resulted in marked improvements in the technique and speed of making drilling dies. Although the present facilities for die drilling in the United States only about equal minimum requirements, expansion to provide for increased demand is under way.[38] Wheel-dressing tools use more of the larger diamonds, but diamond core drilling consumes the larger portion of the smaller sizes, although the use of smaller stones in a cast or sintered head for dressing tools is increasing.[39] The grinding of hard and brittle metals, nonmetals, and synthetics with bonded diamond products has increased enormously in 1942 compared with 1941. Research has resulted in improvements in the composition of metal bonds and in manufacturing processes and in the introduction of a new bond of the ceramic vitrified type with a high glass content.[40]

Excellent summaries of the many industrial applications of diamonds and diamond tools appeared in the Mining Journal[41] and in

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[31] Averkin, A. A., and Shafranovskiĭ, I. I., Diamonds from the New Diamond-Bearing Region of the Middle Ural Region: Mem. soc. russe minéral., vol. 68, 1939, pp. 357–369; Chem. Zentralb 1940, part II, pp. 2286–2287; Chem. Abs., vol. 36, No. 21, November 10, 1942, p. 6454.

[32] Economist, Diamond Supplies: Vol. 144, No. 5193, March 6, 1943, pp. 309–310.

[33] South African Mining and Engineering Journal, Diamonds in Industry—Increasing Demand for Stones: Vol. 53, pt. 1, No. 2586, August 22, 1942, p. 633.

[34] Economist, Control of Industrial Diamonds: Vol. 142, No. 5145, April 4, 1942, pp. 478–479.

[35] Kraus, Edward H., and others, Symposium on Diamonds: Am. Mineral., vol. 28, No. 3, March 1943, pp. 141–150.

[36] Ball, Sydney H., Diamond Production: See Kraus, Edward H., and others, work cited in footnote 35, pp. 141–143.

[37] Kaplan, Lazare, Gem Diamonds and Their Present Trends: See Kraus, Edward H., and others, work cited in footnote 35, pp. 143–145.

[38] Shayne, Alexander, Diamond Dies: See Kraus, Edward H., and others, work cited in footnote 35, pp. 145–148.

[39] Slawson, Chester B., Diamond-Set Tools: See Kraus, Edward H., and others, work cited in footnote 35, pp. 148–149.

[40] Klein, A. A., Recent Development of Bonded Diamond Wheels: See Kraus, Edward H., and others, work cited in footnote 35, pp. 149–150.

[41] Mining Journal, Essential Role of Industrial Diamonds in Peace and War: Vol. 220, No. 5604, January 16, 1943, pp. 35–36.

Foreign Commerce Weekly.[42] The latter also presented a brief description of localities, production, history, and uses of South American diamonds, especially the Brazilian product. The usefulness of the diamond in the mechanical engineering field was discussed.[43] The experience of a large manufacturing plant in standardizing its diamond tools was published.[44] Information as to shapes and sizes of diamonds suited for truing and dressing purposes and methods of mounting diamonds individually and in diamond-impregnated tools were presented by Larson.[45] In order to cope with the expanding requirements for wheel-dressing tools, a more efficient method of setting the cutting edge was developed, making use of a vacuum for "positioning" the diamond.[46]

Padowicz [47] discussed the factors affecting die requirements and die performance in drawing copper wire at a large wire-drawing mill. Diamond failure was due not so much to wear as to breakage and chipping, caused by various strains having a possible correlation, in certain cases, to the angle of the drilling axis. Preparation, drilling, polishing, and mounting of diamond dies for use in wire drawing were described by Dudding, Eden, and Leeds.[48] Patent history with respect to the invention of the rock drill and notes regarding the early use of diamonds for drilling purposes were presented by Grodzinski.[49]

ARTIFICIAL ABRASIVES

Stimulated by the enormous activity in the munitions, shipbuilding, airplane, and other industries making war materials, the output of manufactured (artificial) abrasives in 1942 surpassed the former peak year (1941) by 33 percent in tonnage and 45 percent in value. Records also were established individually by all three classes of abrasives included in the Bureau of Mines figures. As in 1941, plants making crude aluminum oxide and silicon carbide in the United States and Canada operated at full capacity in 1942 and produced 61,681 short tons of silicon carbide valued at $4,904,309 and 183,633 tons of aluminum oxide valued at $12,719,337—an increase of 37 percent in tonnage of silicon carbide and 24 percent in tonnage of aluminum oxide. Operating at 72 percent of capacity, manufacturers of metallic abrasives (steel shot and grit) increased their sales in 1942 to 125,264 tons valued at $6,232,842, a gain of 45 percent in quantity and 54 percent in value.

[42] Foreign Commerce Weekly, Diamonds for Victory—South American Diamond Bullets Aid Democracy: Vol. 6, No. 3, January 17, 1942, pp. 3–5, 35.
[43] South African Mining and Engineering Journal, Diamonds in Industry—Some Applications in the Engineering Field: Vol. 52, pt. II, No. 2557, January 31, 1942, pp. 619, 621.
[44] Machinery, Buick Plant Standardizes Diamond Tools: Vol. 49, No. 8, April 1943, pp. 200–201.
[45] Larson, E. T., Diamonds and Devices for Truing and Dressing: Grits and Grinds, vol. 33, No. 3, March 1942, pp. 1–7; pub. by Norton Co., Worcester, Mass.
[46] Jameson, R. T., Setting Diamonds in Wheel-Dressing Tools: Am. Mach., vol. 86, No. 17, August 20, 1942, p. 884.
[47] Padowicz, H. N., Diamond Dies for the High-Speed Drawing of Copper Wire: Bell Sys. Tech. Jour., vol. 21, No. 1, June 1942, pp. 20–36.
[48] Dudding, B. P., Eden, C. G., and Leeds, R. E., Diamond Dies for Wire Drawing: Metal Ind., vol. 61, No. 21, November 6, 1942, pp. 290–293; condensed in Metals and Alloys, vol. 17, No. 2, February 1943, p. 358.
[49] Grodzinski, P., Invention of the Rock Drill: Canadian Min. Jour., vol. 16, No. 1, January 1942, pp. 15–16.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1938–42 [1]

Year	Silicon carbide [2]		Aluminum oxide [2]		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1938	25,346	$1,904,925	53,220	$3,098,132	25,771	$1,234,977	104,337	$6,238,034
1939	24,206	1,713,207	50,468	3,047,337	42,015	1,743,859	116,689	6,504,403
1940	33,042	2,359,876	98,531	5,464,986	50,016	2,317,829	181,589	10,142,691
1941	44,962	3,325,928	147,759	9,067,732	86,309	4,050,659	279,030	16,444,319
1942	61,681	4,904,309	183,633	12,719,337	125,264	6,232,842	370,578	23,856,488

[1] Bureau of Mines not at liberty to publish data for United States separately.
[2] Production; includes material used for refractories and other nonabrasive uses.

Production of silicon carbide and aluminum oxide is concentrated largely in the Niagara Falls region of Canada and the United States; some output of aluminum oxide comes from Quebec, Canada, and Alabama. "White High Purity or Special" aluminum oxide produced in 1942 totaled 31,665 short tons valued at $4,509,486, compared with 22,659 tons valued at $2,676,753 in 1941, an increase of 40 percent in tonnage and 52 percent in dollars. Estimated percentage of total consumption of silicon carbide for nonabrasive or refractory purposes in 1942 rose to 35 percent, compared with 32 percent in 1941 and 1940 and 29 percent in 1939. Similar percentages for aluminum oxide were 3 percent in 1942 and 1941, 2 percent in 1940, and 4 percent in 1939.

Metallic abrasives, including steel grit and shot but excluding steel wool, are manufactured in Michigan, New Hampshire, Ohio, and Pennsylvania. An illustrated article describing the plant and manufacturing process of the Harrison Abrasive Corporation, Manchester, N. H., appeared in 1942.[50] A flowing stream of molten steel is broken up by jets of steam. The resulting globules and irrregular particles fall into water, which chills and hardens them. The shot are graded into 16 commercial sizes, and the irregular pieces are crushed and screened into 12 sizes and marked as grit. The material is sold largely for cleaning castings and working stone.

The properties and uses of silicon carbide, aluminum oxide, and boron carbide and particularly their application and employment in the various types of grinding wheels were described in a report printed during 1942.[51] Manufactured abrasives and their utilization in grinding wheels also were discussed by Arend.[52] A description was given of the preparation of crude abrasive aluminum oxide ore received at the manufacturing plant of the Abrasive Co., Philadelphia, Pa., from its electric furnaces in Canada, beginning with the crushing and pulverizing operations through magnetic separation and elaborate grading to the manufacture of the principal end product (abrasive

[50] Park, Allen, S., Chilled Steel Shot and Grit: Compressed Air Mag., vol. 47, No. 3, March 1942, pp. 6684–6688.
[51] Cooper, Hermon C., Modern Abrasives: Jour. Chem. Education, vol. 19, No. 3, March 1942, pp. 122–127.
[52] Arend, A. G., Grinding Wheels; Composition of Abrasives from Electric Furnaces: Electrical Rev. (London), vol. 131, September 25, 1942, pp. 391–392.

wheels) by controlled firing schedules.[53] About 75 percent of the firm's business is in aluminous oxide products and the remainder in abrasives made of silicon carbide, which is received at the Philadelphia mill in the form of grain.

MISCELLANEOUS MINERAL ABRASIVE MATERIALS

In addition to the natural and manufactured abrasive materials discussed, many other mineral substances have abrasive uses. Various oxides, including tin oxide, rouge, 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, slate flour, whiting, feldspar, and other substances also are used as abrasives.

FOREIGN TRADE[54]

Imports of corundum ore in 1941 reached 5,865 short tons, slightly over double the 1940 imports and the highest figure at least since 1924. (Before 1924 imports of corundum and emery ore were not shown separately in Mineral Resources volumes.) Imports in 1942, however, declined 19 percent to 4,739 tons. As in 1941, no emery ore was received, and receipts of pumice were at an extremely low level. Imports of "flint, flints, and flint stones, unground," in 1942 were about one-quarter of those received in 1941. Imports of bort increased sharply. Imports of smaller diamonds, comprizing "glaziers' and engravers', unset, and miners' diamonds," totaled 11,203,704 carats valued at $22,154,076 in 1942, compared with 6,882,248 carats valued at $14,908,809 in 1941. The imports in both years were greatly in excess of those in the industrially active years 1940 and 1939. The influence of the expanded war production, as well as the ever-widening utilization of diamonds in industry, contributed largely to this indicated increased consumption.

The value of exports of natural abrasive materials in 1942 totaled $6,684,352, the highest year since 1920. The value of grindstones exported in 1942 rose 20 percent over 1941 to $224,998. The chief increase in value of exports, however, was in emery or corundum abrasive wheels, which were higher in 1942 than in any year since 1918. The value of exports of all other natural abrasives and abrasive products in 1942, though more than double that of 1939 and 1940, declined slightly from the 1941 value.

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[53] Ceramic Industry, Abrasive Industry Plays an Important Part in the War Program: Vol. 39, No. 4, October 1942, pp. 66, 68, 70, 72.

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

Abrasive materials imported for consumption in the United States, 1940–42, by kinds

Kind	1940		1941		1942	
	Quantity	Value	Quantity	Value	Quantity	Value
Millstones and burrstones: Bound up into millstones short tons	40	$2,167	12	$685	2	$153
Grindstones, finished or unfinished short tons	634	18,275	511	14,745	491	17,719
Hones, oilstones, and whetstones short tons	37	42,482	22	41,168	48	59,196
Emery:						
Ore do	5,718	73,935				
Grains, ground, pulverized, or refined pounds	(1)	(1)	(1)	(1)	(1)	(1)
Paper and cloth of emery or corundum	(2)	91,112	(2)	165,544	(2)	156,846
Wheels, files, and other manufactures of emery or corundum or garnet pounds	4,348	2,473	786	476	5,757	1,329
Corundum (see also "Emery"):						
Ore short tons	2,922	165,270	5,865	287,102	4,739	260,783
Grains, ground, pulverized, or refined pounds	[1] 134,606	[1] 9,262	[1] 102,906	[1] 4,021	[1] 124,362	[1] 7,001
Tripoli and rottenstone short tons	227	3,767	431	9,116	231	4,826
Pumice:						
Crude or unmanufactured do	3,758	20,771	43	987	67	1,391
Manufactures of, or of which pumice is the component material of chief value	(3)	6,468				
Diamond:						
Bort carats	785	19,660	502	16,196	2,147	26,559
Dust do	(3)	2,515	(3)	2,805	1,050	776
Glaziers' and engravers', unset, and miners' carats	3,809,071	11,026,563	6,882,248	14,908,809	11,203,704	22,154,076
Flint, flints, and flint stones, unground short tons	2,840	32,397	1,467	18,494	376	5,683
		11,517,117		15,470,148		22,696,338

[1] Emery included with corundum; not separately classified.
[2] 1,562 reams in 1940, 2,975 reams in 1941, 1,787 reams in 1942; weight not recorded.
[3] Quantity not recorded.

Value of domestic abrasive materials exported from the United States, 1938–42

Material	1938	1939	1940	1941	1942
Grindstones	$122,720	$173,575	$215,156	$187,621	$224,998
Abrasive wheels, emery and corundum	116,456	125,303	179,514	144,393	3,665,386
All other natural abrasives, whetstones, hones, etc	835,894	1,116,711	1,211,291	2,887,628	2,793,968
	1,075,070	1,415,589	1,605,961	3,219,642	6,684,352

SULFUR AND PYRITES

By G. W. Josephson and M. S. Jensen[1]

SUMMARY OUTLINE

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GENERAL SUMMARY

For the sulfur industry, 1942 was a year of activity and readjustment to meet wartime demands. Except for Great Britain, which still depends largely on imports, the major belligerents enjoyed adequate supplies of sulfur and its primary compounds derived either from natural deposits or recovered as industrial byproducts. Many countries, especially those in isolated or exposed positions like New Zealand, Turkey, and Sweden, began to feel a shortage as their stock piles became depleted and imports were reduced by blockade or deficiency of shipping facilities.

Almost everywhere realization of the crucial role being played by sulfur in industry led to the adoption of policies aimed at achieving national self-sufficiency. Production from local deposits or from previously untapped byproduct sources was encouraged by high prices or subsidies.

As most of the output of the United States sulfur industry is marketed in North America, the decline in export activity was not a serious factor. On the other hand, Italian and Spanish producers, being largely dependent on foreign markets, found that they had lost free access to many of their usual customers, and fully compensating demand did not develop in Europe. Activity was stimulated among the smaller producers, like Chile, Bolivia, Australia, and Canada, which are conveniently located to supply the neglected markets.

In the United States, as in many other countries, new production and consumption records were attained. Mine shipments were not as high as in 1941, owing principally to completion of stock-piling programs. Although sulfur production capacity was ample and stock piles adequate for at least 1½ years' consumption requirements were above ground, conditions in the industry were observed closely by various Government agencies. Transportation was an outstanding

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

problem. Price structures along the East coast were based upon low-cost coastwise water delivery of crude sulfur. With the advent of submarine attacks and requisitioning of ships for other service, sulfur was largely diverted to more expensive railroad and barge routes. Sufficient equipment was available in 1942 to carry sulfur and its

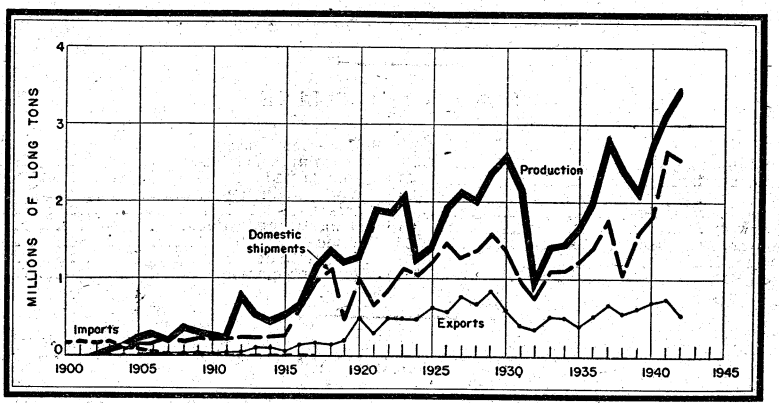

FIGURE 1.—Domestic production, shipments for domestic consumption, exports, and imports of crude sulfur, 1900–1942.

compounds, but some concern was expressed as the tonnage of acids increased. On December 5, 1942, the War Production Board placed sulfuric acid under allocation to permit prompt action in case of emergency and to assure supplies for explosives requirements. Sulfur consumers were urged to maintain large stocks as insurance against future transportation bottlenecks. Prices of sulfur and its compounds remained substantially stable during the year.

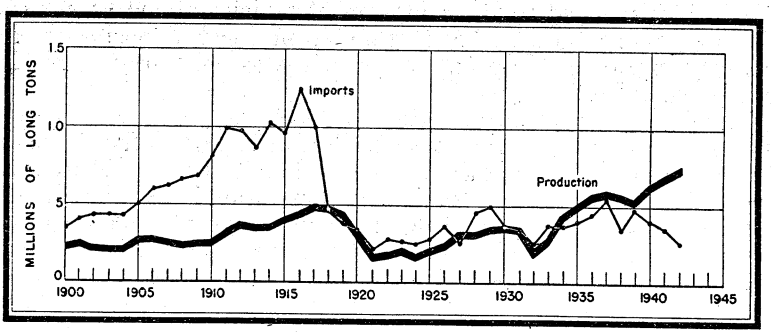

FIGURE 2.—Domestic production and imports of pyrites, 1900–1942.

On June 26, 1942, an indictment charging a violation of the anti-trust laws in the manufacture, distribution, and sale of sulfuric acid was returned against 15 companies and 37 individuals. However, upon the representation of the Secretaries of War and Navy that trial of the case would interfere with the war program, the Attorney General requested its postponement until after the war. The defendants agreed to this.[2]

[2] Source: Englehart, Otto T., Special Assistant to the Attorney General, U. S. Department of Justice.

The story of the American sulfur industry was told by William Haynes in a book published in 1942, entitled "The Stone That Burns."

Salient statistics of the sulfur industry in the United States, 1925–29 (average) and 1939–42

	1925–29 (average)	1939	1940	1941	1942
Sulfur:					
Production of crude sulfur---long tons	1,951,034	2,090,979	2,732,088	3,139,253	3,460,686
Shipments of crude sulfur:					
For domestic consumption---do	1,397,411	1,605,998	1,812,274	2,671,946	2,560,060
For export---do	707,175	627,819	746,468	729,464	568,499
Total shipments---do	2,104,586	2,233,817	2,558,742	3,401,410	3,128,559
Imports:					
Ore---do	1,896	35	(1)		
Other---do	295	13,941	27,845	28,631	25,632
Exports of treated sulfur---do	11,956	25,005	19,745	31,312	17,030
Producers' stocks at end of year---do	2,413,000	4,000,000	4,200,000	3,900,000	4,300,000
Price of crude sulfur f. o. b. mines per long ton	$17.50	$16	$16	$16	$16
Pyrites:					
Production---long tons	273,936	519,497	626,640	[2] 645,257	720,363
Imports---do	372,958	482,336	407,004	368,838	300,139
Price of imported pyrites c. i. f. Atlantic ports---cents per long-ton unit	12–13	12–13	12–13	12	12
Sulfuric acid: Production of byproduct sulfuric acid (60° B.) at copper and zinc plants---short tons	1,118,453	778,441	840,937	915,989	960,764

[1] Less than 1 ton. [2] Revised figures.

SULFUR

DOMESTIC PRODUCTION

Production of crude sulfur in the United States in 1942 attained a new record of 3,460,686 long tons, exceeding the previous high, established in 1941, by 10 percent. Mine shipments, adversely influenced by export restrictions and completion or modification of domestic stock-piling programs, were 8 percent lower than in 1941. Approximately 1,600 long tons of sulfur-bearing ore, containing 10 to 50 percent sulfur, mined in Colorado and Texas for agricultural purposes, are not included in the sulfur total.

REVIEW BY STATES

More than 83 percent of the native sulfur mined in the United States in 1942 came from deposits in Texas and over 16 percent from Louisiana. The remaining fraction of 1 percent was supplied by mines in California and Utah.

Sulfur produced and shipped in the United States, 1938–42

Year	Produced (long tons)				Shipped	
	Texas	Louisiana	Other States [1]	Total	Long tons	Approximate value
1938	2,060,845	328,405	4,158	2,393,408	1,628,847	$27,300,000
1939	1,665,400	422,600	2,979	2,090,979	2,233,817	35,500,000
1940	2,212,839	512,935	6,314	2,732,088	2,558,742	40,900,000
1941	2,596,731	533,620	8,902	3,139,253	3,401,410	54,400,000
1942	2,885,621	570,345	4,720	3,460,686	3,128,559	50,100,000

[1] 1938–40 and 1942: California and Utah; 1941: California.

California.—Pacific Sulphur Co. produced sulfur from the Crater claims at Bigpine, Inyo County.

Louisiana.—Freeport Sulphur Co. supplied the entire Louisiana output from Grande Ecaille, Plaquemines Parish. Production from this dome continued to increase steadily.

Texas.—As indicated in the following table (compiled from information issued by the Texas State Comptroller's Office), four organizations produced practically all the Texas output. Duval Texas Sulphur Co. reported production from Orchard Dome, Fort Bend County; Freeport Sulphur Co. from Hoskins Mound and Jefferson Lake Sulphur Co., Inc., from Clemens Dome, both in Brazoria County; and Texas Gulf Sulphur Co., from Boling Dome, Wharton County. The Pecos Orla Sulphur Co. mined sulfur ore at the Michigan claims in Culberson County.

Sulfur produced in Texas in 1942, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co	545,313	592,191	564,850	471,028	2,173,382
Freeport Sulphur Co	118,350	115,280	113,815	97,055	444,500
Jefferson Lake Sulphur Co., Inc	13,096	8,575	21,695	33,218	76,584
Duval Texas Sulphur Co	48,820	58,660	39,305	44,088	190,873
	725,579	774,706	739,665	645,389	[1] 2,885,339

[1] Total differs slightly from Texas production figure in preceding table because certain reports to Texas Comptroller are closed for year on December 25, whereas Bureau of Mines total covers calendar year.

Utah.—Pacific Sulphur Co. produced sulfur in Beaver County.

RECOVERY AS BYPRODUCT

The treatment of copper and zinc ores yields large quantities of sulfur, which are recovered at the mills as pyrites concentrates or at the smelters as sulfuric acid or elemental sulfur. The production of pyrites concentrate is discussed in the Pyrites section of this chapter. In smelting copper and zinc concentrates, sulfur is driven off as a constituent of gases, principally sulfur dioxide, which are used in the manufacture of sulfuric acid at many smelters. The equivalent of about 190,000 long tons of sulfur was recovered as sulfuric acid annually from this source during the 5 years ended in 1942. 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.

Byproduct sulfuric acid [1] (expressed as 60° B.) produced at copper and zinc plants in the United States, 1938–42, in short tons

	1938	1939	1940	1941	1942
Copper plants [1]	220,297	249,569	254,025	243,812	265,522
Zinc plants	466,879	528,872	586,912	672,177	695,242
	687,176	778,441	840,937	915,989	960,764

[1] Includes small quantity of sulfuric acid produced as byproduct in roasting of high-sulfide gold and silver concentrates.

The recovery of sulfur or sulfur compounds from coke-oven, refinery-still, natural, and other fuel gases is receiving increasing attention. In many foreign countries these processes are encouraged as a step

toward self-sufficiency and in the United States as a means of profitably utilizing a waste product or of conserving natural resources. Exemplifying this activity, a description was published in 1942 of progress in attempts to extract elemental sulfur from the enormous reserves of sour natural gas available in southwest Arkansas; here, removal of the sulfur has the additional advantage of greatly improving the quality and value of the fuel gas itself.[3]

Most of the elemental sulfur recovered from gas purification comes from operations using the Thylox process; relatively small quantities are recovered with the Ferrox and Nickel processes. Production in 1942 (reduced to 100 percent sulfur) totaled 5,125 long tons; 4,520 tons valued at $168,333 were shipped. Output came from Illinois, Maryland, Massachusetts, Missouri, New Jersey, New York, Washington, West Virginia, and Wisconsin; Massachusetts and New York were the largest producers. The product was marketed as a paste containing 37 to 50 percent sulfur or as dried relatively pure sulfur. The fine particle size of this material makes it valuable as a fungicide and insecticide, and these uses absorb most of it. Of the 1942 shipments (reduced to 100 percent sulfur), 37 percent was in the form of paste, and the remainder was dried sulfur.

Sulfur is also removed from fuel gases in the form of hydrogen sulfide, most of which is either converted into sulfuric acid or burned as fuel. The hydrogen sulfide recovered in 1942 came from plants using the phenolate, phosphate, and Girbotol processes. In 1942 the recovery of hydrogen sulfide (largely for sulfuric acid manufacture) was equivalent to 19,097 long tons of sulfur; the plants were in California, New Jersey, and Pennsylvania.

The figures covering the byproduct yield of sulfur from gas purification are not included in the sulfur production figures for the United States.

STOCKS

Stocks of crude sulfur held at the mines increased during the year and on December 31 amounted to 4,300,000 long tons. In addition, the producing companies hold substantial tonnages at other locations or in transit. The combined total of all producer-owned stocks at the end of the year was about 5,114,000 long tons, 9 percent more than on December 31, 1941. Although exactly comparable figures are not available for past years, it is apparent that producers' stocks are at or near an all-time high.

PRICE

Crude sulfur was quoted by trade journals at $16.00 per long ton f. o. b. mines throughout 1942. On May 11 (announced April 28) the Office of Price Administration froze prices at the maximum levels of March 1942. Subsequently there were intermittent reports of efforts to both raise and lower prices, but no change was authorized. Refined-sulfur prices, reflecting increased freight costs, were raised approximately 10 percent by some manufacturers before the General Maximum Price Regulation was established, but little or no change took place thereafter.

Sulfuric acid, 66° B., was quoted by journals at $16.50 per short ton at works in tank cars. The General Maximum Price Regulation

[3] Lee, James A., Sulphur from Arkansas Sour Gas: Chem. and Met. Eng., vol. 49, No. 6, June 1942, p. 80.

established ceiling prices, which were not disturbed. However, some acid producers were able to increase their over-all realization somewhat by bringing some of their lower-priced sales closer to the standard ceiling.[4]

CONSUMPTION AND USES

The apparent domestic consumption of sulfur in 1942 increased 6 percent over 1941, attaining a new record. This figure may be slightly low, as it does not allow for stock piles accumulated by consumers during 1941.

The following table shows the apparent domestic consumption of sulfur during the past 5 years.

Apparent consumption of sulfur in the United States, 1938–42, in long tons

	1938	1939	1940	1941	1942
Shipments [1]	1,628,847	2,233,817	2,558,742	3,076,038	3,032,043
Imports	2,603	13,976	27,845	28,631	26,018
	1,631,450	2,247,793	2,586,587	3,104,669	3,058,061
Exports:					
Crude	579,107	627,819	746,468	729,464	568,499
Refined	12,707	25,005	19,745	31,312	17,030
	591,814	652,824	766,213	760,776	585,529
Apparent consumption	1,039,636	1,594,969	1,820,374	2,343,893	2,472,532

[1] 1938–40: Mine shipments; 1941–42: Apparent shipments to consumers.

The pattern of industrial sulfur consumption has been estimated by Chemical and Metallurgical Engineering as follows:

Sulfur consumed in the United States, 1938–42, by uses, in long tons [1]

Use	1938 [1]	1939	1940	1941	1942
Chemicals	484,000	695,000	800,000	[2] 1,060,000	[2] 1,570,000
Fertilizer and insecticides	220,000	370,000	410,000	450,000	500,000
Pulp and paper	174,000	240,000	320,000	360,000	365,000
Explosives	50,000	64,000	74,000	[2] 83,000	[2] 90,000
Dyes and coal-tar products	40,000	46,000	51,000	65,000	60,000
Rubber	29,000	43,000	47,000	55,000	35,000
Paint and varnish	50,000	49,000	54,000	65,000	70,000
Food products	5,500	6,000	6,000	6,000	6,000
Miscellaneous	47,500	82,000	86,000	95,000	120,000
	1,100,000	1,595,000	1,848,000	2,239,000	2,816,000

[1] Figures for 1938 not truly representative of consumption but rather of shipments to these specified industries. Consumers carried over large stocks from 1937, therefore consumption in 1938 was larger than total shown.

[2] To avoid disclosing estimated consumption of sulfur in direct defense applications, such as military explosives, sulfur so used in 1941 and 1942 is included under "Chemicals."

Under recent peacetime conditions approximately 70 percent [5] of the brimstone consumed in the United States was converted into sulfuric acid, and the wartime demands of the explosives and petroleum industries have probably increased the proportion. Production of sulfuric acid, calculated as 50° B., is estimated to have increased to 12,520,000 short tons in 1942, 14 percent above the 1941 output of 10,944,000 tons.[6]

[4] From information supplied by Office of Price Administration.

[5] Texas Gulf Sulphur Co., Sulphur, An Essential to Industry and Agriculture: 1940, 45 pp.

[6] Chemical and Metallurgical Engineering, Sulphuric Acid and Sulphur: Vol. 50, No. 2, February 1943, p. 103.

Chemical and Metallurgical Engineering has estimated the consumption of sulfuric acid, by industries, from 1938 through 1942 as follows:

Sulfuric acid (expressed as 50° B.) consumed in the United States, 1938–42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Fertilizer	1,900,000	1,970,000	2,260,000	2,500,000	2,950,000
Petroleum refining	1,100,000	1,210,000	1,260,000	1,400,000	1,650,000
Chemicals	800,000	975,000	1,120,000	[1] 1,790,000	[1] 2,250,000
Coal products	585,000	740,000	900,000	940,000	970,000
Iron and steel	590,000	980,000	1,300,000	1,500,000	1,600,000
Other metallurgical	350,000	570,000	640,000	800,000	840,000
Paints and pigments	430,000	520,000	580,000	700,000	760,000
Explosives	140,000	160,000	170,000	[1] 190,000	[1] 195,000
Rayon and cellulose film	320,000	405,000	470,000	555,000	625,000
Textiles	90,000	116,000	125,000	165,000	145,000
Miscellaneous	355,000	384,000	360,000	500,000	530,000
	6,660,000	8,030,000	9,185,000	11,040,000	12,515,000

[1] To avoid disclosing estimated consumption of acid in direct defense applications, such as military explosives, acid so used in 1941 and 1942 is included under "Chemicals."

It is estimated that industry as a whole used 13 percent more sulfuric acid in 1942 than in 1941. The largest increases in consumption were made in the petroleum, fertilizer, and chemical (which includes military explosives) industries—18, 18, and 26 percent, respectively. With the exception of textiles, which decreased 12 percent, other industries enjoyed modest increases of 3 to 12 percent.

Two of the more significant applications of sulfuric acid during this wartime period are in the production of aviation gasoline by the alkylation process and in military explosives. Large expansion programs in these fields are making themselves felt both as volume consumers of strong acids and as producers of spent acids. Each locality has its individual spent-acid problems, which must be solved by regeneration, consumption in some intraplant operation in which weaker acids are satisfactory, or sale to other less critical industries. Whatever the solution, readjustments in the normal handling and distribution of acids are required. Local consumption or regeneration of spent acid was advocated as a means of alleviating the steadily growing demands on railroad facilities. Rail shipments of sulfuric acid have more than doubled during the past 2 years.

The versatility of sulfur in war is illustrated by the practice of stimulating the flow of gum from southern turpentine pines by painting the tap wounds with sulfuric acid.

That sulfur continued to occupy a prominent position in research laboratories is indicated by its use in synthetic rubber, and in less publicized discoveries, such as the compound tetraethyl thiuram monosulfide (a preventive of a serious poultry disease).[7]

FOREIGN TRADE

As a result of the stringent shipping situation, exports of crude and treated sulfur were, respectively, 22 and 46 percent lower than in 1941. The accompanying table of exports by countries reveals the changes in pattern of distribution caused by the war.

[7] Science News Letter, vol. 42, No. 5, August 1, 1942, p. 72.

Imports of elemental sulfur (principally from Canada) decreased 10 percent. Imports of sulfuric acid (also largely from Canada) totaled 13,689 short tons and exports 9,679 short tons.

Sulfur exported from the United States, 1941–42, by countries

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1941		1942		1941		1942	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
North America:								
Canada	208,915	$3,880,002	297,955	$6,251,551	8,302,636	$189,291	8,151,119	$224,702
Central America	210	6,182	84	3,294	650,309	15,957	589,188	14,403
Mexico	5,900	113,274	4,489	87,863	3,259,937	62,950	3,907,260	73,970
Newfoundland	11,489	195,573	14,822	311,930	2,910	116	4,500	207
West Indies	17,295	294,052	12,247	212,721	656,784	20,436	370,377	16,878
	243,809	4,489,083	329,597	6,867,359	12,872,576	288,750	13,022,444	330,160
South America:								
Argentina			16,338	294,975	119,205	20,649	145,753	15,709
Brazil	10,944	212,668	16,582	333,984	4,781,876	104,339	4,198,350	92,668
Chile					12,800	387	268	24
Colombia			230	4,913	573,656	14,139	716,494	19,614
Equador					31,297	1,143	39,580	1,261
Peru					137,193	2,999	113,120	3,177
Uruguay	3,170	54,340	1,224	39,368	139,900	4,136	693,444	13,875
Venezuela			20	501	148,237	5,330	109,298	2,938
Other South America	299	6,950			7,552	214	16,393	482
	14,413	273,958	34,394	673,741	5,951,716	153,336	6,032,700	149,748
Europe:								
Greece					19,651,804	274,551		
Sweden					26,100	640		
United Kingdom [1]	296,498	4,622,371	121,807	1,888,005	4,859,614	104,996	3,126,884	76,624
Other Europe	21	801			9,918	595	103,910	2,372
	296,519	4,623,172	121,807	1,888,005	24,547,436	380,782	3,230,794	78,996
Asia:								
Arabia					2,973,210	30,401		
British Malaya					701,330	23,093	66,352	995
Burma	1,080	32,800			154,280	2,752	112	39
China	641	14,598			1,125,200	18,896	2,500	1,013
Hong Kong	234	7,162			1,012,324	21,139		
India and Dependencies [2]	28,774	565,135	11,028	273,210	10,051,463	189,970	8,246,626	223,278
Indochina, French					334,450	9,377		
Iran	2,500	57,500	4,281	86,864			3,997,000	36,450
Netherlands Indies	1,800	32,400			362,096	13,035	178,350	3,978
Other Asia	1,271	39,464	2,300	46,625	657,164	16,522	403,431	10,679
	36,300	749,059	17,609	406,699	17,371,517	325,185	12,894,371	276,432
Africa:								
Belgian Congo					144,319	2,978	491,312	12,093
British East Africa					1,503,323	31,998	700,752	17,509
Egypt			1,450	29,338	2,212,534	52,261	355,582	7,530
Madagascar					440,050	8,658		
Mozambique			150	3,555	99,746	5,432		
Nigeria			3	77	16,056	474	32,535	1,057
Union of South Africa	20,947	380,565	17,992	318,032	3,621,021	83,331	1,103,514	28,689
Other Africa	434	14,572			239,884	4,475	3,709	195
	21,381	395,137	19,595	351,002	8,276,933	189,607	2,687,404	67,073
Oceania:								
Australia	53,232	925,050	28,323	481,010	924,674	18,435	49,239	1,703
New Zealand	63,810	1,064,609	17,174	280,674	182,668	4,303	229,739	7,416
Other Oceania					11,700	285	1,360	70
	117,042	1,989,659	45,497	761,684	1,119,042	23,023	280,338	9,189
	729,464	12,520,068	568,499	10,948,490	70,139,220	1,360,683	38,148,051	911,598

[1] United Kingdom of Great Britain and Northern Ireland.
[2] British India.

Sulfur imported into and exported from the United States, 1938–42

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
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
1941			28,631	487,758	729,464	12,520,068	31,312	1,360,683
1942			25,632	442,811	568,499	10,948,490	17,030	911,598

[1] Less than 1 ton.

WORLD PRODUCTION

Censorship restrictions of the belligerent nations have for several years eliminated publication of their production statistics, making any estimate very arbitrary. Available figures are shown in the following table. Judging from the meager information at hand, world production of elemental sulfur probably exceeded 4,300,000 long tons in 1942.

World production of native sulfur, 1937–42, by countries, in long tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Bolivia (exports)	1,712	1,632	2,126	4,065	2,315	3,535
Chile [2]	16,766	20,959	26,999	28,997	24,784	42,000
Ecuador	54	68	72	(3)	(3)	(3)
France (content of ore)	157	140	(3)	(3)	(3)	(3)
Greece	67	75	(3)	(3)	(3)	(3)
Guatemala	11	15	12	11	(3)	(3)
Italy (crude) [4]	338,101	374,339	(3)	(3)	(3)	(3)
Japan	138,283	(3)	(3)	(3)	(3)	(3)
Mexico	(3)	49	(3)	(3)	(3)	(3)
Netherlands East Indies	12,474	15,986	17,293	16,908	(3)	(3)
Palestine	494	1,196	829	1,248	(3)	(3)
Peru	1,551	1,944	569	610	923	(3)
Spain [5]	1,950	2,050	(3)	(3)	(3)	(3)
Turkey	2,229	3,684	2,560	(3)	(3)	(3)
United States	2,741,970	2,393,408	2,090,979	2,732,088	3,139,253	3,460,686
Estimated world total	3,400,000	3,100,000	2,900,000	3,500,000	4,000,000	4,300,000

[1] Native sulfur believed to be produced also in Argentina, China, Cuba, India, Iran, Taiwan, and U. S. S. R., but quantity unknown.
[2] In addition, 1,050 tons of sulfur rock (40–80 percent sulfur) reported for 1937.
[3] Data not available.
[4] In addition, following quantities of sulfur rock reported—1937: 19,793 tons; 1938: 16,545 tons. Similar data not available for later years.
[5] Estimated sulfur content of ore, excluding sulfur made from pyrites.

Bolivia.—Active demand and high prices are stimulating expansion of both Concepción and San Pablo de Napa, the latter being the principal Bolivian producer.[8]

Canada.—Substantial quantities of byproduct elemental sulfur were produced for domestic consumption and export; 25,071 long tons were exported to the United States.

Chile.—Surface deposits of sulfur occur along the Andes from the Peruvian frontier to about 36° south latitude. The principal mines

[8] Engineering and Mining Journal, vol. 143, No. 7, July 1942, p. 100.

are around Mount Tacora in Arica and in Antofagasta Province near the Bolivian border.[9] Wartime shipping restrictions put Chile's sulfur industry in a good competitive position in the Argentine, Uruguayan, and Brazilian markets, even at high prices. Old operations were active, and the Corporación de Fomento granted capital to open a new deposit in Arica.[10] Although the present situation is satisfactory, the industry is still not particularly profitable, and it is realized that the postwar outlook depends on the development of a more efficient method of treating these ores. The problem is complicated by the fact that these operations, in barren terrain 13,000 to 19,000 feet above sea level, depend on a local resinous moss for fuel.[11] Destructive harvesting is seriously threatening the supply. As coal would have to be brought, at considerable expense, by steamer, rail, and pack horse from south central Chile, the situation is causing some concern. Chilean authorities are sponsoring less destructive methods of harvesting and a program to determine whether or not the plant can be domesticated and cultivated.

Germany.—Although Sicily's sulfur supplies were available to Germany in 1942, the somewhat meager information obtainable indicates it was not necessary to draw heavily on the Italian deposits. Germany's sulfur needs were apparently satisfied by its well-developed byproduct installations and plants using pyrites or calcium sulfate as a raw material. The literature indicates that German technology reported progress in developing efficient sulfur burners and processes that recover sulfur from very low concentrations in coke-oven and coal-distillation gases.[12]

Great Britain.—A committee of the Institution of Gas Engineers recommended three processes—the active-carbon, the oil-washing, and the catalytic—for removing sulfur from coal gas. The active-carbon and oil-washing processes are now in use at 25 plants and the catalytic at 1 plant. Sulfur supplies were conserved by licensing consumers.[13]

Italy.—Conflicting reports obscure the Italian sulfur situation. On the one hand, it has been said that production in 1940–41 was 7 percent less than in the previous year and that labor and equipment shortages, transportation problems, and loss of export markets have seriously restricted the industry. On the other hand, it is stated that the financial situation of producers was satisfactory and no Government subsidies were required; that 200,000 men are now employed compared with 80,000 in 1938–40; and that all requirements were satisfied without diminishing existing stocks.[14] Evidence of some difficulties is found in the organization of a joint German-Italian company, Societa per Incremento Produzione Zolfi, whose stated purpose is to deal with the problems of high costs and lost markets by pooling inventions and introducing a more efficient process.

Japan.—Although exact information is lacking for 1942, it is known that native sulfur deposits in Japan make it self-sufficient in this commodity.

Mexico.—At present the only sulfur produced in Mexico is a very impure material from the State of San Luis Potosí. A new carbon disulfide plant will use it as a raw material.

[9] Benitez, Fernando, Chile: Eng. and Min. Jour., vol. 143, No. 8, August 1942, p. 78.
[10] Chemical and Engineering News, vol. 20, October 25, 1942, p. 1311.
[11] Wilson, James Parker, Consular Report 290.
[12] Chemical and Metallurgical Engineering, vol. 49, No. 1, January 1942, pp. 159–160.
[13] Chemical and Engineering News, vol. 20, No. 24, December 25, 1942, p. 1655.
[14] Mining Journal (London), vol. 219, No. 5588, September 26, 1942, p. 459.

New Zealand.—Consideration was given to opening deposits in the Hot Lakes district, and research agencies studied the concentration problems involved.

Palestine.—In the Gaza Area a sulfur deposit estimated at 1 million tons has been reported.[15]

Spain.—The European press reported that Sociedad Española de Construccion Electromecanica is to operate a new plant capable of producing 50,000 tons of sulfur and 15,000 tons of sulfuric acid annually.

Sweden.—Sulfur is a byproduct of the Swedish Navy's new shale-oil plant at Kinnekulle. Sulfur supplies are under strict allocation.[16]

U. S. S. R.—Reports continue to appear of the discovery of huge supplies of native sulfur, comparable with the Sicilian deposits, in the Turkmen S. S. R. east of the Caspian Sea.

PYRITES

DOMESTIC PRODUCTION

In 1942, for the third successive year, a new record was attained in production of pyrites in the United States—12 percent higher than the 1941 total. Ninety-eight percent of the output was classified as fines, largely flotation concentrates, and the remainder as lump.

Pyrites (ores and concentrates) produced in the United States, 1938–42

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulfur content (percent)			Gross weight (long tons)	Sulfur content (percent)	
1938	555,629	39.4	$1,685,766	1941 [1]	645,257	41.9	$2,009,000
1939	519,497	42.3	1,560,000	1942	720,363	42.6	2,464,000
1940	626,640	41.8	1,920,000				

[1] Revised figures.

In 1942, 492,720 long tons were consumed by the producing companies and 234,639 tons were sold compared with 443,983 and 207,504 tons, respectively, in 1941.

REVIEW BY STATES

California.—The Mountain Copper Co. produced pyrites in California in 1942; output came from the Hornet mine in Shasta County.

Colorado.—Four companies reported a total production of 11,067 long tons in 1942. They were Minnesota Mines, Inc., Clear Creek County; Rico Argentine Mining Co., Dolores County; and John Hamm Mining & Milling, Ltd., and Resurrection Mining Co., Lake County.

Illinois.—From its coal-cleaning plant in Henry County, the Midland Electric Coal Corporation produced 13,562 long tons of pyrite (coal brasses) in 1942.

Indiana.—The Snow Hill Coal Corporation produced pyrite (coal brasses) at its Talleydale mine in Vigo County in 1942.

Montana.—The pyrites produced in Montana in 1942 came from the Anaconda Copper Mining Co. at Anaconda, where it is recovered as a flotation concentrate in copper-plant operations.

New York.—In 1942 New York produced 68,826 tons of pyrites.

[15] Chemical Age, vol. 47, No. 1205, August 1, 1942, p. 105.
[16] Foreign Commerce Weekly, vol. 8, No. 6, August 8, 1942, p. 28.

Pennsylvania.—The Bethlehem Steel Co. produced pyrite concentrates in Lebanon County.

Tennessee.—The Tennessee Copper Co. operations in Ducktown Basin, Polk County, made Tennessee the largest producer of pyrites in 1942. None of this material, a flotation concentrate, appeared on the market, as all of it was consumed by the producing company.

Virginia.—The General Chemical Co. produced a substantial tonnage of pyrites at the Gossan mine in Carroll County and consumed the entire output in its own manufacturing operations.

Wisconsin.—The one company reporting production of pyrites in Wisconsin in 1942 was the Vinegar Hill Zinc Co., Grant County. The company sulfuric acid plant consumed the entire output.

FOREIGN TRADE

Compared with 1941, imports of pyrites decreased 19 percent in 1942, largely owing to an 87-percent drop in tonnage from Spain. Increased Canadian shipments, which now occupy the position in the United States market formerly held by Spanish, partly counteracted the loss. Canada furnished 94 percent of the imports in 1942.

Although little or none was available, Spanish pyrites, guaranteed 48 percent sulfur, was quoted nominally at 12 cents per long-ton unit of sulfur, c. i. f. United States ports.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1938–42, by countries

Country	1938		1939		1940		1941		1942	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	30,064	$135,659	176,804	$470,336	81,157	$560,476	244,287	$1,151,964	282,896	$1,313,295
Greece			22,800	106,271						
Mexico	202	522			203	719	320	1,500	682	2,995
Spain	303,968	709,983	282,732	738,439	325,644	790,172	124,231	326,052	16,561	43,866
	334,234	846,164	482,336	1,315,046	407,004	1,351,367	368,838	1,479,516	300,139	1,360,156

In 1942 receipts of pyrites in the Philadelphia and Baltimore customs districts sank to 6 percent of the total, and none came into New York. Seventy-five percent entered through the Buffalo district.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1938–42, by customs districts, in long tons

Customs district	1938	1939	1940	1941	1942
Buffalo	5,130	21,940	80,076	227,510	225,924
Maryland	113,838	176,982	19,702	24,231	12,561
Massachusetts					82
Michigan				12,569	29,163
Montana and Idaho					366
New York	55,830	46,170	82,292	317	
Ohio		2,000			1
Philadelphia	130,703	189,727	215,373	88,219	6,102
St. Lawrence					80
San Diego	202		203	320	732
South Carolina	5,265	4,396			
Vermont	15,713	31,433	937	3,889	15,439
Virginia	7,553	8,885	8,331	11,781	4,000
Washington		803	90	2	5,689
	334,234	482,336	407,004	368,838	300,139

WORLD PRODUCTION

Although little or no precise statistical information is available for the wartime period, world production of pyrites in 1942 probably approximated 9 million metric tons containing about 3,900,000 tons of sulfur.

World production of pyrites (including cupreous pyrites), 1938, 1941, and 1942, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1938		1941		1942	
	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)	(2)	(2)	(2)	(2)
Canada	40,464	20,300	275,202	135,287	(2)	(2)
Cyprus (exports)	523,574	256,551	(2)	(2)	(2)	(2)
Czechoslovakia [3]	(2)	(2)	[4] 22,000	(2)	[4] 10,000	(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	(2)	(2)	(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	251,250	172,759	[4] 77,740	[5] 112,624	[4] [5] 50,680
Rumania	11,205	7,061	(2)	(2)	(2)	(2)
Southern Rhodesia	27,065	10,900	(2)	(2)	(2)	(2)
Spain [6]	2,727,003	[4] 1,145,341	490,096	[4] 205,840	[7] 241,678	[4] [7] 101,505
Sweden	186,390	84,345	(2)	(2)	(2)	(2)
Union of South Africa	31,017	13,947	[5] 28,613	(2)	[8] 30,264	(2)
United Kingdom	4,351	(2)	(2)	(2)	(2)	(2)
United States	564,547	222,612	[9] 655,613	[9] 274,702	731,925	311,885
Uruguay	70	(2)	(2)	(2)	(2)	(2)
Yugoslavia	150,402	67,681	(2)	(2)	(2)	(2)
Estimated world total	10,000,000	4,300,000	8,500,000	3,700,000	9,000,000	3,900,000

[1] In addition to countries listed Belgium, Brazil, China, Chosen, Eire, India, Japan, and U. S. S. R produced pyrites, but production data are not available.
[2] Data not available.
[3] Slovakia only.
[4] Estimated.
[5] January to October, inclusive.
[6] Average sulfur content of pyrites was 42 percent in 1931, latest year for which such information is available.
[7] January to July, inclusive.
[8] January to September, inclusive.
[9] Revised figures.

Australia.—Before the war Australian sulfur demand was supplied principally by imported elemental sulfur. As this trade dwindled under the pressure of shipping priorities, attention was given to the possibility of achieving self-sufficiency through pyrite. A pyrite industry already exists on Tasmania. Deposits at Eulaminna near Murrin, the Great Victoria at Burbridge, the Iron King at Norseman, and others at Spargo's Reward and St. Ives were explored.[17] During the latter part of 1942 it was reported that production of pyrite had begun.

Canada.—With Spanish pyrites available only intermittently during 1942, Canadian concentrates enjoyed a very good market in the United States. Aldermac was shipping at the rate of 16,000 tons monthly (12,000 tons from production and the rest from stock). The life of this mine was estimated early in 1942 at 16 months, as the ore body is near exhaustion.[18] Other pyrite-producing mines active in

[17] Mineral Trade Notes, Confidential Series 10, April 1943, p. 29.
[18] Northern Miner, vol. 28, No. 15, July 2, 1942, p. 9.

1942 were the Noranda in Quebec and the Britannia in British Columbia. Prices on most contracts were 5 cents or better per unit.[19] Development of a property in Delestre Township, Quebec, was proposed by Delandore Iron & Sulphur Mines. Open-pit methods would be used on a deposit reported in 1937 to total 13,500,000 tons, containing 12 percent pyrite, and 88 percent pyrrhotite, which would concentrate to 37.5 percent sulfur and 54.5 percent iron.[20] A proposal was reported to install equipment in the Golden Manitou Mill in Quebec to enable it to recover 130 tons of pyrite per day from its zinc-gold-silver-pyrite ore.

Cyprus.—Pyrite production in Cyprus has virtually ceased as the island is in a critical and exposed position in the war zone.[21]

Eire.—After years of idleness, the pyrite deposits in County Wicklow are supplying sulfuric acid for the production of fertilizer from phosphate deposits in County Clare. The goal is to supply a quarter of Eire's normal consumption of superphosphate.[22]

Portugal.—During the first 10 months of 1942, 112,624 metric tons of pyrites were produced in Portugal.[23]

Spain.—In spite of Spain's enigmatic position in the war, it maintained its pyrites trade with Great Britain and to some extent with the United States. During the first 9 months of 1942, 162,417 metric tons were reported shipped to the United Kingdom through the ports of Huelva and Seville. Only 16,561 tons were exported to the United States in 1942—a mere fraction of the 1938–40 average (300,000 tons a year). American shipments were limited to Spanish ships, and no cargoes moved after September. In general, the evidence seems to agree that 1942 was a poor year for Spanish pyrites, and efforts were made to consume greater quantities within Spain, partly to benefit the industry but more particularly to relieve an acute shortage of arsenic and copper. Conversion of pyrites to more salable products was encouraged, and several plants took steps to install additional equipment for that purpose. The Seville Sulphur Copper Co. was ready to suspend operations owing to low quality and to transportation difficulties.[24]

Sweden.—Domestic production of pyrites increased as imports declined; but all sulfur supplies were very low, and some industrial activity was curtailed by the shortage.[25]

U. S. S. R.—Some reports indicate that in 1938 Russia was one of the leading pyrites producers, with an output approaching 1 million tons, derived chiefly from cupriferous ore bodies in the Urals and from coal mines.[26] Details are lacking for 1942, but it is certain that vast quantities of sulfur were required in the development and operation of Russia's large, rapidly expanding industries.

[19] Northern Miner, vol. 28, No. 24, September 3, 1942, p. 17.
[20] Canadian Mining Journal, vol. 63, No. 1, January 1942, p. 62.
[21] Iron and Coal Trades Review, vol. 144, No. 3866, April 3, 1942, p. 316.
[22] Chemical Age (London), vols. 46 and 47, Nos. 1196 and 1223, May 30 and December 5, 1942.
[23] Mineral Trade Notes, Confidential Series 9, March 1943, p. 33.
[24] Metal Bulletin (London), No. 2709, July 14, 1942, p. 4.
[25] Mineral Trade Notes, Confidential Series 10, April 1943, p. 38.
[26] Williams, David, Mineral Resources of U. S. S. R.: South African Min. and Eng. Jour., vol. 53, part 2, No. 2594, October 17, 1942.

PHOSPHATE ROCK

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

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GENERAL CONDITIONS

The record for marketed production of phosphate rock made in 1941 was not quite attained in 1942, as the quantity sold or used by producers was 4,644,240 long tons (see fig. 1), about 45,000 tons less

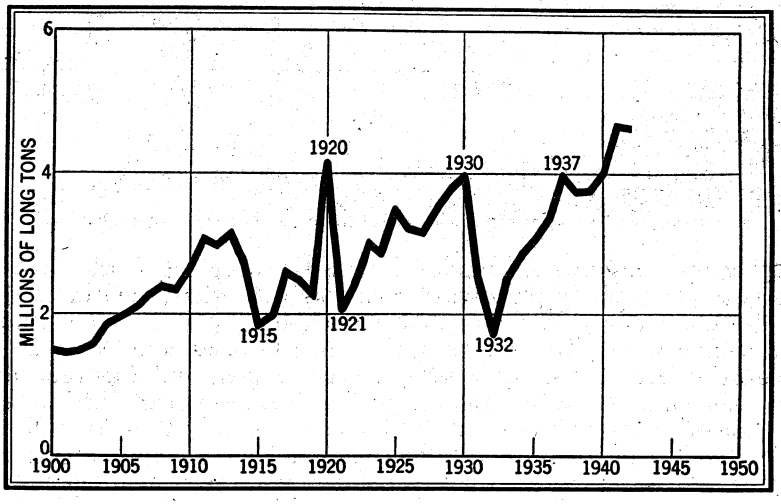

Figure 1.—Marketed production of domestic phosphate rock, 1900–1942.

than in 1941. The value, however, was about a million dollars greater than in 1941. Mined production—4,818,938 long tons in 1942—was 2 percent less than the all-time record of 4,922,183 tons in 1941. Exports fell nearly one-half million tons to 528,716 tons, whereas imports, a few thousand tons only, were slightly less than in 1941. Stocks in producers' hands at the end of the year increased 5 percent over 1941. Apparent domestic consumption of phosphate rock in 1942 was much the greatest ever recorded, exceeding 1941 by 12 percent.

General scientific papers published recently include those by Frondel,[1] Dietz, Emery, and Shepherd,[2] McConnell,[3] and de Villiers.[4] A paper by Jacob[5] covers the phosphate-rock industry in general.

Salient statistics of the phosphate-rock industry in the United States, 1941–42

	1941			1942		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
Production (mined)	[1] 4,922,183	(2)	(2)	4,818,938	(2)	(2)
Sold or used by producers:						
Florida:						
Land pebble	3,279,706	$9,890,510	$3.02	2,893,756	$8,826,705	$3.05
Soft rock	47,750	132,472	2.77	48,470	155,345	3.20
Hard rock	38,116	211,049	5.54	70,014	396,527	5.66
Total Florida	3,365,572	10,234,031	3.04	3,012,240	9,378,577	3.11
Tennessee [3 4]	1,120,358	4,590,965	4.10	1,366,335	6,127,792	4.48
Idaho	97,274	444,154	4.57	114,079	511,249	4.48
Montana	105,108	318,588	3.03	150,402	572,464	3.81
Utah	1,340	8,535	6.37	1,184	7,410	6.26
Virginia	(4)	(4)	(4)	(4)	(4)	(4)
Total United States	[1] 4,689,652	[1] 15,596,273	[1] 3.33	4,644,240	16,597,492	3.57
Imports [5]	4,340	32,816	7.56	3,765	24,887	6.61
Exports [6]	1,019,960	5,738,859	5.63	528,716	3,348,341	6.33
Apparent consumption [7]	3,674,032			4,119,289		
Stocks in producers' hands, Dec. 31:						
Florida [8]	1,483,000	(2)	(2)	1,426,000	(2)	(2)
Tennessee [3 8]	292,000	(2)	(2)	437,000	(2)	(2)
Other	3,000	(2)	(2)	4,000	(2)	(2)
Total stocks	1,778,000	(2)	(2)	1,867,000	(2)	(2)

[1] Revised figures.
[2] Figures not available.
[3] Includes sintered matrix.
[4] Virginia included with Tennessee.
[5] Market value (or price) at port and time of exportation to the United States.
[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 in 1941 and 1942 and blue rock in 1942.

Effects of war on world trade.—Before the onset of World War II international trade in phosphate rock was well established in certain definite channels; this commodity moved largely from three major producing centers—North Africa, the United States, and Oceania—to three principal consuming areas—Europe, Japan, and Australia and New Zealand. Two of the producing areas—North Africa and Oceania—exported virtually all of their production; that from North Africa went principally to Europe, but some was sent to Japan; and that from Oceania was split between Japan and the British Dominions Australia and New Zealand. The other important producing area, the United States, shipped only its surplus (about a third of its production). This went chiefly to Europe and Japan. Of the various consuming areas, Europe depended almost entirely upon imports, as did also Australia and New Zealand. Japan depended largely upon foreign sources, whereas the United States alone was entirely independent in respect to external supplies.

[1] Frondel, Clifford, Mineralogy of the Calcium Phosphates in Insular Phosphate Rock: Am. Mineral., vol. 28, No. 4, April 1943, pp. 215–232.
[2] Dietz, R. S., Emery, K. O., and Shepherd, F. P., Phosphorite Deposits on the Sea Floor off Southern California: Bull. Geol. Soc. America, vol. 53, 1942, pp. 815–848.
[3] McConnell, Duncan, Griphite, a Hydrophosphate Garnetoid: Am. Mineral., vol. 27, 1942, pp. 452–461.
[4] de Villiers, J. E., The Carbonate Apatites; Francolite from the Richtersveld, South Africa: Am. Jour. Sci., vol. 240, 1942, pp. 443–447.
[5] Jacob, K. D., Phosphate Rock (in 1941): Mineral Ind., vol. 50, 1942, pp. 413–433.

These normal world trade relations in phosphate rock have been almost completely upset by the war's developments. Each major development has reacted on international trade in this commodity. The outbreak of the war between the Allied Nations England and France and the German Reich on September 3, 1939, with the consequent British blockade of Germany, brought to a complete stop all exports of American and North African rock to Germany and the territory it controlled in central Europe—Austria, Czechoslovakia, Danzig, and Poland—except those that may have entered through the neutral Mediterranean countries in southeastern Europe.

With the invasion of Norway by Germany in April 1940, phosphate-rock shipments to the Scandinavian countries from the United States ceased, and in May 1940 the German invasions of Netherlands and Belgium ended all possibility of further shipments to those countries.

The defeat of France in June 1940 had many repercussions in the world phosphate-rock trade. It stopped the movement to Britain and the Union of South Africa from the North African deposits—normally the principal source of supply for this material—in consequence, Great Britain turned to the United States for supplies, and exports of American rock to Great Britain in 1940 exceeded even the large amount sent from the United States to Japan in that year. Large shipments were also made in 1940 from the United States to the Union of South Africa, which normally obtained its requirements from Morocco. Record shipments went to Canada from the United States, and American rock was sent to Portugal for the first time in many years. As a result of these new demands, exports from America were maintained at about 70 percent of the pre-war volume.

The entrance of Italy into the war as an Axis partner, following the collapse of France, stopped the shipments of American phosphate rock not only to Italy but also to countries such as Switzerland and Hungary that had been receiving American phosphates through Italian ports. The defeat of France and the entry of Italy into the war also had a very adverse effect on the phosphate industry of the French possessions in North Africa—Algeria, Morocco, and Tunisia—countries that normally produce about 4 million tons of rock a year and export about 3½ million tons to Europe. Shipments from French North Africa in 1940 and exports to Europe in that year are stated to have been only about 50 percent of those of 1939. Shipments were destined chiefly to France, Italy, and Spain. North African shipments moved to Germany through Italian ports. All exports from Tunisia in the latter half of the year and throughout most of 1941 went to Germany and Italy. Owing principally to the stoppage of Italian commerce through the Suez Canal by the British and to a great drop in shipments to Japan, phosphate exports from Egypt, which in 1938 and 1939 had amounted to over 400,000 metric tons a year, decreased to only 77,069 tons in 1940.

On September 20, 1940, Japan invaded Indochina, and 7 days later (September 27, 1940) joined the Berlin-Rome Axis, resulting in the cutting off of shipments of phosphate rock to Japan by Britain from Egypt, Nauru and Ocean Islands, and Christmas Island.

In 1941 two further major interferences in world trade in phosphate rock occurred. The first was the German attack on Soviet Russia in June 1941, which cut off imports of Russian apatite into Germany and initiated movement of the Kola Peninsula apatite from the port of

Murmansk to Britain and the United States. The second was the surprise attack on Pearl Harbor in the Hawaiian Islands on December 7, 1941, which brought the United States into the war on the side of Britain and stopped shipments from the United States to Japan.

Early in 1942 Japan conquered most of the phosphate-producing islands of Oceania (Nauru, Ocean, and Christmas Islands) and became self-sufficient in this commodity, fully compensating for the loss of imports from the United States, Egypt, and French possessions. This move by Japan also largely cut off the supplies to the British Dominions Australia and New Zealand, which had come principally from Nauru and Ocean Islands.

The world phosphate-trade picture changed again in November 1942 with United Nations occupation of the phosphate-bearing areas of French North Africa in Algeria, Morocco, and Tunisia, and German occupation of the former "unoccupied" portion of France. These events stopped the supplies of North African phosphates that had been going to France, Italy, and Germany and cut off the entire continental European market except the neutral coastal countries of Spain and Portugal, throwing the entire North African production on the remaining vastly restricted world markets in Allied and neutral countries in direct competition with American phosphate rock and also raising the possibility of invasion of the American domestic market by the French North African phosphate. The British Isles can now again get their supplies from French North Africa, releasing space on ships traveling from the United States to Britain and possibly eliminating much of the American export trade in this material. Australia and New Zealand—long cut off from their former sources of supply in Nauru and Ocean Islands—and the Union of South Africa can now obtain phosphate rock from North African sources.

Thus, at the beginning of 1943 Japan alone of the Axis Powers is self-sufficient in phosphate rock, whereas the European members have been cut off from the U. S. S. R. and all extra-European sources of supply and are limited to small, controlled European deposits, apparently inadequate for their economy. The United Nations, on the other hand, have at their disposal the great phosphate resources and industries of the United States and French North Africa—a supply far exceeding the needs of both Allied and neutral nations of the world.

PRODUCTION

Phosphate rock was mined in 1942 in Florida, Tennessee, Montana, Idaho, and Utah, and apatite was recovered from an apatite-ilmenite ore in central Virginia. Total mine production declined about 100,000 tons from the all-time record output reached in 1941.

Phosphate rock mined in the United States, 1933–42, by States, in long tons

Year	Florida	Tennessee [1]	Western States	United States	Year	Florida	Tennessee [1]	Western States	United States
1933	2,039,531	296,441	23,663	2,359,635	1938	2,722,927	[2] 999,551	137,998	3,860,476
1934	2,464,969	394,311	38,958	2,898,238	1939	2,791,360	1,057,570	139,040	3,987,970
1935	2,598,337	493,501	67,490	3,159,328	1940	2,782,956	1,120,551	164,570	4,068,077
1936	2,645,819	737,866	79,152	3,462,837	1941	3,417,900	1,301,067	[3]203,216	[3]4,922,183
1937	3,179,588	942,158	139,670	4,261,416	1942	2,984,503	1,568,162	266,273	4,818,938

[1] Includes small quantity of apatite from Virginia.
[2] Includes also small quantity of phosphate rock from South Carolina.
[3] Revised figures.

SALES

For the third consecutive year in this decade the quantity of domestic phosphate rock sold or used by producers exceeded 4 million tons. In 1942 the phosphate rock sold or used was about 45,000 long tons less than the all-time record figure of 1941. Although its value was more than a million dollars greater than in 1941, it was still far below the record value of the boom year 1920.

Phosphate rock sold or used by producers in the United States, 1938–42

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1938	3,739,238	$12,952,143	$3.46	1941 [1]	4,689,652	$15,596,273	$3.33
1939	3,757,067	12,294,042	3.27	1942	4,644,240	16,597,492	3.57
1940	4,002,700	12,334,662	3.08				

[1] Revised figures.

DISTRIBUTION OF SALES

Two distinct groups appear in the shipments of domestic phosphate rock by grades in recent years; one contains all phosphate rock of less than 60 percent B. P. L. (bone phosphate of lime) and the other all grades of 68 percent B. P. L. and higher. Both groups are increasing in size, and the gap between them is more distinct.

Seventy percent of the domestic phosphate rock sold or used by producers in 1942 is reported to have gone into the manufacture of superphosphates, and the quantity so consumed was over 400,000 tons greater than in 1941.

Phosphate rock sold or used by producers in the United States, 1941–42, by grades and uses

	1941			1942		
	Quantity		Value	Quantity		Value
	Long tons	Percent of total		Long tons	Percent of total	
Grades—B. P. L.[1] content (percent):						
Below 60	428,869	9	(2)	477,916	10	(2)
60 to 66	[3] 10,968	(4)	(2)	1,412	(4)	(2)
68 basis, 66 minimum	232,540	5	(2)	373,329	8	(2)
70 minimum	408,454	9	(2)	198,320	4	(2)
72 minimum	1,524,476	32	(2)	1,686,312	37	(2)
75 basis, 74 minimum	1,065,272	23	(2)	736,797	16	(2)
75 minimum						
77 basis, 76 minimum	607,480	13	(2)	559,111	12	(2)
77 minimum						
Above 85 (apatite)	411,593	9	(2)	610,543	13	(2)
Undistributed [5]						
	[3] 4,689,652	100	[3] $15,596,273	4,644,240	100	$16,597,492
Uses:						
Domestic:						
Superphosphates	2,825,456	60	(2)	3,242,689	70	(2)
Phosphates, phosphoric acid, phosphorus, ferrophosphorus	644,948	14	(2)	649,816	14	(2)
Direct application to soil	143,196	3	(2)	184,233	4	(2)
Fertilizer filler	31,381	1	(2)	30,116	1	(2)
Stock and poultry feed	3,771	(4)	(2)	8,466	(4)	(2)
Undistributed [6]	5,492	(4)	(2)	6,146	(4)	(2)
Exports [7]	1,035,408	22	4,448,298	522,774	11	2,354,019
	[3] 4,689,652	100	[3] 15,596,273	4,644,240	100	16,597,492

[1] Bone phosphate of lime. [2] Figures not available. [3] Revised figures. [4] Less than 0.5 percent.
[5] Includes grades of B. P. L. content 65, 68/69, between 69 and 72.9, 72–73, 73, 73.2, 76, 76.9, 78, and above 85 percent; also ground phosphate rock and dust, B. P. L. content not known.
[6] Includes some calcined phosphate and phosphatic material used in pig-iron blast furnaces, construction work, filter bed, parting compounds, research, refractories, in manufacture of concentrated fertilizers, and in minor uses not specified. [7] As reported to Bureau of Mines by domestic producers.

CONSUMPTION

The annual consumption of phosphate rock in the United States from 1867 to 1942 is shown in figure 2. The effect of World War II upon the domestic consumption of phosphate rock is well-shown by the abnormal extension of the line showing consumption above

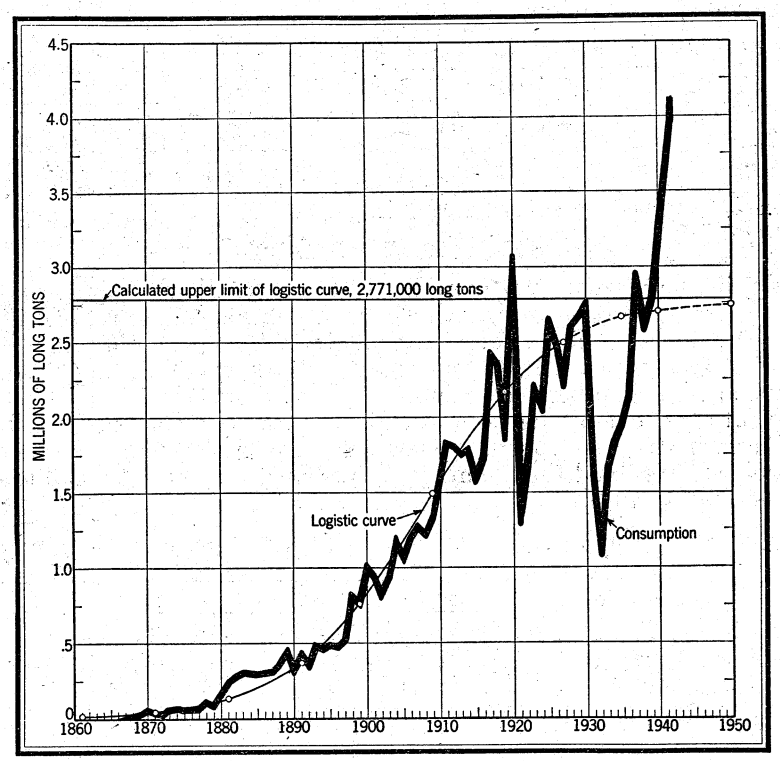

FIGURE 2.—Consumption of phosphate rock in the United States, 1867–1942.

the logistic curve indicative of the normal average demand. The apparent consumption in 1942 was 4,119,289 long tons, much the highest ever recorded.

PRICES

Trade-journal (Oil, Paint and Drug Reporter) quotations for the various grades of phosphate rock changed little during the first 10 months of the year. Maximum prices on Florida land-pebble phosphate rock and Tennessee brown-rock phosphate were established by the Office of Price Administration in a new schedule issued October 13, 1942, and effective October 19, 1942 (Maximum Price Regulation 240).

Prices per long ton of Florida and Tennessee phosphate rock, bulk f. o. b. mine, in 1942 [1]

[Leaders indicate that prices are not quoted]

	Jan. 5–Feb. 23	Mar. 2–June 29	July 6–Sept. 28	Oct. 5–Oct. 12	Oct. 19–Dec. 28
Florida:					
High-grade hard rock:					
Grades—B. P. L.[2] content (percent):					
77–76	$5.00	$5.00			
Land pebble:					
Grades—B. P. L.[2] content (percent):					
68–66	2.00	2.20	$2.20	$2.20	$2.00
70–68	2.40	2.70	2.70	2.70	2.40
72–70	3.00	3.20	3.20	3.20	3.00
75–74	4.00	4.00	4.00	4.00	4.00
77–76					5.00
Tennessee:					
Grades—B. P. L.[2] content (percent):					
72–70	5.00				5.30
75–74	6.00	6.50	6.50	6.50	
68–66		4.50		4.50	4.30
70 minimum		5.00	5.00	5.00	
72 minimum		5.50	5.50	5.50	
60–66			4.50		
70–68					4.80

[1] Weekly quotations of Oil, Paint and Drug Reporter.
[2] Bone phosphate of lime.

Near the close of the fiscal year ended June 30, 1942, the Office of Price Administration made plans for the Federal Trade Commission to study costs, prices, and profits in the fertilizer and related products industry. The inquiry began with a study of 11 important companies in the phosphate rock-mining industry.[6]

REVIEW BY STATES

Florida.—Another set-back to the growth of the Florida phosphate-rock industry occurred in 1942 (see fig. 3). The quantity of phosphate rock sold or used by producers in Florida—3,012,240 long tons—was 353,332 tons less than the 1941 sales; and, although the average value per ton increased from $3.04 to $3.11, the total value of the shipments was $855,454 less. The decrease was due to the greatly lessened foreign demand for Florida land pebble. The average values per ton for all types were higher in 1942. Sales of hard rock nearly doubled those of 1941, but the increase in sales of soft rock was slight.

Hard-rock-phosphate mining operations were conducted jointly by C. & J. Camp, Inc., and J. Buttgenbach & Co. in sec. 22, Citrus County, 3 miles from Hernando. The other hard-rock-phosphate company—the Dunnellon Phosphate Mining Co.—did no mining in 1942 but shipped hard rock from stocks. The Pembroke Chemical Corporation reported its sintering operations as permanently inactive, but this company together with the usual land-pebble producers mined and shipped land pebble.

Stocks of Florida phosphate rock reported by producers December 31, 1942, were 57,000 tons less than at the end of 1941 but still totaled 1,426,000 tons.

[6] Federal Trade Commission, Annual Report for the Fiscal Year Ended June 30, 1942: 1942, 136 pp.; see p. 17.

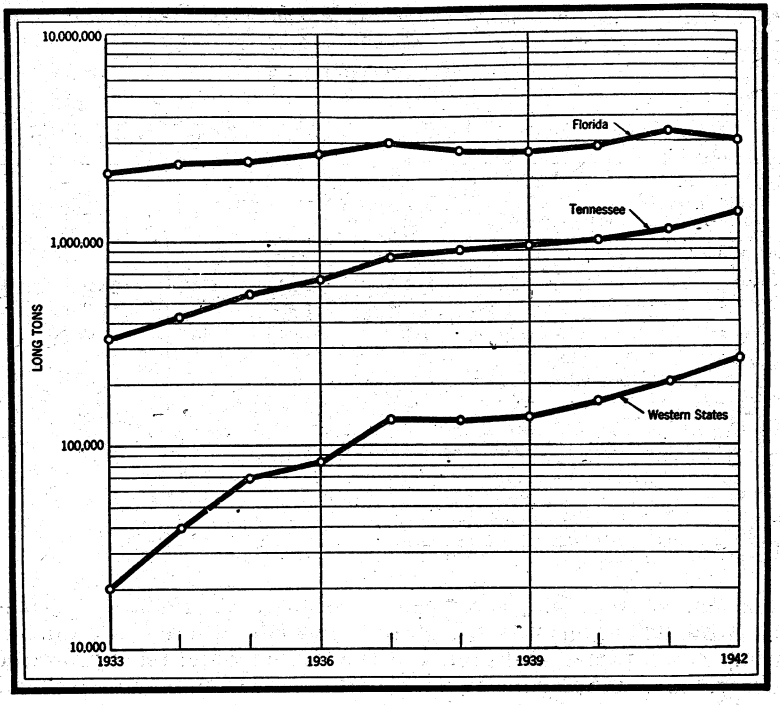

FIGURE 3.—Rate of growth of phosphate rock sold or used by producers, by States, 1933–42.

Florida phosphate rock sold or used by producers, 1938–42, by kinds

Year	Hard rock			Soft rock [1]		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
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
1941	38,116	211,049	5.54	47,750	132,472	2.77
1942	70,014	396,527	5.66	48,470	155,345	3.20

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
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
1941	3,279,706	9,890,510	3.02	3,365,572	10,234,031	3.04
1942	2,893,756	8,826,705	3.05	3,012,240	9,378,577	3.11

[1] Includes material from waste-pond operations.
[2] Includes sintered matrix.

Mansfield [7] presents the results of a detailed study of the phosphate reserves of Florida. Total reserves are placed at 5,081,839,000 long tons, of which 2,058,583,000 are classified as known, 1,227,146,000 tons as probable, and 1,796,110,000 tons as possible. Reserves better than 74 percent B. P. L. total only 130,000,000 tons. Over two-thirds of the reserves are in the land-pebble and nearly one-third

[7] Mansfield, G. R., Phosphate Resources of Florida: Geol. Survey Bull. 934, 1942, 82 pp.

in the hard-rock field. The phosphate rock resources of the Hawthorn formation and the Caloosahatchee marl are not included. Taylor [8] in the fourth article of a series describes some of the current practices in the field of land-pebble phosphate rock.

The International Minerals & Chemical Corporation completed in June 1942 its new Peace Valley mine, washer, and flotation plant, about a mile from Pembroke, on land leased from the Pembroke Chemical Co. Production began July 1, 1942. The output of this operation is sent to International's central drying and grinding plant at Mulberry, the drying capacity of which has recently been increased about 60 percent by the addition of a new 7- by 80-foot oil-fired rotary drier. Detailed descriptions of the Peace Valley Plant have been published.[9] The International Minerals & Chemical Corporation sold to Minerals Separation North American Corporation its half interest in the Phosphate Recovery Corporation, which the two companies had developed since 1928. It is also reported to have bought from the Phosphate Recovery Corporation the flotation plants serving its own phosphate mines.

Edwards [10] discusses in detail the electrical equipment of the completely electrified mines and plants of the International Minerals & Chemical Corporation in the Florida land-pebble-phosphate field and problems of maintenance of this equipment.

The process of separating phosphate by flotation on moving conveyor belts, in use in the land-pebble field at the Hopewell washer (6 miles from Coronet) by the Coronet Phosphate Co., is described in detail in a recent article.[11] Published descriptions also appeared of the froth-flotation and table-concentration plant of the Phosphate Mining Co. in the land-pebble field [12] and the new drying plant of the American Cyanamid Co.[13]

Tennessee.—The tonnage of phosphate rock sold or used by Tennessee producers in 1942 (plus a small quantity of apatite from Virginia) continued the upward trend of recent years (see fig. 3) and exceeded the all-time high of 1941 by 22 percent. The total value of the shipments likewise made a new high record, exceeding the previous record of 1920 ($4,857,399) by over a million and a quarter dollars. The greater part of the shipments were of brown rock, although a small quantity of blue rock drawn from stocks was used in research work by the Tennessee Valley Authority. Total stocks in hands of producers—brown rock and blue rock—at the close of 1942 were 437,000 long tons, an increase of 50 percent over the stocks on hand December 31, 1941.

[8] Taylor, W. H., Land-Pebble Phosphate Deposits of Florida—IV: Pit and Quarry, vol. 35, No. 5, November 1942, pp. 61–65.

[9] Hubbell, A. H., International's New Phosphate Mine and Recovery Plant in the Florida Pebble Field: Eng. and Min. Jour., vol. 143, No. 9, September 1942, pp. 43–48.
Pit and Quarry, Phosphate, Barites, and Other Minerals Felt Stimulus of War Demand in 1942: Vol. 35, No. 7, January 1943, pp. 95–97.

[10] Edwards, J. H., Metering a Factor in International Minerals & Chemical Corporation's Phosphate Operations: Eng. and Min. Jour., vol. 143, No. 6, June 1942, pp. 43–46.

[11] Hubbell, A. H., Phosphate Washer Reject Successfully Concentrated on Moving Conveyor Belt: Eng. and Min. Jour., vol. 143, No. 12, December 1942, pp. 51–54.

[12] Pit and Quarry, Flotation Plant in Florida Recovers Phosphate from Accumulated Tailings: Vol. 35, No. 11, May 1943, pp. 59–62.

[13] Pit and Quarry, Fuel, Power, and Labor Costs Decline as New Drying Plant Goes in Service: Vol. 35, No. 3, September 1942, pp. 53–54, 57; Phosphate, Barites, and Other Minerals Felt Stimulus of War Demand in 1942: Vol. 35, No. 7, January 1943, pp. 95–97.

Tennessee phosphate rock (including sintered matrix) sold or used by producers, 1938–42

[Includes apatite from Virginia]

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1938	899,298	$3,725,601	$4.14	1941	1,120,358	$4,590,965	$4.10
1939[1]	938,448	3,856,505	4.11	1942	1,366,335	6,127,792	4.48
1940	994,361	3,967,043	3.99				

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.

A few private companies and the Tennessee Valley Authority mined phosphate rock in Tennessee in 1942. The private companies include the Armour Fertilizer Works, Charleston Mining Co., Federal Chemical Co., Gilbreath & Pressnell, Harsh Phosphate Co., Hoover & Mason Phosphate Co., International Minerals & Chemical Corporation, Monsanto Chemical Co., and the Virginia-Carolina Chemical Corporation. The Charleston Mining Co., in operation during the first half of 1942, was dissolved and merged June 30, 1942, with its parent company, the Virginia-Carolina Chemical Corporation, which continued mining in Tennessee after the merger. Most of the brown-rock mining in this district is from surface operations.

The International Minerals & Chemical Corporation purchased additional phosphate-rock reserves in the Tennessee field in the fiscal year ended June 30, 1942, according to its annual report, and made further improvements in its mines and plants. Operating practices at this company's plants and at the remodeled phosphate-rock plant of the Virginia-Carolina Chemical Corporation were described in a recent article.[14]

The improvements at the plant of the Hoover & Mason Co. at Mount Pleasant have been described in recent articles.[15] A phosphate-rock grinding plant erected in 1942 on Swan Creek in Hickman County is said to have been operated only a short time.

In 1942 the Tennessee Valley Authority continued [16] its production of elemental phosphorus and phosphatic fertilizers. A plant formerly used for the production of phosphorus-carrying plant foods was enlarged and equipped to produce elemental phosphorus for the Chemical Warfare Service, and large quantities of that element were shipped for munitions manufacture. In June 1942 the Authority had one-fourth of the Nation's capacity for the production of munitions-grade phosphorus. Fertilizer production was continued to the extent that facilities were not needed for elemental phosphorus. The Authority sent about four-fifths of its production of triple superphosphate and calcium metaphosphate fertilizers to United Nations under lend-lease arrangement. The one-fifth reserved for domestic consumption was used in continuing cooperation with State agricultural extension services in a program of tests and demonstrations.

[14] Engineering and Mining Journal, Tennessee Phosphate Field Sees Changes: Vol. 144, No. 3, March 1943, pp. 68–71.

[15] Engineering and Mining Journal, Tennessee Phosphate Field Sees Changes: II. The Hoover & Mason Company Improves Its Washer in Mount Pleasant District: Vol. 144, No. 4, April 1943, pp. 79–80. Nordberg, Bror, Eliminating Phosphate Wastes: Rock Products, vol. 46, No. 5, May 1943, pp. 48–51, 61.

[16] Office of War Information, Tennessee Valley Authority: Advance Release OWI–1043 for Friday afternoon, January 1, 1943, mim., 5 pp.

Construction of the Tennessee Valley Authority field phosphate plant in Maury County, Tenn., was completed, and the plant was put into operation during the summer of 1942. At the end of the year, approximately 500 tons of phosphate rock were mined a day, and the production of sinter amounted to about 190 tons daily. Phosphate mining, washing, and concentrating operations are carried out on the Authority's phosphate tract, about 5 miles from Columbia, Tenn., near Duck River. The plant at the phosphate tract consists of pit-mining equipment, a washer, water-pumping equipment, a hydroseparator, and auxiliary equipment. The phosphate sands from this plant are pumped approximately 3 miles to the classifying and finishing plant adjacent to the railroad at Godwin, Tenn. The Godwin plant consists of a rake classifier, bowl classifier, hydroseparator, Bird classifier, Dwight-Lloyd sintering machine, drier, and auxiliary equipment.

The Authority prospected nine farms covering 1,827 acres in 1942 and acquired options to purchase mineral rights on seven properties containing 1,117 acres. An option to purchase, in fee simple, a 141-acre tract in Williamson County was exercised.

Virginia.—Mining was continued at the Piney River nelsonite deposit in 1942 by the Southern Mineral Products Corporation, subsidiary of the Vanadium Corporation of America. The apatite-ilmenite ore (nelsonite) from the open pit was treated in its nearby mill, with separation of the apatite and ilmenite.

Western States.—Production of phosphate rock in the Western States has been increasing steadily in recent years. The quantity sold or used annually has about doubled in the last 5 years, reaching a record total of 265,665 long tons in 1942 (see fig. 3), with a value exceeding a million dollars for the first time. The production in 1942 came from Idaho, Montana, and Utah, as in 1941.

Idaho rock sold or used reached a new high in 1942 (114,079 long tons). Two companies were active in this State in 1942. Much the larger was the long-established producer—the Anaconda Copper Mining Co.—which operated its No. 3 mine at Conda, Caribou County. These operations have been described in considerable detail.[17] The other company in Idaho, the Teton Phosphate Co., Boise, shipped phosphate rock from Montpelier in February 1942 from its holdings near that place.

Montana was the largest producer of the Western States group in both 1941 and 1942 (see fig. 4). Its sales have increased sharply in recent years—from 44,384 long tons in 1939 to a new high record of 150,402 tons in 1942. In 1942 Montana had three producers. The largest—the Montana Phosphate Products Co. of Trail, British Columbia—operated the Anderson mine and several Federal leases in Powell County; it exported most of the mined phosphate rock to the Consolidated Mining & Smelting Co. of Canada at Trail. The other producers were the Mineral Hill Mining Co., Butte, Mont., which mined and shipped from its mine near Avon, Powell County, and L. H. Skeels, who shipped a small quantity from Maxville. The Northwestern Improvement Co., St. Paul, Minn., former lessee from the United States (Great Falls Serial No. 077838), conducted no mining operations thereunder in 1942 and on July 1 of that year assigned

[17] Mining World, Conda Operations of the ACM Company: Vol. 4, No. 10, October 1942, pp. 3-8.

the lease to the International Minerals & Chemical Corporation (formerly the International Agricultural Corporation). No production or shipments in 1942 were made by this company from the newly acquired property.

In Utah the Garfield Chemical & Mfg. Corporation mined and shipped phosphate rock from Federal-leased land near Spanish Fork, Utah County, in 1942, for use in pig-iron blast furnaces. During the year revised estimates of the phosphate reserves of Utah were published.[18]

On August 27, 1942, all deposits of vanadium and all public lands containing such deposits owned by the United States in Bannock,

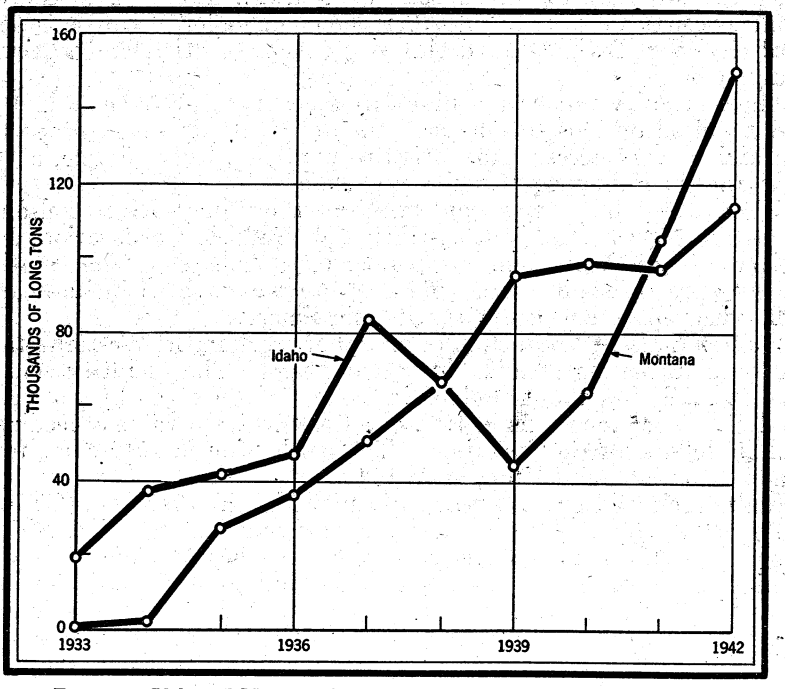

FIGURE 4.—Idaho and Montana phosphate rock sold or used by producers, 1933–42.

Bear Lake, Bingham, Bonneville, and Caribou Counties, Idaho; Rich County, Utah; and Lincoln, Sublette, and Teton Counties, Wyo., were withdrawn (Public Land Order 35, Abe Fortas, Acting Secretary of the Interior) from all forms of appropriation under the public-land laws of the United States, including the mining laws, and from leasing under the provisions of the mineral leasing laws relating to phosphate deposits and were reserved under the jurisdiction of the Secretary of the Interior for use in connection with prosecution of the war. The total area withdrawn, including both public and nonpublic lands, aggregated approximately 332,300 acres.

[18] Williams, J. S., and Hanson, A. M., Phosphate Reserves of Utah: Utah Agric. Exp. Sta. Bull. 304, 1942, 24 pp.

Western States phosphate rock sold or used by producers, 1938–42

Year	Idaho			Montana		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1938	66,014	$296,595	$4.49	66,491	$155,917	$2.34
1939	95,451	431,938	4.53	44,384	112,142	2.53
1940	99,088	441,598	4.46	64,239	184,844	2.88
1941	97,274	444,154	4.57	105,108	318,588	3.03
1942	114,079	511,249	4.48	150,402	572,464	3.81

Year	Utah			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1938				132,505	$452,512	$3.42
1939				139,835	544,080	3.89
1940				163,327	626,442	3.84
1941	1,340	$8,535	$6.37	[1] 203,722	[1] 771,277	[1] 3.79
1942	1,184	7,410	6.26	265,665	1,091,123	4.11

[1] Revised figures.

FOREIGN TRADE [19]

Imports.—Combined imports of apatite and phosphate rock in 1942 totaled 3,765 long tons compared with 4,340 tons (phosphate rock) in 1941. Although no apatite was imported in 1941, in April 1942 a considerable quantity, 920 long tons, was received from the U. S. S. R. Apparently part of this has been included under "Phosphates, crude, not elsewhere specified" in the accompanying table. In May 1942 2,800 long tons of Curaçao phosphate rock were imported.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1938–42

Fertilizer	1938		1939		1940		1941		1942	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite	2	$5	------	------	------	------	------	------	179	$1,025
Phosphates, crude, not elsewhere specified	7,004	80,534	3,500	$23,625	2,953	$19,536	4,340	$32,816	3,586	23,862
Ammonium phosphates, used as fertilizer	29,028	1,286,935	34,995	1,627,608	44,782	1,959,900	55,430	2,483,756	25,521	1,150,319
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	19,581	393,808	40,530	799,179	27,676	618,538	27,607	622,731	7,855	213,970
Guano	15,199	717,817	5,151	211,941	785	17,164	15,394	460,370	3,128	159,799
Slag, basic, ground or unground	691	9,547	405	5,168	452	4,766	------	-------	894	1,011
Precipitated bone, fertilizer grade	3,385	98,725	2,314	68,611	1,141	38,225	------	------	23	851

Exports.—The export trade of the United States in phosphate rock has reacted to the vicissitudes of the present World War. Not only is it much smaller than normal, but the domestic rock is no longer shipped to widely scattered parts of the world. Exports are restricted almost entirely to Canada and the United Kingdom.

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

Phosphate rock [1] exported from the United States, 1938–42

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1938	1,140,841	$6,637,638	$5.82	1941	1,019,960	$5,738,859	$5.63
1939	949,006	5,233,104	5.51	1942	528,716	3,348,341	6.33
1940	751,495	3,845,495	5.12				

[1] 1938–40: Excludes sintered matrix, which is included under "Other phosphate materials." 1941–42: Excludes "Phosphate rock: Florida: Other (including soft rock, colloidal and sintered matrix)," which is included under "Other phosphate materials."

Phosphate rock [1] exported from the United States, 1938–42, by countries

HIGH-GRADE HARD ROCK

Country	1938		1939		1940		1941		1942	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	4,000	$28,000								
Brazil							201	$3,500		
British Malaya	507	5,000	1,200	$12,000						
Canada	67,134	406,463	45,162	276,372	64,542	$394,576	110,658	667,324	157,135	$966,670
Cuba					22	210				
Germany [2]	57,250	369,787	55,246	345,290						
Italy	3,000	18,750	2,000	12,500						
Netherlands	14,450	94,420	14,750	92,188						
Panama	4	48			673	3,365				
Poland and Danzig [2]	2,900	18,125								
Portugal					8,990	60,673				
Sweden	32,675	219,425	14,625	102,375	10,365	72,625				
United Kingdom [3]							45,754	285,062	80,456	499,521
	181,920	1,160,018	132,983	840,725	84,592	531,449	156,613	955,886	237,591	1,466,191

LAND PEBBLE

Country	1938		1939		1940		1941		1942	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Austria	5,781	$32,301								
Belgium	96,073	588,299	36,729	$221,107						
Belgian Congo					3,500	$28,000				
Canada	59,275	250,465	68,386	319,829	87,112	440,346	103,827	$800,951	97,951	$909,986
Czechoslovakia [2]	26,238	155,987	2,498	16,612						
Denmark	7,495	33,503								
Germany [2]	358,077	2,181,869	271,801	1,623,330						
Hungary [2]	10,017	69,107	2,500	15,750	5,261	27,884				
Ireland					6,200	34,100			6,697	46,879
Italy	49,911	305,718	86,375	562,533	33,315	210,286				
Japan	159,270	664,392	229,404	888,598	218,456	813,095	72,722	274,981		
Liberia							28	288		
Mexico	39	200								
Netherlands	103,666	675,249	27,517	178,283						
Nigeria					1,500	12,000				
Norway					2,001	15,007				
Poland and Danzig [2]	2,993	19,821	2,800	18,814						
Portugal					24,837	136,593	32,490	187,866		
Sweden	66,113	412,948	71,479	455,332	11,536	74,290				
Switzerland	6,620	46,316								
Union of South Africa					51,311	282,211	55,345	314,658	3,299	18,969
United Kingdom [3]	7,353	41,445	13,531	71,921	218,872	1,220,721	598,935	3,204,229	183,178	906,316
Yugoslavia			3,003	20,270	3,002	19,513				
	958,921	5,477,620	816,023	4,392,379	666,903	3,314,046	863,347	4,782,973	291,125	1,882,150

[1] 1938–40: Excludes sintered matrix, which is included under "Other phosphate materials." 1941–42: Excludes "Phosphate rock: Florida: Other (including soft rock, colloidal and sintered matrix)," which is included under "Other phosphate materials."

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

[3] United Kingdom of Great Britain and Northern Ireland.

Other phosphate materials [1] exported from the United States, 1938–42

Year	Long tons	Value	Year	Long tons	Value
1938	32,581	$208,550	1941	22,988	$262,045
1939	29,080	192,306	1942	5,192	285,869
1940	11,924	201,047			

[1] Includes bone ash, dust, and meal; animal carbon for fertilizer; basic slag; sintered matrix, etc.

High-grade hard-rock phosphate [1] exported from the United States, 1941–42, by customs districts

Customs district	1941		1942	
	Long tons	Value	Long tons	Value
Buffalo	255	$3,016		
Dakota	11	147	81	$1,024
Florida	45,754	285,062	80,273	497,080
Michigan	306	2,116	815	9,053
Montana and Idaho	88,960	534,042	152,224	913,267
Ohio	1,401	9,413		
Philadelphia	201	3,500		
St. Lawrence	2	33	183	2,441
Vermont	244	2,859		
Washington	19,479	115,698	4,015	43,326
	156,613	955,886	237,591	1,466,191

[1] Includes Florida high-grade hard rock, Tennessee and Idaho and Montana phosphate rock.

WORLD PRODUCTION

Few figures are yet available on phosphate-rock production in foreign countries during 1942.

World production of phosphate rock, 1938–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1938	1939	1940	1941	1942
Algeria	584,452	[2] 450,000	(3)	(3)	(3)
Angaur Island (exports)	105,578	(3)	(3)	(3)	(3)
Australia:					
New South Wales	244	(3)	(3)	(3)	(3)
South Australia	254	(3)	(3)	8,597	(3)
Western Australia			40	(3)	(3)
Brazil	100	(3)	(3)	(3)	(3)
Canada	189	142	325	2,256	1,716
Chile (apatite)		9,014	32,000	(3)	(3)
China [2]	8,000	8,000	(3)	(3)	(3)
Christmas Island, Straits Settlements (exports)	162,425	177,972	241,826	(3)	(3)
Egypt	458,404	547,538	183,182	111,708	(3)
Estonia	13,012	(3)	(3)	(3)	(3)
Germany	3,221	(3)	(3)	(3)	(3)
India, British	23	185	(3)	(3)	(3)
Indochina	37,341	35,694	22,266	(3)	(3)
Italy		(3)	(3)	(3)	(3)
Madagascar	5,699	[4] 6,600	495	(3)	(3)
Makatea Island (exports)	102,941	160,680	173,177	(3)	(3)
Morocco, French (shipments) [5]	1,447,544	1,491,754	(3)	(3)	(3)
Nauru and Ocean Islands [6]	1,184,816	1,244,170	1,263,385	(3)	(3)
Netherlands Indies	33,113	18,777	34,085	(3)	(3)
Netherlands West Indies: Curaçao (exports)	99,283	64,072	6,047	111,995	(3)
New Caledonia	5,000	(3)	(3)	(3)	(3)
Rumania	970	(3)	(3)	(3)	(3)
Seychelles Islands (exports)	21,703	23,545	14,613	(3)	(3)
South-West Africa			869	(3)	(3)
Spain	23,429	(3)	(3)	(3)	(3)
Sweden (apatite)	6,192	6,267	(3)	(3)	(3)
Tanganyika Territory	69	132	9	(3)	(3)
Tunisia	1,934,200	1,608,045	(3)	[3] 720,000	(3)
U. S. S. R. (apatite)	(3)	(3)	(3)	[3] 2,000,000	(3)
United States (sold or used by producers)	3,799,253	3,817,368	4,066,943	[7] 4,764,921	4,718,780
	[8] 11,800,000	[8] 11,500,000	[8] 9,800,000	(3)	(3)

[1] In addition to the countries listed, Austria, Belgium, France, Japan, Philippine Islands, Poland, and Taiwan produce phosphate rock, but data of output are not available. [2] Estimated.
[3] Data not available. Estimate included in the total for 1938–40. [4] Exports.
[5] Including exports as follows: 1938, 1,427,643 tons; 1939, 1,465,673 tons.
[6] Exports during fiscal year ended June 30 of year stated. [7] Revised. [8] Partly estimated.

TECHNOLOGIC DEVELOPMENTS

Several papers [20] on various phases of phosphate-rock technology, in addition to those mentioned in other parts of this chapter, have appeared in recent months.

SUPERPHOSPHATES

The following table gives the outstanding features of the superphosphate industry in the United States from 1940 to 1942:

Salient statistics of the superphosphate industry in the United States, 1940–42

	1940	1941	1942
Production [1] short tons	3,898,641	4,326,402	5,144,484
Shipments,[1] total do	2,934,336	3,633,871	3,961,362
To mixers do	1,530,474	1,638,026	1,916,772
To other acidulators (including exchange transfers) do	471,855	659,514	541,225
To all others (including Government agencies) do	932,007	1,336,331	1,503,365
Stocks in manufacturers' hands, Dec. 31 [1] do	1,142,585	932,683	973,224
Exports of superphosphates [2] long tons	141,289	146,875	165,092
Imports of superphosphates [2] do	10,017	17,368	16,659
Sales of phosphate rock by producers for superphosphate production long tons	2,564,844	2,825,456	3,242,689

[1] Bureau of the Census, Monthly Statistics, Superphosphate Industry, 18 percent available phosphoric acid.
[2] Department of Commerce.

Superphosphates (acid phosphates) exported from the United States, 1941–42, by countries

Country	1941		1942	
	Long tons	Value	Long tons	Value
Africa:				
British East Africa	1,042	$17,292	2,679	$52,500
Union of South Africa	662	25,269		
Argentina	455	29,682		
Brazil	23,283	437,135	123	11,014
British Guiana	203	2,980	150	3,525
Canada	48,924	550,080	64,626	999,803
El Salvador	324	16,152	270	6,004
Mexico	232	10,863	110	6,000
Netherlands Indies	2,039	55,782		
United Kingdom [1]	49,578	1,526,857	80,536	3,601,014
West Indies:				
British:				
Trinidad and Tobago	10	493	125	1,625
Other British	152	2,933		
Cuba	17,897	257,344	16,411	196,650
Dominican Republic	36	614		
French West Indies	560	19,930		
Other countries	1,478	30,176	62	3,928
	146,875	2,983,582	165,092	4,882,063

[1] United Kingdom of Great Britain and Northern Ireland.

[20] Howatt, D. D., Furnace Treatment of Phosphate Ores: Mine and Quarry Eng., vol. 7, No. 7, July 1942, pp. 163–166.
Jacobs, M. B., War Gases—Their Identification and Decontamination: New York Interscience Publishers, Inc., 1942, 180 pp.
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Brown, B. E., and Clark, K. G., An Appraisal of Calcium and Potassium Metaphosphates as Sources of Phosphorus for Crop Plants: Am. Fertilizer, vol. 98, No. 5, February 27, 1943, pp. 10–11, 24, 26.
Pole, G. R., and Beinlich, A. W., Jr., New Refractory Compositions Resistant to Molten Rock Phosphate: Jour. Am. Ceram. Soc., vol. 26, No. 1, January 1, 1943, pp. 21–37.
Fraas, Foster, and Ralston, O. C., Contact Potential in Electrostatic Separation: Bureau of Mines Rept. of Investigations 3667, 1942, 17 pp.
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Walthall, J. H., and Bridger, G. L., Fertilizer by Fusion of Rock Phosphate with Olivine: Paper read before Am. Chem. Soc. meeting, Buffalo, N. Y., September 7–11, 1942; abs., Chem. and Met. Eng., vol. 49, No. 9, September 1942, pp. 209–210.

Superphosphates (acid phosphates) imported for consumption in the United States, 1940–42, by classes [1]

Class	1940		1941		1942	
	Long tons	Value	Long tons	Value	Long tons	Value
Normal (standard) (not over 25 percent P_2O_5 content)	7,057	$97,682	12,017	$172,990	5,965	$80,409
Concentrated (treble) (over 25 percent P_2O_5 content)	2,864	39,982	5,333	133,835	10,694	300,342
Ammoniated	96	1,951	18	376	-------	-------
	10,017	139,615	17,368	307,201	16,659	380,751

[1] All from Canada.

Several articles relating to the superphosphate industry have appeared in recent months.[21]

BASIC SLAG

No recent figures for the production of basic slag are available. In Great Britain, however, the production is said to have increased substantially during the present war, and this is probably likewise true of some of the Axis-controlled nations. In the United States only a few thousand tons of basic slag are produced annually—in the Birmingham iron district, Alabama—and a few hundred tons is imported a year. Phosphatic slag is produced at the steel furnaces at Sydney, Nova Scotia, and the Canadian Government is investigating its possible agricultural utilization.

[21] Harvey, E. W., and Rohner, L. V., Chemical Properties of Various Commercial Superphosphates Before and After Ammoniation: Am. Fertilizer, vol. 97, No. 8, October 10, 1942, pp. 5–6, 24, 26; paper read before Am. Chem. Soc. meeting, Division of Fertilizer Chemistry, Buffalo, N. Y., September 7, 1942.

MacIntire, W. H., and Hardin, L. J., Stability of Admixed Rock Phosphate in Cured Concentrated Superphosphate: Jour. Assoc. Off. Agric. Chem., vol. 25, 1942, pp. 168–176.

Hardesty, J. O., Adams, J. R., and Ross, W. H., Factors Affecting the Availability of Ammoniated Superphosphates: Paper read before Am. Chem. Soc. meeting, Division of Fertilizer Chemistry, Buffalo, N. Y., September 7–11, 1942; abs. Am. Fertilizer, vol. 97, No. 6, September 12, 1942, p. 10.

Jacob, K. D., Marshall, H. L., Reynolds, D. S., and Tremearne, T. H., Composition and Properties of Superphosphate, Volatilization of Fluorine in Superphosphate Manufacture: Ind. and Eng. Chem., ind. ed., vol. 34, No. 6, June 1942, pp. 722–728.

Brown, B. E., Jacob, K. D., and Reid, F. R., Plant Culture and Nitrification Studies with Sludge-Acid Superphosphate: Am. Fertilizer, vol. 96, No. 7, March 28, 1942, pp. 5–6, 24, 26.

Jacob, K. D., Analysis of the Production of Ordinary Superphosphate in the United States in the Calendar Years 1940 and 1941: Am. Fertilizer, vol. 97, No. 2, July 18, 1942, pp. 5–8, 24, 26; No. 3, August 1, 1942, pp. 8–11, 24, 26; No. 4, August 15, 1942, pp. 10–11, 26, 27; No. 5, August 29, 1942, pp. 9–11, 22, 24, 26.

TALC, PYROPHYLLITE, AND GROUND SOAPSTONE [1]

By BERTRAND L. JOHNSON AND K. G. WARNER

SUMMARY OUTLINE

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GENERAL CONDITIONS

Declines in the demand in several industries for talc, pyrophyllite, and ground soapstone depressed both the mined production and the quantity sold and used in 1942 to levels below those of 1941. Sales in 1942 were 387,963 short tons, a 7-percent decrease from 1941;

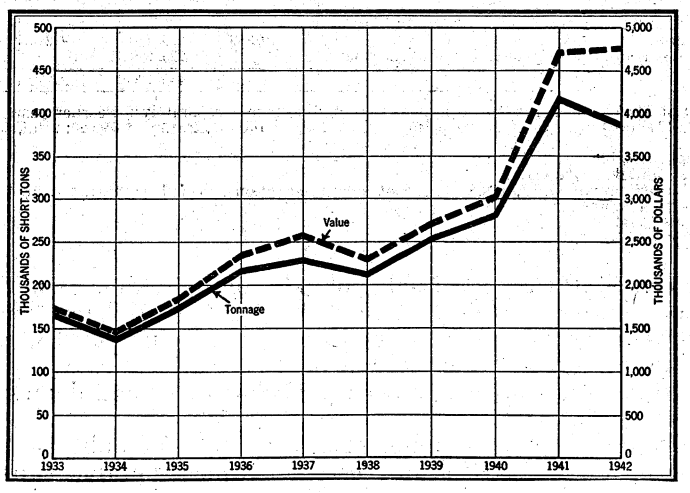

FIGURE 1.—Sales of domestic talc, pyrophyllite, and ground soapstone, 1933–42.

however, the total value of sales—$4,754,076—was the highest on record. (See fig. 1.) Sales of crude, sawed and manufactured, and ground all decreased in quantity, but only the crude is reported to have decreased in value. All classes of imports were less in quantity and, with the exception of the crude, lower in value. Exports declined both in quantity and value.

Pyrophyllite is included with talc in this discussion because it resembles talc in certain physical properties and is interchangeable

[1] Soapstone sold in slabs or blocks is included in the chapter on Stone.

with talc in some uses, although during recent years certain specialized uses for pyrophyllite have been developed. It is a hydrous aluminum silicate, $Al_2Si_4O_{10}(OH)_2$, whereas talc is a hydrous magnesium silicate. Pyrophyllite sometimes is classed as one of the kaolin minerals. Production and sales figures for pyrophyllite are available for publication separately in 1942 for the first time.

Salient statistics of the talc, pyrophyllite,[1] and ground-soapstone industries in the United States, 1941–42

	1941		1942	
	Short tons	Value	Short tons	Value
Mined:				
Total	414,544	(2)	403,801	(2)
Used by producers	370,444	(2)	354,126	(2)
Sold by producers—				
Crude [3]	43,823	$393,839	33,837	$303,166
Sawed and manufactured	4,186	308,467	1,505	370,631
Ground	368,360	3,999,586	352,621	4,080,279
	416,369	4,701,892	387,963	4,754,076
Imports for consumption: [4]				
Crude and unground steatite and French chalk	341	5,780	292	5,849
Cut and sawed	71	10,611	(5)	36
Ground, washed, or pulverized	18,225	225,857	8,487	94,591
	18,637	242,248	8,779	100,476
Exports:				
Talc, steatite, soapstone, and pyrophyllite, crude and ground	10,889	216,440	9,246	191,900
Powder—talcum (in packages), face, and compact	(6)	1,229,280	(6)	678,313
		1,445,720		870,213

[1] Bureau of Mines not at liberty to publish pyrophyllite figures separately for earlier years. In 1942: Mined, 53,247 short tons. Sold—crude, 6,440 tons, $35,790; ground, 47,229 tons, $379,026; total, 53,669 tons, $414,816.
[2] Data not available.
[3] Includes pinite from Nevada.
[4] Exclusive of "manufactures, n. s. p. f., except toilet preparations," as follows: 1941, $11,701; 1942, $2,704. Quantities not available.
[5] Less than 1 ton.
[6] Quantity not recorded.

Thirteen States reported sales of talc, pyrophyllite, ground soapstone, or pinite in 1942—2 more than in 1941. Alabama and New Mexico were new producers. The Eastern States furnished 83 percent of total domestic sales, the same as in 1941.

Descriptions have recently been published of several domestic talc deposits.[2]

To provide adequate supplies of steatite talc for military use and to prevent its dissipation into uses for which suitable substitutes were available, the War Production Board issued Conservation Order M–239 October 13, 1942, forbidding the use, sale, and delivery of steatite talc except for (1) insulators in communications, radio, radar, and underwater sound instruments; (2) spark plugs for certain war industries; (3) filtering of foods, flavoring extracts, and medicines; and (4) medicines and health supplies, but not including talcum powder or cosmetics. This order was amended February 6, 1943, and certain essential uses formerly forbidden were permitted. These included its

[2] McMurray, Lynn, and Bowles, Edgar, The Talc Deposits of Talladega County, Ala.: Geol. Survey Alabama Circ. 16, University of Alabama, 1941, 31 pp.
Bureau of Economic Geology, Soapstone of Northeastern Gillespie County, Tex.: Mineral Resource Survey Circ. 55, University of Texas, Austin, Tex., 1942, 10 pp.
Bureau of Mines, Johnny Gulch Talc Deposit, Madison, Mont.: War Minerals Report 178, 1943, 9 pp.
Page, B. M., and Wright, L. A., Talc in the Ganim Mine, Shasta County, Calif.: Geol. Survey, Strategic Minerals Investigations Preliminary Maps, 1943.

use in electrical and heat insulating products (not including refractories), electric light bulbs, and experimental work. Changing conditions in the talc industry, altering the supply and demand situation, resulted in the issuance on April 29, 1943, by the War Production Board of another amendment to M–239, which removed the existing restrictions on the delivery and use of steatite talc for other than specified uses, established control over production and grading of steatite talc, provided a system of inventory control based upon maximum consumer stocks, and released all frozen stocks of steatite talc purchased before the original issuance of M–239 on October 13, 1942.

Stock-piling of steatite talc was started by Metals Reserve Co. early in 1943.

SALES

In 1942 producers sold or used 28,406 short tons less of talc, pyrophyllite, and ground soapstone than in 1941, but because of an increase in average value the total value of the sales was $52,184 greater, reaching a new all-time high record of $4,754,076. Sales of crude, sawed and manufactured, and ground materials were all lower in 1942 than in the previous year.

Talc, pyrophyllite,[1] and ground soapstone sold by producers in the United States, 1938–42, by classes

Year	Crude			Sawed and manufactured		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1938	13,498	$72,845	$5.40	1,729	$70,268	$40.64
1939	15,722	82,188	5.23	1,871	77,915	41.64
1940	[2] 17,724	[2] 118,424	[2] 6.68	1,894	140,565	74.22
1941	[2] 43,823	[2] 393,839	[2] 8.99	4,186	308,467	73.69
1942	[2] 33,837	[2] 303,166	[2] 8.96	1,505	370,631	246.27

Year	Ground			Total		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1938	197,548	$2,159,447	$10.93	212,775	$2,302,560	$10.82
1939	236,383	2,540,731	10.75	253,976	2,700,834	10.63
1940	261,757	2,749,331	10.50	281,375	3,008,320	10.69
1941	368,360	3,999,586	10.86	416,369	4,701,892	11.29
1942	352,621	4,080,279	11.57	387,963	4,754,076	12.25

[1] Bureau of Mines not at liberty to publish pyrophyllite figures separately for earlier years. In 1942: Crude, 6,440 tons, $35,790; ground, 47,229 tons, $379,026; total, 53,669 tons, $414,816.
[2] Includes pinite from Nevada.

Sales by States.—The tonnages sold or used by producers declined in most of the States for which comparative figures can be shown for 1941 and 1942. Declines were greatest in New York (11 percent), North Carolina (12 percent), and California (13 percent). Georgia was the only State in 1942 to attain a new all-time high record. New York was by far the outstanding producer, and its output was double that of any other State. North Carolina was the only State marketing pyrophyllite. Sales figures for this commodity are available for publication for the first time.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1941–42, by States

State	1941		1942	
	Short tons	Value	Short tons	Value
California	59,203	$811,793	51,649	$678,906
Georgia	28,511	364,560	29,930	464,160
Maryland	15,628	105,363	15,294	144,707
Nevada [1]	13,178	126,433	12,339	236,033
New York	153,560	1,917,732	136,752	1,886,678
North Carolina	64,783	567,921	[2] 56,909	[2] 503,082
Vermont	57,248	663,468	58,695	659,314
Washington	6	2,426	7	2,864
Other States [3]	24,252	142,196	26,388	178,332
	416,369	4,701,892	[2] 387,963	[2] 4,754,076

[1] Includes pinite.
[2] Includes pyrophyllite from North Carolina as follows: 53,669 tons, valued at $414,816; Bureau of Mines not at liberty to publish figures separately for earlier years.
[3] 1941: Montana, Pennsylvania, and Virginia; 1942: Alabama, Montana, New Mexico, Pennsylvania, and Virginia.

MARKETS

Five industries—paint, roofing, ceramics, rubber, and paper—consumed 76 percent of the domestic sales of talc, pyrophyllite, and ground soapstone in 1942, according to reports from producers to the Bureau of Mines. Of these five, the paint and roofing industries alone showed increases. The paint industry consumed over 5,000 tons more than in 1941, taking 32 percent of the total compared with 29 percent in 1941. Roofing was the second-largest consuming industry, rising from fourth to second place and consuming 20 percent more in 1942 than in 1941. The ceramic industry, in second place in 1941, took 39 percent less in 1942 than the previous year or a little less than the roofing industry, thus falling into third place. The rubber industry also declined sharply as a market for these commodities (30 percent), going from third to fourth place. Use in paper declined 20 percent but remained in fifth place.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1941–42, by uses

Use	1941		1942	
	Short tons	Percent of total	Short tons	Percent of total
Paint	120,319	29	125,518	32
Ceramics	78,990	19	48,372	13
Rubber	58,114	14	40,487	10
Roofing	40,605	10	48,870	13
Paper	37,884	9	30,440	8
Toilet preparations	21,119	5	18,902	5
Insecticides	10,479	2	15,810	4
Foundry facings	6,705	2	7,822	2
Crayons	3,186	1	1,474	(1)
Other uses reported [2]	24,280	6	27,631	7
Use not reported	14,688	3	22,637	6
	[3] 416,369	100	[3] 387,963	100

[1] Less than 0.5 percent.
[2] 1941: Bleaching, insulation, lubricants, refractory, textile, and other minor uses; 1942: Refractory, chemical war service, insulation, plastics, bleaching, textile, lubricants, and other minor uses.
[3] Includes pinite.

PRICES

The average values of sales of all grades of talc, pyrophyllite, and ground soapstone in the past 5 years, as reported to the Bureau of Mines by producers, are given in the table under Sales.

Quotations on ground domestic talc, per ton, f. o. b. works, on June 21, 1943, according to the Oil, Paint and Drug Reporter, were as follows:

California: $17.50 to $43.00.

New York: Fibrous, coarse, off-color, $13.00. Fine, 325-mesh, 93 to 94 percent, $13.00 to $18.00; 98 to 99.5 percent, $15.25 to $19.25; 99.85 to 99.95 percent, $17.00 to $21.00.

Pennsylvania: $11 to $13.50.

Vermont: $14.00.

Canadian talc, bags, carlots, per ton, $24.00 to $30.00.

The quoted prices on pyrophyllite in the same journal were: Standard, 200-mesh, carlots, paper bags, mines, per ton, $10.00; 325-mesh, same basis, ton, $13.00; No. 3, 200-mesh, carlots, mines, ton, $8.00; 325-mesh, same basis, $11.00.

DEVELOPMENTS IN THE INDUSTRY

Talc.—Thurnauer and Rodriguez [3] define "steatite" as a group of ceramic materials that contain hydrous magnesium silicate (talc or soapstone) as a predominant constituent in the unfired condition. A survey of the literature on the crystal structure of calcined talc and steatite materials is given. The changes in the structure of four typical talc and steatite bodies brought about by varying heat treatment and by the addition of different fluxes were studied. Only two crystal modifications of magnesium metasilicate were observed under the conditions of the investigation. One was the unstable form, protoenstatite, and the other the stable modification, clinoenstatite. Great differences in the rate of crystal growth and extent of polymorphic transformation of one magnesium metasilicate modification into another were observed in the different bodies. Protoenstatite was always found during the early stages of firing or when the crystals remained small, whereas clinoenstatite appeared when the crystals were large. Weakening of the body appeared to be caused by the mechanical cracking of the large crystals of clinoenstatite. Provided the crystals are kept small enough (—7 microns) the body would remain dense, regardless of the number of firings it received.

Relatively small quantities of steatitic talc porcelains were used before the war in radio equipment; their main ingredient was hand-picked talc, largely from a single California source.[4] With the development of a greatly increased war demand, the location of additional sources became imperative. Most talcs are unfit for use in these highly specialized bodies, as they usually contain too much iron and lime as impurities. Some talcs, however, may be beneficiated and brought up to grade—that is, having a content of less than 1 percent each of Fe_2O_3 and CaO. A talc giving excessive firing shrinkage is also undesirable, and the final test of suitability is whether a fired ceramic

[3] Thurnauer, Hans, and Rodriguez, A. R., Notes on the Constitution of Steatite: Jour. Am. Ceram. Soc., vol. 25, No. 15, November 1, 1942, pp. 443-450.

[4] Ralston, O. C., and Stern, A. G., Report of the Nonmetals Division, Fiscal Year 1942: Bureau of Mines Rept. of Investigations 3675, 1942, p. 21.

body containing the talc makes an acceptable insulator. The Bureau of Mines made a Nation-wide search for talcs meeting these specifications. Field engineers inspected the deposits and collected the samples, which were analyzed and evaluated at the Tuscaloosa (Ala.) laboratory. Beneficiating tests were made on all but the most hopeless, and if the results were at all promising large batches were beneficiated and prepared for testing at the Norris (Tenn.) laboratory in regular bodies for electrical and other properties. Some promising talcs were found in California and Alabama. In the East there are large talc deposits in Alabama, North Carolina, Virginia, and New York, which seem unusually good, especially if processed according to modern flotation milling methods. The Bureau of Mines developed methods for treating domestic talcs and processed several million radio insulators.

Late in 1942 Gunzenhauser[5] presented the third of a series of articles on steatite and special ceramic materials used for electrical insulating parts; he discussed the physical properties of such materials in this latest paper.

The use of a steatite body by the Star Porcelain Co., Trenton, N. J., in the manufacture of porcelain welding ferrules is described in a recent article.[6]

Hendricks[7] discussed the lattice structure of talc and pyrophyllite.

Rigterink, Grisdale, and Morgan[8] prepared a number of steatite bodies under carefully controlled conditions and measured their dielectric losses and direct-current resistances at elevated temperatures. It was found that variations of the ratio of talc to kaolin within certain limits had little effect on the dielectric properties. These properties, however, were changed to a considerable extent by varying the amounts, proportions, and kinds of alkaline-earth oxides added as fluxes. The data indicate also that the conditions in a ceramic body favorable to a high specific resistance are not necessarily those favorable to a low dielectric loss.

The results of tests on the thermal-expansion characteristics of steatite by Rigby and Green, originally published in 1941, were reprinted in 1942.[9]

Tremolitic talc dust has been classed as a silicate dust capable of causing a disabling pneumoconiosis.[10] Other papers relating to talc as an occupational hazard are those by Schultz and Williams[11] and Snyder.[12]

Pyrophyllite.—The pyrophyllite open-pit mine and mill of the Carolina Pyrophyllite Co., Randolph County, N. C., are described

[5] Gunzenhauser, A., Physical Properties of High Frequency Electrical Ceramic Insulating Parts: Ceram. Ind., vol. 39, No. 5, November 1942, pp. 68, 70, 72.

[6] Ceramic Industry, Porcelain Welding Ferrules Made by Regular Steatite Production Methods: Vol. 39, No. 1, July 1942, pp. 42–43.

[7] Hendricks, S. B., Lattice Structure of Clay Minerals and Some Properties of Clay: Jour. Geol., vol. 50, 1942, pp. 276–290.

[8] Rigterink, M. D., Grisdale, R. O., and Morgan, S. O., Relation Between Chemical Composition and Dielectric Properties of Ceramic Materials with Low Dielectric Losses: Jour. Am. Ceram. Soc., vol. 25, No. 15, November 1, 1942, pp. 439–443.

[9] Rigby, G. R., and Green, A. T., Thermal-Expansion Characteristics of Some Calcareous and Magnesium Minerals: Bull. British Refrac. Research Assoc., No. 58, 1941; reprinted in Trans. British Ceram. Soc., vol. 41, No. 5, 1942, pp. 123–143. Ceram. Abs. (Am. Ceram. Soc.), vol. 21, No. 11, November 15, 1942, p. 249.

[10] Porro, F. W., Patton, J. R., and Hobbs, A. A., Jr., Pneumoconiosis in the Talc Industry: Am. Jour. Roentgenol. and Radium Therapy, vol. 47, April 1942, pp. 507–524.
Siegel, W., Smith, A. R., and Greenburg, Leonard, Dust Hazards in Tremolitic Talc Mining, Including Roentgenological Findings in Talc Workers: Am. Jour. Roentgenol. and Radium Therapy, vol. 49, January 1943, pp. 11–29.

[11] Schultz, R. Z., and Williams, C. R., Commercial Talc. Animal and Mineralogic Studies: Jour. Ind. Hyg. and Toxicol., vol. 24, April 1942, pp. 75–79.

[12] Snyder, C. A., Why Industrial Dust Control is Necessary: Occupational Hazards, vol. 5, No. 2, 1942, p. 9; Canadian Machinery, vol. 53, No. 11, 1942, p. 94.

in a recent article.[13] Air drills are used in mining. The broken pyrophyllite, hand-loaded on 6-ton trucks, is dumped into open storage or bins at the mill. It is crushed in a 12- by 24-inch Reliance jaw crusher set to 1 inch; the crushed material is then elevated to two surge bins, one for each of the two mill units. Each of these units is equipped with a Hardinge conical mill, 8 feet by 36 inches in one and 8 feet by 80 inches in the other, each being followed by a 14-foot Gayco separator. Oversize from each separator is sent back to the corresponding mill. The finished material is delivered to a bin, from which it is shipped in bulk or bagged. Salisbury (N. C.) granite blocks are used to line the Hardinge mills; this granite is also used as the grinding medium, replacing Belgian flint pebbles. Ground products shipped range from 80- to 325-mesh. Rock crushed to one-half inch and three-fourths inch has also been shipped.

Hendricks' discussion of the lattice structure of pyrophyllite has already been mentioned.[14]

FOREIGN TRADE[15]

Imports.—Total talc, steatite or soapstone, and French chalk imports in 1942 dropped 53 percent in quantity and 59 percent in value

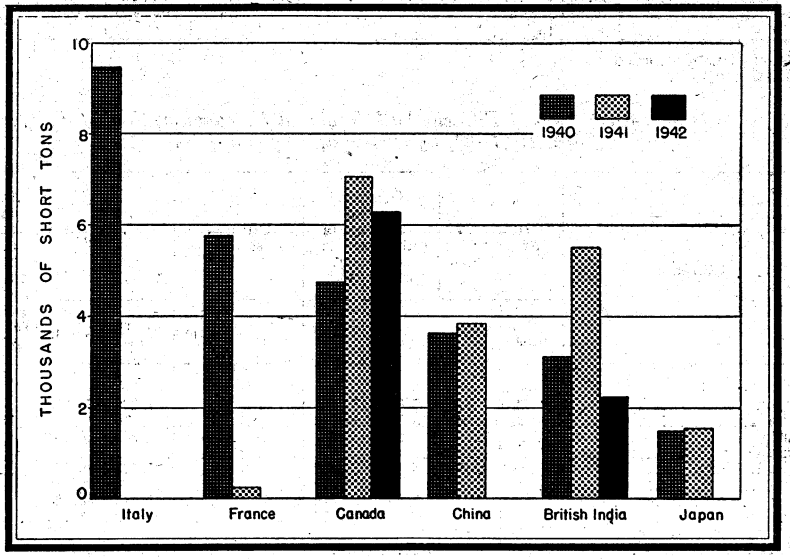

FIGURE 2.—Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1940–42, by leading countries.

from 1941. Nearly all of the imports consisted of materials "ground, washed, powdered, or pulverized, except toilet preparations," only a few hundred tons being of "crude and unground" and "cut and sawed" materials. India furnished 286 tons of crude block steatite, as well as considerable ground steatite. Imports in 1942 came principally from Canada and British India (see fig. 2); only minor

[13] Engineering and Mining Journal, United Feldspar's Pyrophyllite Enterprise: Vol. 144, No. 4, April 1943, pp. 69–71.
[14] Hendricks, S. B., Work cited in footnote 7.
[15] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

quantities came from Japan and United Kingdom. Imports incorrectly reported as from Kwantung (Japanese-leased territory) in the import tables in the Talc chapter, Minerals Yearbook 1941 (p. 1397), actually came from British India.

Steatite talc imports were placed under import control November 23, 1942 (General Imports Order M–63, December 27, 1941, Federal Register, vol. 6, No. 252, December 30, 1941, pp. 6796–6797, as amended November 20, 1942, Federal Register, vol. 7, No. 230, November 24, 1942, pp. 9702–9703).

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1938–42, by classes

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
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)	21,568
1941	341	5,780	18,225	225,857	71	10,611	18,637	242,248	(1)	11,701
1942	292	5,849	8,487	94,591	(2)	36	8,779	100,476	(1)	2,704

[1] Quantity not recorded.
[2] Less than 1 ton.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1941–42, by classes and 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 (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1941									
Canada	2	$14	7,018	$73,941	------	------	7,020	$73,955	------
China	66	562	3,810	39,990	------	------	3,876	40,552	$11,074
France	------	------	250	6,587	------	------	250	6,587	------
Hong Kong	------	------	------	------	------	------	------	------	45
India, British	248	4,397	5,278	75,532	------	------	5,526	79,929	------
Italy	------	------	20	519	------	------	20	519	------
Japan	------	------	1,507	25,515	71	$10,611	1,578	36,126	539
Kwantung	------	------	342	3,773	------	------	342	3,773	------
Union of South Africa	25	807	------	------	------	------	25	807	------
United Kingdom	------	------	------	------	------	------	------	------	43
	341	5,780	18,225	225,857	71	10,611	18,637	242,248	11,701
1942									
Canada	6	96	6,296	62,126	------	------	6,302	62,222	7
China	------	------	------	------	------	------	------	------	510
Hong Kong	------	------	------	------	------	------	------	------	2,186
India, British	286	5,753	1,963	28,863	------	------	2,249	34,616	1
Japan	------	------	9	259	(1)	36	9	295	------
United Kingdom [2]	------	------	219	3,343	------	------	219	3,343	------
	292	5,849	8,487	94,591	(1)	36	8,779	100,476	2,704

[1] Less than 1 ton.
[2] United Kingdom of Great Britain and Northern Ireland.

Exports.—The quantity of "talc, steatite, soapstone, and pyrophyllite, crude and ground" exported from the United States reached an all-time record of 10,889 short tons in 1941 but was 1,643 tons less in 1942. The value of "powders—talcum (in packages), face, and compact," exported in 1941 was higher than in any year since 1931, but the value of the exports in 1942 was 45 percent less than in 1941.

Talcum and other powders exported from the United States, 1938–42

Year	Description	Short tons	Value	
			Total	Average
1938	Talc, steatite, and soapstone, crude and ground	7,118	$124,194	$17.45
	Powders—talcum (in packages), face, and compact	(1)	978,100	
1939	Talc, steatite, and soapstone, crude and ground	9,047	162,426	17.95
	Powders—talcum (in packages), face, and compact	(1)	1,115,176	
1940	Talc, steatite, and soapstone, crude and ground	9,402	167,992	17.87
	Powders—talcum (in packages), face, and compact	(1)	945,530	
1941	Talc, steatite, soapstone, and pyrophyllite, crude and ground	10,889	216,440	19.88
	Powders—talcum (in packages), face, and compact	(1)	1,229,280	
1942	Talc, steatite, soapstone, and pyrophyllite, crude and ground	9,246	191,900	20.75
	Powders—talcum (in packages), face, and compact	(1)	678,313	

[1] Quantity not recorded.

WORLD PRODUCTION

Production figures for talc, pyrophyllite, and soapstone in 1942 are lacking for most countries.

World production of talc, pyrophyllite, and soapstone, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Argentina	208	80	303	1,168	1,975	(2)
Australia:						
New South Wales	526	597	(2)	(2)	(2)	(2)
South Australia	991	973	1,115	1,349	2,972	(2)
Tasmania				(2)	(2)	(2)
Canada [3]	11,301	9,846	11,924	13,758	16,484	14,183
China (Manchuria) (exports)	111,140	81,215	93,772	[4] 72,495	(2)	(2)
Egypt	2,266	1,251	833	2,212	5,229	(2)
Finland	881	(2)	(2)	(2)	(2)	(2)
France	56,300	(2)	(2)	(2)	(2)	(2)
Germany:						
Austria (exports)	14,089	5,625	(2)	(2)	(2)	(2)
Bavaria	7,790	6,805	(2)	(2)	(2)	(2)
Greece	1,838	1,293	1,003	(2)	(2)	(2)
India, British	13,249	18,888	22,616	(2)	(2)	(2)
Indochina	428		400	305	(2)	(2)
Italy	45,714	53,511	(2)	(2)	(2)	(2)
Morocco, French (exports)	841	1,702	(2)	(2)	(2)	(2)
Newfoundland	(2)	1,605	(2)	284	508	(2)
Norway	24,701	23,703	(2)	(2)	(2)	(2)
Rumania	1,976	2,256	(2)	(2)	(2)	(2)
Spain [5]	3,021	8,438	(2)	28,643	(2)	(2)
Sweden	7,937	6,797	7,195	(2)	(2)	(2)
Tanganyika Territory		38	5	6	(2)	(2)
Union of South Africa: Transvaal	376	1,554	449	1,757	[4] 1,379	[4] 1,283
United States [6]	208,650	193,025	230,402	255,258	377,722	351,952
Uruguay (exports)	437	952	1,111	1,699	1,867	[7] 2,192

[1] In addition to countries listed talc or pyrophyllite is reported produced in Brazil, Bulgaria, U. S. S. R., and Western Australia but data on production are not available.
[2] Data not available.
[3] Excludes soapstone, which is reported only by value and was as follows: 1937, $40,513; 1938, $35,038; 1939, $41,471; 1940, $74,905; 1941, $155,925; 1942, $121,766. Soapstone is sold in the form of both blocks and powder.
[4] January to September, inclusive.
[5] Includes steatite, as follows—1937: 500 tons; 1938: 3,480 tons; 1940: 17,191 tons.
[6] Talc, pyrophyllite, and ground soapstone sold by producers; includes also pinite in 1940, 1941, and 1942.
[7] January to June, inclusive.

Canadian talc and soapstone developments in 1941 have been described as follows:[16]

Active production of ground talc in Canada was begun in 1906 from deposits in the Madoc area, Ontario, and these deposits have since been the main source of supply. Canada Talc, Limited, is the chief producer in the area, having taken over the holdings of G. H. Gillespie Company, the pioneer operator, in 1937. There have been various other small operations in the area. In 1941, Trent Mining Syndicate began to develop a property adjoining that of Canada Talc, Limited, where surface showings indicate an easterly extension of the same vein system, and at the end of the year was proceeding with the erection of a small mill. R. W. Bonter and associates of Trenton ground a small tonnage of slightly off-color talc in the mill of Canadian Slate Products, a mile and a half north of Madoc; the crude was brought in by truck from a deposit operated by W. C. Spry near Ompah, Frontenac County, 65 miles distant. The talc from Ompah is finely schistose, cream-colored, and distinct in character from the white foliated talc of the Madoc district.

In British Columbia, the deposits near McGillivray, on the Pacific Great Eastern Railway, and at Kapoor, near Victoria, have been idle since 1935. The crude was shipped to a grinding plant at Vancouver, for local roofing use.

Quebec has been supplying soapstone in small quantities since 1922, and the industry has been supplying mainly blocks and bricks for alkali recovery furnaces of domestic kraft mills. Some cut furnace stone has been exported. In recent years the sawing of crayons has been undertaken. Broughton Soapstone and Quarry Company, the principal operator, has developed a large quarry near Leeds Station on the Quebec Central Railway, in Broughton Township. This company produces cut furnace stone and crayons and has a grinding mill in which quarry and sawing waste, as well as a more highly talcose rock occurring in a band cutting its main soapstone body, are pulverized. The company took over the Louis Cyr holdings at St. Pierre de Broughton in 1940. Other operators in the same area are Charles Fortin, of Robertson, and L. C. Pharo, of Thetford Mines. L. C. Pharo installed a small grinding unit on his property in Thetford township in 1938. Some of the dust from these operations is sold to domestic roofing firms, and a considerable tonnage of quarry and sawing waste is shipped to the grinding plant of Pulverized Products, Limited, 4820 Fourth Avenue, Rosemount, Montreal. Baker Mining and Milling Company, 4010 St. Catherine Street West, Montreal, the only other operator in Quebec, has a mine and mill near Highwater in Potton township, Brome County, close to the Vermont line.

Extensive studies on steatite deposits in Canada are reported, and a steatite industry is said to have been established.[17] In Quebec the output of talc and soapstone in 1942 increased over 1941.[18]

In the U. S. S. R. the large agalmatolite deposits in the Ak-Tash region of Central Asia and tests of this material for porcelain and faience production were described recently by Vikhireva.[19]

Steatite was produced in Western Australia in 1942.[20]

[16] Canada, Department of Trade and Commerce, The Talc and Soapstone Industry, 1941: Dominion Bureau of Statistics, Mining, Metallurgical and Chemical Branch, Ottawa, Canada, 1942. (Data abstracted from report on Talc and Soapstone by the Bureau of Mines, Ottawa.)

[17] Keith, G. C., Ceramic Lines Widen Rapidly in War Effort: Clay Prod. News, vol. 16, No. 1, 1943, p. 3.

[18] DeMille, J. B., Mining in Quebec in 1942: Canadian Min. Jour., vol. 64, No. 2, 1943, pp. 84–88.

[19] Vikhireva, L. A., Use of the Raw Materials of Middle Asia in Porcelain and Faience Production: Keram. Sbornik, No. 13, 1941, pp. 29–37; Ceram. Abs. (Am. Ceram. Soc.), vol. 21, No. 3, March 1, 1942, p. 69.

[20] Chemical Engineering and Mining Review, vol. 35, No. 409, October 10, 1942, p. 13.

FLUORSPAR AND CRYOLITE

By H. W. Davis[1]

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FLUORSPAR

SUMMARY

The period of intense activity in fluorspar mining, which began in 1940, continued unabated throughout 1942. Despite some strikes, manpower shortage, and other handicaps, production and shipments (337,000 and 360,316 short tons, respectively) in 1942 were 8 and 12 percent greater than in 1941, the previous record year, and shipments were 37 percent more than in 1918 during World War I. Attaining first place in 1942, Illinois shipments (161,949 tons) exceeded by 3.4 percent the previous high (156,676 tons) reached in 1917. New Mexico and Utah also established new records in 1942. Shipments from Kentucky in 1942 were 6 percent under the all-time record made in 1941. Shipments by river or river-rail (79,049 tons) also made a new record in 1942. However, imports, amounting to 2,151 tons, declined 71 percent from 1941 and were smaller than in any year since records were first kept (1910). Exports, which are usually small, decreased 26 percent but for the second time exceeded imports.

During 1942 much prospecting and development work were done; probably more shafts were sunk and more mills were constructed than in any one previous year. However, because of a shortage of labor and the need to use most of the available manpower to mine ore, many producers could not keep their development as far ahead of mining as was desirable.

Notwithstanding the record production of fluorspar in 1942, the output of metallurgical grade did not keep pace with consumption; as a consequence, inventories at consuming plants declined substantially. Fortunately, the monthly survey of fluorspar, inaugurated by the Bureau of Mines in January 1942, reflected the lag in production in the early part of 1942, and the War Production Board was able to take corrective action much sooner than would have been possible had monthly data not been available. Among other things this action included an extensive examination of deposits in the Illinois-Kentucky district and in the West by the Geological Survey, a drilling and development program in these areas by the Bureau

[1] Figures on imports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce; those on exports of fluorspar supplied by the producers.

of Mines, an increase in maximum price, and a change in specifications. Based upon the field work of the Bureau of Mines and upon data made available from other sources, a number of war minerals reports [2] on fluorspar have been prepared for the confidential use of Federal war agencies.

Salient statistics of the fluorspar industry in the United States, 1941–42

	1941		1942	
	Short tons	Value	Short tons	Value
Shipments from domestic mines—				
To consumers in United States:				
Metallurgical	222,832	$4,239,436	240,088	$5,473,820
Ceramic	32,979	847,941	23,126	640,515
Chemical	52,674	1,359,623	88,086	2,540,869
To consumers in foreign countries	12,184	277,782	9,016	242,545
	320,669	6,724,782	360,316	8,897,749
Stocks at mines or shipping points Dec. 31:				
Finished	31,997	(1)	19,429	(1)
Crude	40,200	(1)	32,181	(1)
	72,197	(1)	51,610	(1)
Imports for consumption—				
Containing more than 97 percent CaF_2	1,516	29,850	1,882	31,951
Containing not more than 97 percent CaF_2	6,008	50,285	269	3,578
	7,524	80,135	2,151	35,529
Consumption (by industries):				
Metallurgical	219,100	(1)	257,200	(1)
Ceramic	28,500	(1)	22,000	(1)
Chemical	56,000	(1)	81,600	(1)
	303,600	(1)	360,800	(1)
Stocks at consumers' plants Dec. 31:				
Metallurgical	[2] 90,800	(1)	68,500	(1)
Ceramic	[2] 7,900	(1)	8,500	(1)
Chemical	10,200	(1)	19,000	(1)
	[2] 108,900	(1)	96,000	(1)

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

Despite the fact that demand for metallurgical-grade fluorspar was supplied with some difficulty, no prohibitions or limitations were placed on its use, but the War Production Board requested steel manufacturers to employ fluorspar as sparingly as possible. Although supplies of metallurgical-grade fluorspar were not allocated during 1942, it was necessary to divert shipments to certain consumers who had inadequate supplies. However, beginning January 1943 shipments of both metallurgical and ceramic grades will be controlled by the War Production Board, which will forbid any supplier to ship fluorspar to consumers having an inventory greater than a "practicable working minimum."

Although consumption of acid-grade fluorspar gained remarkably

[2] Mineral Ridge Fluorspar Property, Livingston County, Ky.: Bureau of Mines War Minerals Rept. 18, December 1942, 7 pp.
United States Fluorspar Mine, Sierra County, N. Mex.: Bureau of Mines War Minerals Rept. 21, December 1942, 4 pp.
Fluorspar and Zinc Properties on the Babb and Commodore Faults, Crittenden County, Ky.: Bureau of Mines War Minerals Rept. 23, December 1942, 8 pp.
Spar Mine, Catron County, N. Mex.: Bureau of Mines War Minerals Rept. 24, November 1942, 7 pp.
Illinois-Kentucky Fluorspar District: Bureau of Mines War Minerals Rept. 35, January 1943, 32 pp.
Clum Mine, Grant County, N. Mex.: Bureau of Mines War Minerals Rept. 104, March 1943, 8 pp.
Mirabal Fluorspar Mine, Valencia County, N. Mex.: Bureau of Mines War Minerals Rept. 214, May 1943, 6 pp.

in 1942, production increased still more and in consequence inventories were larger at the end than at the beginning of 1942. Likewise, production of ceramic-grade fluorspar was more than adequate for consumption which, however, declined in 1942.

Recognizing the importance of fluorspar in the military program, representatives of the Army Air Forces spent considerable time studying the fluorspar plants in southern Illinois; as a result, the Forces took over the responsibility of protecting the plants at Rosiclare against sabotage and other malicious damage. The properties have been fenced, and each plant has a regular force of guards.

At Rosiclare, Ill., a Government housing project involving an expenditure of approximately $500,000 was started to provide housing facilities for 150 families.

Sales of fluorspar to consumers in the United States totaled 353,469 short tons in 1942 (351,300 tons from domestic mines and 2,169 tons from foreign sources) compared with 316,074 tons in 1941 (308,485 tons from domestic mines and 7,589 tons from foreign sources). Total sales to steel plants in the United States advanced to 225,502 tons in 1942 from 220,222 tons in 1941, and sales to domestic manufacturers of hydrofluoric acid (essential in the manufacture of artificial cryolite and aluminum fluoride—aluminum raw materials) increased to 89,983 tons from 54,092 tons, but sales to domestic makers of glass and enamel declined to 22,813 tons from 32,051 tons.

The greatly accelerated demand for fluorspar in 1942 was accompanied by an advance in prices. The average composite selling price ($24.66) of all grades (both domestic and foreign) delivered to consumers in the United States was $3.68 more than in 1941 ($20.98). The average selling price f. o. b. Illinois-Kentucky mines of fluorspar shipped to domestic steel plants was $23.82 a short ton ($19.62 in 1941), of that shipped to domestic manufacturers of hydrofluoric acid $28.86 ($26.78 in 1941), and of that shipped to domestic makers of glass and enamel $29.44 ($27.39 in 1941).

Effective November 23, 1942, the Office of Price Administration established new base ceiling prices for metallurgical-grade fluorspar ranging from $25 to $28 a short ton according to calcium fluoride and silica content. These prices compared with previous prices of $23 to $25 a ton for standard metallurgical grade in the Illinois-Kentucky district. The new prices are subject to freight adjustments. At the same time, a price of $32 a short ton, subject to freight adjustments, was established for acid-grade fluorspar (except in the Illinois-Kentucky district) containing a minimum of 97½ percent calcium fluoride and a maximum of 1½ percent silica.

In the trade agreement between the United States and Mexico, the duty on fluorspar containing not more than 97 percent calcium fluoride was lowered to $5.62½ a short ton from $7.50.

The total quantity of fluorspar shipped in and imported into the United States from about 1870 through 1942 was approximately 6,270,000 short tons, comprising 5,209,000 tons from domestic mines and 1,061,000 tons from foreign sources.

PRODUCTION AND SHIPMENTS

Production of fluorspar (expressed in terms of finished product) totaled 337,000 short tons in 1942 compared with 313,000 tons in 1941. Of the output in 1942, 10 mines producing over 10,000 tons

each supplied 156,000 tons or 46 percent, 12 mines producing 5,000 to 10,000 tons each supplied 83,000 tons or 25 percent, and 26 mines producing 1,000 to 5,000 tons each supplied 65,000 tons or 19 percent; thus, 48 mines produced 304,000 tons or 90 percent of the total. The remainder (33,000 tons or 10 percent) was produced in quantities ranging from a few tons to 1,000 tons from an undetermined number of small mines and prospects and reclaimed from waste dumps and old workings of abandoned mines.

Fluorspar shipments from domestic mines in 1942 aggregated 360,316 short tons valued at $8,897,749, increases of 12 percent in quantity and 32 percent in total value over 1941, and were the largest on record. Of the 1942 total, 79,049 tons (an all-time high) was shipped by river or river-rail for delivery to consumers in Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia.

Illinois (45 percent) and Kentucky (37 percent) supplied 82 percent of the fluorspar shipped in 1942 compared with 86 percent in 1941. Shipments from the Illinois-Kentucky district in 1942 gained only 7 percent over 1941 compared with an increase of 44 percent in the West.

In 1942 mines operated by consumers shipped about 92,000 short tons of fluorspar for use in their own plants compared with 59,644 tons in 1941.

The average value of all grades of domestic fluorspar shipped in 1942 was $24.69 a short ton ($3.72 more than the 1941 average).

The following table shows shipments of fluorspar, by States, 1941 and 1942. (For historic table, see Minerals Yearbook, 1941, p. 1401.)

Fluorspar shipped from mines in the United States, 1941–42, by States

State	1941			1942		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Colorado	15,566	$225,069	$14.46	31,743	$640,938	$20.19
Illinois	133,333	3,047,247	22.85	161,949	4,306,750	26.59
Kentucky	142,862	2,957,982	20.71	134,133	3,266,257	24.35
Arizona, New Mexico, Texas	19,089	355,951	18.65	23,291	530,025	22.76
Nevada	8,967	138,533	14.11	8,020	153,779	16.72
Utah	748			1,018		
Washington	104			48		
Tennessee				114		
	320,669	6,724,782	20.97	360,316	8,897,749	24.69

Ferrous and nonferrous plants are the chief purchasers of fluorspar, taking 66 percent of the total shipped from domestic mines in 1942. Of the fluorspar shipped to these plants in 1942, 97.9 percent was metallurgical grade, 0.5 percent ceramic grade, and 1.6 percent acid grade. Chemical plants, which use acid-grade fluorspar, and glass and enamel makers, which use fluorspar varying widely in calcium fluoride and silica content, took 25 and 6 percent, respectively, of the domestic shipments in 1942.

The next table shows shipments of fluorspar, by grades and industries, in 1942.

Fluorspar shipped from mines in the United States in 1942, by grades and industries

Grade and industry	Short tons	Value	
		Total	Average
Metallurgical:			
Ferrous and nonferrous	233,658	$5,275,924	$22.58
Cement	264	5,871	22.24
Miscellaneous	80	1,735	21.69
Exported	3,330	88,452	26.56
	237,332	5,371,982	22.63
Ceramic:			
Glass and enamel	[1] 22,813	633,086	27.75
Ferrous and nonferrous	1,210	32,524	26.88
Cement	49	1,558	31.80
Miscellaneous	1,307	45,939	35.15
Exported	787	27,993	35.57
	[1] 26,166	741,100	28.32
Acid:			
Chemical	88,086	2,540,869	28.85
Ferrous and nonferrous	3,833	117,698	30.71
Exported	4,899	126,100	25.74
	96,818	2,784,667	28.76
Total:			
Ferrous and nonferrous	238,701	5,426,146	22.73
Glass and enamel	22,813	633,086	27.75
Chemical	88,086	2,540,869	28.85
Cement	313	7,429	23.73
Miscellaneous	1,387	47,674	34.37
Exported	9,016	242,545	26.90
	360,316	8,897,749	24.69

[1] Of this quantity 2,985 tons were unground, including 2,602 tons of a purity equivalent to metallurgical grade.

SHIPMENTS, BY USES

The steel industry is the predominant purchaser of fluorspar, as is evident from the following table; it also consumes considerable hydrofluoric acid and sodium fluoride, in which fluorspar is the basic material.

Fluorspar shipped from mines in the United States, 1941–42, by uses

Use	1941				1942			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	66.77	214,120	$4,048,454	$18.91	62.51	225,233	$5,085,037	$22.58
Foundry	.85	2,724	53,044	19.47	.95	3,408	65,073	19.09
Glass and enamel	9.99	32,051	839,547	26.19	6.33	22,813	633,086	27.75
Hydrofluoric acid	16.43	52,674	1,359,623	25.81	24.45	88,083	2,540,766	28.85
Miscellaneous	2.16	6,916	146,332	21.16	3.26	11,763	331,242	28.16
	96.20	308,485	6,447,000	20.90	97.50	351,300	8,655,204	24.64
Exported	3.80	12,184	277,782	22.80	2.50	9,016	242,545	26.90
	100.00	320,669	6,724,782	20.97	100.00	360,316	8,897,749	24.69

USES

As figure 1 shows graphically, the steel industry is the chief consumer of fluorspar in the United States. Fluorspar is used as a flux in basic open-hearth and basic electric steel furnaces; a comparatively small amount is used in Bessemer-steel furnaces. The second-largest

use is in the manufacture of hydrofluoric acid, which is employed to make artificial cryolite and aluminum fluoride (aluminum raw materials) and refrigerating mediums; hydrofluoric acid is also used in the electrolytic refining of metals, the pickling of metals, chromium plating, the processing of high-octane gasoline and synthetic rubber, and the etching of glassware, as well as for other purposes. The glass industry, which uses fluorspar as an opacifier and as a flux, ranks third in importance. The enamel industry uses fluorspar as an ingre-

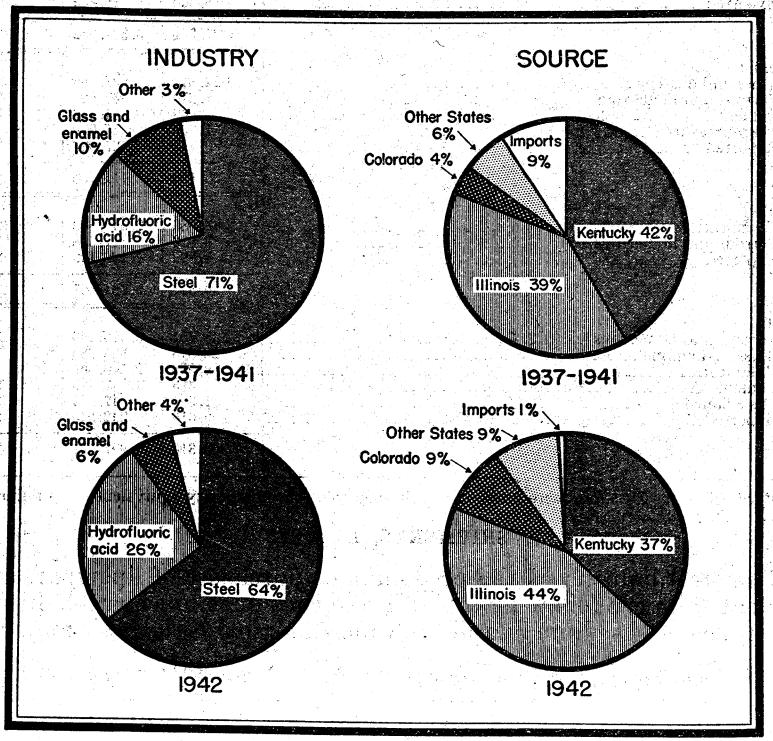

FIGURE 1.—Average annual fluorspar sales (domestic and foreign) to consumers in the United States, 1937–41, compared with 1942, by consuming industries and by sources.

dient in frit; it formerly ranked fourth but dropped to sixth place in 1942. Comparatively small quantities of fluorspar are used in a number of miscellaneous operations, such as production of the finer grades of iron castings, chilled-iron rolls, brass and bronze ingots, nickel and Monel metal, aluminum, magnesium, tin, cement, ferro-alloys, carbon electrodes, rock wool, and calcium carbide and cyanamid; in smelting refractory ores of gold, silver, and copper; as a paint pigment; as a binder for abrasives; in a formula for coating welding rods; as a boiler-cleaning compound; as a flux to deslag high-pressure steam generators; for stripping anodizing racks; as an ingredient in various types of fluxing compounds; and in a special cement used to produce a coating for artificially colored roofing granules for camouflage purposes.

SPECIFICATIONS

The chief commercial grades of fluorspar are metallurgical, ceramic, and acid. The standard chemical specification for metallurgical

grade is a minimum of 85 percent calcium fluoride and a maximum of 5 percent silica and 0.3 percent sulfur. However, under pressure of increasing demand and as a result of a change in the ceiling-price structure, metallurgical-grade fluorspar containing less calcium fluoride and more silica is being accepted by many consumers. The standard chemical specification for acid-grade fluorspar is a minimum of 98 percent calcium fluoride and a maximum of 1 percent each of silica and calcium carbonate, but a product containing 97½ percent calcium fluoride and 1½ percent silica is now being accepted by consumers. The specifications for ceramic-grade fluorspar vary widely, but the standard specification is a minimum of 95 percent calcium fluoride and a maximum of 2½ percent silica.

CONSUMPTION AND CONSUMERS' STOCKS

The following tables give data on consumption and consumers' stocks of fluorspar.

Fluorspar (domestic and foreign) consumed and in stock in the United States, 1941–42, by industries, in short tons

Industry	1941		1942		
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31
Basic open-hearth steel	191.300	[1] 86,800	217,100	63,400	4,084
Electric-furnace steel	18,300		25,300		
Bessemer steel	800		200		
Iron foundry	2,600	[1] 1,300	3,600	1,100	57
Ferro-alloys	2,500	1,000	4,200	1,000	----------
Hydrofluoric acid	56,000	10,200	81,600	19,000	585
Primary aluminum	800	400	2,000	1,100	49
Primary magnesium	300	100	700	400	----------
Glass	27,600	[1] 5,300	18,500	7,200	596
Enamel		[1] 2,300	3,100	1,100	57
Cement	900	300	400	200	49
Miscellaneous	2,500	[1] 1,200	4,100	1,500	123
	303,600	[1] 108,900	360,800	96,000	5,600

[1] Revised figures.

Consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1938–42

	1938	1939	1940	1941	1942
Production of basic open-hearth steel ingots and castings, long tons	25,868,000	43,368,000	55,038,000	[1] 66,056,000	67,821,000
Consumption of fluorspar in basic open-hearth steel production, short tons	73,600	116,200	143,800	191,300	217,100
Consumption of fluorspar per ton of steel made, pounds	5.7	5.4	5.2	5.8	6.4
Stocks of fluorspar on hand at steel plants at end of year, short tons	55,000	69,900	79,800	84,200	60,400

[1] Revised figures.

The quantity of fluorspar used per long ton of basic open-hearth steel varies with each plant, each operator, each furnace, and each heat but probably ranges from less than 1 to 80 pounds. The average for all plants is generally 5 to 8 pounds—a relatively small proportion of the furnace charge. From 1921 (the first year for which these data were collected) to 1940 the average consumption of fluorspar per

long ton of steel made declined almost steadily from 8.2 to 5.2 pounds. However, it increased to 5.8 pounds in 1941 and further to 6.4 pounds in 1942—the highest since 1935. The gain in 1941 and 1942 was due partly to the manufacture of proportionately more armor steel; a poorer quality of scrap, higher charges of lime, and rushing of heats. Although electric-furnace steel plants are small users of fluorspar compared with basic open-hearth steel plants, the average consumption (13.5 pounds in 1942) is substantially greater.

PRICES

On January 20, 1942, the Office of Price Administration requested producers of fluorspar "not to publish or quote prices on, nor sell your fluorspar at prices above your prices in effect on January 2, 1942." On January 2 the general price range for standard fluxing gravel fluorspar in the Illinois-Kentucky district was $23 to $25 a short ton f. o. b. mines. Inasmuch as production of fluxing gravel fluorspar did not pace consumption, the Office of Price Administration deemed a price increase to be essential to stimulate production and to encourage new producers to enter the fluorspar field. Consequently, new base ceiling prices for metallurgical-grade fluorspar, which became effective November 23 and ranged from $25 to $28 a ton, according to calcium fluoride and silica content, were established in Maximum Price Regulation 126 (Fluorspar), issued November 17, 1942. At the same time, dollar-and-cents ceiling prices were established for acid-grade fluorspar, except in the Illinois-Kentucky field. The following excerpts are quoted from Maximum Price Regulation 126:

(a) Metallurgical grade. (1) The maximum price f.o.b. a consumer's plant on any shipment shall be the price for the effective CaF_2 content as listed in the following table, plus either (i) railroad freight on such shipment from the producer's shipping point to the consumer's plant, or (ii) railroad freight on such a shipment from Rosiclare, Ill., to the consumer's plant, whichever is lower.

Effective CaF_2 content	Base price per short ton
70 percent or more	$28.00
65 percent but less than 70 percent	27.00
60 percent but less than 65 percent	26.00
Less than 60 percent	25.00

(2) The maximum price f.o.b. a producer's railroad or waterway shipping point shall be his maximum delivered price as determined under subparagraph (1) less freight from such shipping point to the consumer's plant.

(3) The effective CaF_2 content shall be determined by deducting 2½ times the SiO_2 content from the CaF_2 content.

(b) Acid-grade fluorspar produced outside the Illinois-Kentucky fluorspar district. (1) The maximum price f.o.b. a consumer's plant for any shipment of acid-grade fluorspar with a minimum of 97½ percent CaF_2 and a maximum of 1½ percent SiO_2 shall be $32.00 per ton, plus either (i) railroad freight on such shipment from the seller's shipping point to the consumer's plant or (ii) railroad freight on such a shipment from Rosiclare, Ill., to the consumer's plant, whichever is lower.

(2) The maximum price f.o.b. a producer's railroad or waterway shipping point for such acid-grade fluorspar shall be his maximum delivered price as determined under subparagraph (1) less freight from such shipping point to the consumer's plant.

The Office of Price Administration on November 28, 1942, exempted fluorspar ore (milling grade) from price control in Amendment No. 42 to Supplementary Regulation No. 1 to the General Maximum Price Regulation, effective November 23, 1942. Ceiling prices previously were the highest charged during March 1942.

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 1942 totaled 51,610 tons, or 29 percent less than in 1941. These stocks comprised 19,429 tons of finished fluorspar and 32,181 tons of crude fluorspar (calculated to be equivalent to 14,000 tons of finished fluorspar).

Stocks of fluorspar at mines or shipping points in the United States, December 31, 1941 and 1942, by States, in short tons

State	1941			1942		
	Crude [1]	Finished	Total	Crude [1]	Finished	Total
Arizona	30		30	30		30
California	150		150	150		150
Colorado	666	434	1,100	3,601	1,067	4,668
Illinois	23,711	19,966	43,677	10,521	13,984	24,505
Kentucky	12,579	10,981	23,560	1,774	3,970	5,744
New Mexico	2,539	425	2,964	15,605	312	15,917
Texas		43	43			
Utah	525	110	635	500	96	596
Washington		38	38			
	40,200	31,997	72,197	32,181	19,429	51,610

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

TECHNOLOGIC DEVELOPMENTS

To meet the large and increasing demand for acid-grade fluorspar, several new flotation plants were completed during 1942, the capacity of some existing plants was enlarged, and two new plants were being constructed. New plants were completed and put into operation near Jamestown, Colo., by Harry M. Williamson & Son and the General Chemical Co.; near Salida, Colo., by the Fluorspar Processing Co. and Kramer Mines (Inc.); and at Elizabethtown, Ill., by James W. Patton & Sons. Near Smithland, Ky., Butler & Moodie added a 3-cell flotation machine to its milling plant. The flotation plants of the Aluminum Ore Co. and Rosiclare Lead & Fluor Spar Mining Co. at Rosiclare, Ill., of the Indian Metals Co. at Lordsburg, N. Mex., and of P. L. Grattan at Deming, N. Mex., were enlarged. New plants were being constructed at Los Lunas, N. Mex., by the Zuñi Milling Co., and near Marion, Ky., by the Corod Minerals Co.

Output of flotation concentrates gained phenomenally in 1942, amounting to 106,974 short tons compared with 64,627 tons in 1941.

Experimental work was done on the Heavy-Media Process for separating fluorspar from gangue material. This work proved encouraging, and the installation will be made by the Rosiclare Lead & Fluor Spar Mining Co. in 1943. In applying this process ferrosilicon is used as the heavy medium. The Mahoning Mining Co. is adding to its flotation plant, enabling the company to mill high-barite ore.

FLUORSPAR INDUSTRY IN 1942, BY STATES

Arizona.—Production in Arizona came from mines and prospects in Greenlee and Pima Counties; that from Greenlee County was shipped to flotation plants at Deming and Lordsburg, N. Mex. The flotation concentrates recovered from the fluorspar, rather than the run-of-mine material, have been credited in the statistics to Arizona. The fluorspar from Pima County was produced at the Fluxore

Claims by N. A. Gonzales and shipped to steel plants and iron foundries on the West coast. The property discontinued operating in April 1942.

California.—The Industrial Minerals & Chemical Co. shipped a small quantity of ground fluorspar during 1942. This company has a plant at West Berkeley, where fluorspar from Nevada is ground. The fluorspar is credited in the statistics to Nevada.

Colorado.—The reopening of mines in Boulder and Jackson Counties and greatly accelerated production at mines in Chaffee County are reflected in the shipment of 31,743 short tons of fluorspar from Colorado in 1942 compared with 15,566 tons in 1941. Shipments in 1942, however, were 17 percent less than the all-time high established by Colorado in 1918. Of the 1942 shipments, 56 percent went to steel plants, 30 percent to hydrofluoric-acid plants, 8 percent to glass and enamel plants, and the remaining 6 percent to iron foundries, welding-rod manufacturers, and aluminum, magnesium, ferro-alloy, and cement plants.

Production in Colorado in 1942, which amounted to 33,400 tons, came from Boulder, Chaffee, Jackson, and Mineral Counties, but mines in Chaffee County supplied 47 percent of the State total.

The flotation mill of Harry M. Williamson & Son near Jamestown made its initial production of concentrates in March 1942; the ore treated in the mill came from the company Emmett mine in Boulder County. At its Brown Spar mine, also in Boulder County, the shaft was sunk to 300 feet and a heavier hoist installed. The General Chemical Co., which acquired the Chancellor, Yellow Girl, and Burlington mines in Boulder County in 1940, acquired the Alice mine, also in Boulder County, in 1942. These mines furnish ore for the company flotation mill near Jamestown, which began production in May 1942. This company also operates a flotation mill in New Mexico. The American Fluorspar Corporation made a substantial increase in production at its mine near Salida (Chaffee County), did considerable development work, electrified the mine, and began opening a mine at Poncha Springs in the same county. The flotation mill of the Fluorspar Processing Co., on property of the American Fluorspar Corporation, began operating in April 1942; the ore milled is supplied by the American Fluorspar Corporation. The Colorado Fluorspar Corporation reported gains over 1941 of 24 and 86 percent, respectively, in production of metallurgical-grade and flotation concentrates. A shaft was sunk to the 118-foot level, and a 100-foot tunnel was driven along a newly found ore body. The flotation mill of Kramer Mines, Inc., near Salida, began operating in October 1942. Ore for the mill comes from the company mine, also near Salida. The Western Feldspar Milling Co., Denver, shipped 8 percent more ground fluorspar to the glass trade in 1942 than in 1941. The ore ground by this company is supplied by the American Fluorspar Corporation. The Western Fluorspar Corporation spent the latter part of 1941 and the first half of 1942 rehabilitating the long-idle mine near Northgate, Jackson County, and remodeling and enlarging the mill. Production was begun on July 15, 1942, and continued until December 10, when a fire destroyed the mill; it is now being rebuilt. The Wagon Wheel Gap mine, of the Colorado Fuel & Iron Corporation in Mineral County, was inactive in October because the concentrating mill was being remodeled; in consequence, production was 8 percent less than in 1941.

Illinois.—Approximately 282,000 short tons of fluorspar-bearing material, equivalent to 145,000 tons of finished fluorspar, were mined in 1942 compared with 248,000 tons, equivalent to 135,000 tons of finished fluorspar, in 1941. Of the finished fluorspar produced in 1942, it is estimated that about three-fifths was from vein deposits and two-fifths from bedded deposits. Of the fluorpsar produced in Illinois in 1942, about 95 percent came from Hardin County and 5 percent from Pope County.

Fluorspar-bearing material milled in 1942 totaled 296,000 tons, from which about 156,000 tons of finished fluorspar were recovered—a ratio of 1.9:1. Considerable Kentucky fluorspar is milled in Illinois, and some Illinois fluorspar is milled in Kentucky; the finished fluorspar so recovered, as well as that shipped, is credited in the statistics to the State of origin.

Shipments from Illinois (161,949 tons) in 1942, which established a new record, were 21 percent more than in 1941 and 3.4 percent greater than in 1917, the previous record year. The 1942 shipments comprised 77,947 tons to steel plants, 62,573 tons to hydrofluoric-acid plants, 7,520 tons to glass and enamel plants, 7,155 tons to Canada and Peru, and 6,754 tons to iron foundries, nonferrous smelters, aluminum- and magnesium-reduction plants, and ferro-alloy, nickel, and welding-rod manufacturers. Of the 1942 total, 42,250 tons were shipped by river or river-rail to consumers compared with 39,918 tons in 1941.

The Air Shaft-Midway-North Boundary, Argo, Blue Diggings, Crystal, A. L. Davis, W. L. Davis, Deardorff, W. C. Green, Hillside, Humm, Lead Hill, North Daisy, Roberts, Rosiclare, Stewart, and Victory mines supplied about 87 percent of the total finished fluorspar produced in Illinois in 1942; the remainder came from many mines and prospects, including the Austin, Big Creek, Cave in Rock, Cooper, Crabb, Douglas, Du Bois, Eureka No. 4 and No. 5, Good Hope, Hamp, Hanson, J. W. Hill, Last Chance, Lost 40, Love, Pell, Red Tipple, Rose Creek, South Boundary, Wall, and Winn.

The Fluorspar Products Co. operated the Lead Hill and Stewart mines and also milled purchased ore from various properties. Shipments were 8 percent less than in 1941. Two shafts were sunk on the Stewart property. A core drill was operated about 9 months.

The Aluminum Ore Co. produced 95 percent more fluorspar at its flotation plant in 1942 than in 1941. The mill feed comprised ore from the company Argo, Blue Diggings, Good Hope, Hamp, Hanson, and Last Chance mines and a small quantity of purchased ore. Additional flotation cells and drying and grinding equipment were added to the mill in 1942, doubling its capacity. The company was active sinking shafts in 1942. Its Fairview shaft, on the Argo-Blue Diggings veins, has been sunk to the 700-foot level; it is being sunk an additional 90 feet and will be the largest shaft in the fluorspar district, being 12 by 12 feet cross section in the clear. Three smaller shafts have been sunk along the same veins to the 300-foot level; these shafts were required to supply the immediate demand for crude material, and each was brought into production during the latter part of 1942.

Production at the Crystal mine of the Crystal Fluorspar Co. was slightly less than in 1941. Considerable output was lost as a result of two strikes. Prospecting and development work included 17,211 feet of churn and diamond drilling at the Crystal mine and 935 feet of churn drilling along the Crystal-Mahoning east-west property line.

Hillside Fluor Spar Mines purchased the Dimick property, adjoining the Hillside property on the northwest, and has rehabilitated the shaft to the 200-foot level. Workings are being carried forward on two prominent ore bodies to develop them for production. Exploration work is being done by drilling in cooperation with the Illinois Geological Survey, which also has been doing some geophysical work. Production of gravel fluorspar and flotation concentrates by Hillside Fluor Spar Mines was 7 and 4 percent, respectively, less than in 1941. The mill feed came from the Dimick, Hillside, and Wall mines in Illinois and the Keystone mine near Marion, Ky.

The Rosiclare Lead & Fluor Spar Mining Co. operated the Daisy, Eureka No. 4 and No. 5, Midway-North Boundary-Air Shaft, North Daisy, Rosiclare, and South Boundary mines in 1942, but the North Boundary and Rosiclare mines were the chief producers. Production at the gravity concentrating mill was 5 percent less than in 1941. Output at the flotation plant, however, was 89 percent more than in 1941. Shipments of fluorspar of all grades were 33 percent greater than in 1941. The flotation mill was enlarged during 1942. Experimental work was done on the Heavy-Media Process for separating fluorspar from gangue material. This work proved encouraging, and the installation will be made in 1943. In applying this process ferrosilicon is used as the heavy medium. The company pushed development work in all its mines and did considerable surface and underground drilling. Development work was under way on the 600- and 700-foot levels of the Rosiclare mine, and considerable prospecting was done on an outlying property.

The Victory mine of the Victory Fluorspar Mining Co. was operated at about the same rate as in 1941. A diamond-drilling program was carried on during the summer and fall without any notable finds.

The Cave in Rock Spar Co. remodeled its mill and did some development work at its mining properties. Most of the ore milled in 1942 was purchased from local producers. Production of finished fluorspar, however, was substantially less than in 1941.

The flotation mill of the Mahoning Mining Co. produced 28 percent more fluorspar concentrates than in 1941. The mill feed comprised ore from the A. L. Davis, W. L. Davis, Deardorff, and W. C. Green mines and a small quantity of purchased ore. Production of finished fluorspar comprised 86.4 percent acid grade and 13.6 percent pelletized gravel. During 1942 a new shaft (the East Green) was completed to develop an ore body, and the A. L. Davis and West Green ore bodies were opened. At the flotation plant, improvements are in progress to enable the mill to handle high-barite ore and to increase capacity to some extent. The motors in the flotation mill [3] and the new Diesel generating unit at the W. L. Davis mine [4] have been described by Edwards.

Jas. W. Patton & Sons treated tailings from the Crystal mine in its flotation plant near Elizabethtown.

The Humm mine was operated by C. C. Mackey during the first 9 months of 1942, then it was worked by Barnett, Karber & Adams. Output by all operators was at about the same rate as in 1941.

The Yingling Mining Co. did considerable development work and produced a small quantity of fluorspar at the Nicholas Hamp and

[3] Edwards, J. H., Some Electrical Aspects of a New Fluorspar Plant: Eng. and Min. Jour., vol. 143, No. 3, March 1942, pp. 56–58.

[4] Edwards, J. H., Mahoning's New Diesel Unit Generates 240 Volts A. C.: Eng. and Min. Jour., vol. 143, No. 4, April 1942, p. 55.

Rose Creek mines. It remodeled a mill formerly run by the Big Creek Fluorspar Co., which discontinued operations in March 1942. The mill includes air tables and electrostatic separation to produce fluorspar, lead, and zinc concentrates.

A new operator, the Minerva Oil Co., is developing a mine near Cave in Rock and expects to get into production the latter part of 1943. A shaft is being sunk to a depth of 630 feet, and a flotation plant to produce fluorspar and zinc concentrates is planned.

Production at the Roberts mine in Pope County, operated by Roberts & Frazer of Illinois (Kentucky Fluor Spar Co. affiliate) more than tripled that in 1941. This mine is equipped with log washer, picking belt, and screens.

Kentucky.—Production of fluorspar (expressed in terms of finished product) in Kentucky was about 121,500 short tons in 1942 compared with 135,500 tons in 1941. Shipments were 134,133 tons in 1942, a decline of 6 percent from the all-time record of 1941. The 1942 shipments comprised 111,370 tons to steel plants, 11,141 tons to glass and enamel plants, 4,576 tons to hydrofluoric-acid plants, 1,750 tons to Canada, and 5,296 tons to iron foundries, nonferrous smelters, and cement, ferro-alloy, and aluminum-reduction plants. Of the 1942 total, 36,799 tons were shipped to consumers by river or river-rail compared with 34,698 tons in 1941.

Production in Caldwell County came chiefly from the Hollowell & Hobby, Hughett, Marble, Senator, and Tyrie (Lester) mines.

John Hughett completed a shaft at his mine near Princeton and began production in 1942.

Production at the Hollowell & Hobby mine, operated by the New York & Kentucky Mining Co., was about 25 percent less than in 1941. The company did much prospecting but did not locate any extensive ore bodies.

Core drilling by W. H. Crider disclosed a productive ore body at the Senator mine, and a shaft was sunk and machinery installed. The mine was sold to the Midland Minerals Corporation in December 1942.

Various operators produced fluorspar at the Marble mine of the S. L. Crook Corporation during 1942.

About 90 percent of the production in Crittenden County came from the Bachelor, Davenport, Keystone, Pigmy, Summers, Tabb, Waddell, and Watson (Eagle) mines. Most of the remainder came from many smaller mines (including the Barnes, Blue, Brown, Butler, Corn, Crystal, Dyke, Gilless, Haffaw, Hodge, Krause, Madry, Memphis, Pogue, Redd, Reiter, Simpkins, Sullinger, and Watkins) and from numerous prospects; some was reclaimed from waste dumps and old workings of abandoned mines.

The Eagle Fluor Spar Co. produced 17 percent more fluorspar at its Watson mine than in 1941. The 1942 production comprised 74 percent of metallurgical grade and 26 percent of acid grade. Perry & Loyd reworked the Watson tailings and recovered considerable fluorspar.

The mill of R. J. Forester handled ore from his Summers mine and some purchased ore, recovering about the same quantity of finished fluorspar as in 1941.

The Tabb mines and mill of the United States Coal & Coke Co. produced 8 percent more finished fluorspar than in 1941; shipments were 40 percent greater. The company did considerable development work and made improvements in its mill during 1942.

The Kentucky Fluor Spar Co., which operates a mill a short distance south of Marion, did the largest volume of business in its history; tonnage and dollar sales were 14 and 31 percent, respectively, greater than in 1941. In 1942 the company, through its mining division (Roberts & Frazer), operated the C. R. Babb, Carr, and Ellis mines in Livingston County, Ky., and the Roberts mine in Pope County, Ill.; about two-thirds of the company supply came from these mines, and the remainder chiefly from the Barnes, Nancy Hanks, and Waddell mines in Kentucky.

At the Keystone mine of Hillside Fluor Spar Mines a new deep-well pump, operated by direct-connected Diesel engine and capable of handling 1,000 gallons of water a minute against a 600-foot head, was installed in 1942. With this equipment it is hoped to keep the lower levels unwatered during the heavy-rain season and to extend the workings at least to the 600-foot level. A new shaft (No. 4) was sunk to 300 feet and encountered good ore. The workings of this shaft will be connected with other mine workings to the north to give additional tramming and hoisting facilities. Production at the Keystone mine was considerably less than in 1941. Although the fluorspar from this mine is finished at the company mill at Rosiclare, Ill., production and shipments are credited in the statistics to Kentucky.

Production at the Pigmy mine of the Pigmy Corporation (subsidiary of the Rosiclare Lead & Fluor Spar Mining Co.) was 19 percent less than in 1941. Development work at the Pigmy mine consisted chiefly of shaft sinking, drifting, and diamond drilling.

Development work at the Davenport mine consisted of locating an unknown ore body by drilling and of driving a crosscut to it. A new shaft to cut the extension of this ore body is contemplated. A new 6-cell coarse jig was added to the mill. Production was about 21 percent less than in 1941. The mineral right and some surface at the Davenport mine were purchased December 31, 1942, by the National Fluorspar Co., which previously operated the mine under lease.

In 1942 the Delhi Fluorspar Corporation continued development work at its Bachelor mine and plans to sink a 600-foot shaft in early 1943. Production was substantially less than in 1941. However, the 1942 deficit in production was made up with purchased fluorspar; as a consequence, shipments from Kentucky were greater than in 1941.

The Howard Easley Corporation, which operates a custom mill near Marion, worked two shifts during part of 1942 and as a result milled considerably more ore than in 1941. In the mill a second crusher was added and many improvements were made to increase production.

In Livingston County the bulk of the fluorspar produced came from the C. R. Babb, Carr, Ellis, Nancy Hanks, and Wright mines, from C. R. Babb and Nancy Hanks tailings, and from the jig reclaiming plant working Klondike tailings.

Output at the C. R. Babb, Carr, and Ellis mines of Roberts & Frazer was 31 percent greater than in 1941. Edwin W. Frazer reworked the tailings at the C. R. Babb mine and recovered 380 tons of fluorspar.

The levels in the Nancy Hanks mine, operated by W. V. Haynes, Jr., were retimbered during 1942, causing some loss in production. Nevertheless, output of finished fluorspar was 7 percent more than in 1941. Tinsley & Loyd reclaimed a substantial quantity of fluorspar from Nancy Hanks tailings.

Butler & Moodie, operating a jig plant reclaiming fluorspar from Klondike-mine tailings, recovered about half as much fluorspar from that source as in 1941. Some ore was also milled for John Hughett. A 3-cell flotation machine was installed during January 1943.

As the result of an increase in price and a change in the specification for metallurgical-grade fluorspar, Ralph E. Jones has reopened the Faircloth mine in Woodford County near Wilmore and has remodeled the mill. The ore in this mine is impregnated with considerable calcite and is difficult to mill to 85 percent calcium fluoride. However, it is associated with but little silica and is therefore amenable to a product containing 70 percent effective calcium fluoride. A small production was made in 1942.

Nevada.—Shipments of fluorspar from Nevada in 1942—8,020 short tons—were 11 percent less than the all-time record of 8,967 tons in 1941. Most of the 1942 total went to steel mills and hydrofluoric-acid plants.

The chief producing mine in Nevada in 1942 was the Baxter in Mineral County, operated by V. S. Baxter; production was about the same as in 1941. The other active mine was the Daisy in Nye County, operated by J. Irving Crowell, Jr.; production was 25 percent less than in 1941.

New Mexico.—Production of fluorspar in New Mexico, which established a new record in 1942, came from Catron, Dona Ana, Grant, Luna, Sierra, and Valencia Counties.

Shipments from New Mexico, Arizona, and Texas totaled 23,291 short tons compared with 19,089 tons in 1941. Of the 1942 shipments, slightly more than half was of metallurgical grade, which moved to steel mills and iron foundries; the remainder was chiefly flotation concentrates, which were shipped mainly to hydrofluoric-acid and glass plants.

The gravity-flotation mill of the Non-Metallic Corporation at Silver City was operated by the Continental Chemical & Ore Co. during part of 1942; the concentrates produced were shipped to a hydrofluoric-acid plant. The mill feed comprised chiefly purchased ore from the Clum mine in Grant County; a small amount came from the Huckleberry mine in Catron County, operated by the company.

The Diamond mine (formerly Tortugas) near Mesilla Park, Dona Ana County, is being reopened by Jacques K. Stanland. The shaft was extended 300 feet farther, about 1,500 feet of lateral work were done, a railroad connection was built to the mine, and a gravity-concentration mill was expected to be completed in early spring. In the course of development work, some milling-grade ore was produced and shipped to a local flotation plant.

The flotation mill of the Indian Metals Co. at Lordsburg was operated at a substantially reduced rate in 1942. The ore milled was purchased from many properties, but the greater part came from the Howard and Sanders mines in New Mexico and the Ellis (Fourth of July No. 2) mine in Arizona. The Indian Metals Co. practically rebuilt its mill, doubling capacity, in 1942, recently began development work at two mines in Hidalgo County, and plans to develop two additional mines in the same county.

P. L. Grattan's remodeled flotation mill at Deming resumed production in 1942. A new bank of cells was added, and changes and improvements were also made. At the Grattan mine in Luna County

the shaft was straightened, and a head frame, surface houses, and a road were built.

The Lucky and Greenleaf No. 4 mines in Luna County have been under development since October 1942 by the Western Mining Corporation. The Lucky mine made its initial production in January 1943.

The Howard and Sadler mines in Luna County were important producers during 1942.

The flotation mill of the General Chemical Co. at Deming was operated on a substantially larger scale than in 1941. This company also operated the Spar Group and Sadler mines in Luna County and the Osmer (Shriñe) mine in Grant County; the last two mines were acquired in 1942. In addition to the production from its own mines, considerable milling-grade ore was purchased from various producers in Arizona, New Mexico, and Texas.

Since May 1942 Kinetic Chemicals, Inc. (du Pont subsidiary), has carried on development work at its Lyda K mine near Arrey, Sierra County. As of December 31, a new 100-foot shaft had been sunk at the north end of the vein, and a 150-foot drift to the northeast and a 175-foot drift to the southwest had been driven at that level. A new hand-sorting mill, under construction, is expected to be in operation by April 1943 at an annual rate of 10,000 tons. Production is expected to comprise about 15 percent of acid grade, 50 percent of metallurgical grade, and 35 percent of mill-feed grade.

The Navajo mine in Valencia County, operated by Navajo Fluorspar Mines, produced 65 percent more finished fluorspar than in 1941. In addition, a substantial tonnage of ore was produced for mill feed at the flotation mill being constructed at Los Lunas (N. Mex.) by the Zuñi Milling Co., affiliate of Navajo Fluorspar Mines. This mill is expected to be brought into production during 1943.

Development work was done and considerable fluorspar produced during 1942 at the Bonita and Breece mines in Valencia County by the Both Mining & Milling Co.

Small outputs were made at the Mirabal and Keeney properties, also in Valencia County.

Tennessee.—The Foley mine in Smith County near Rome was reopened in 1942 and a small quantity of metallurgical-grade fluorspar was produced and shipped by Frailey & Heap.

Texas.—A small tonnage of milling-grade ore was produced at the Horse Shoe prospect near Hot Wells, Hudspeth County, by U. B. Melton; it was shipped to a flotation plant at Deming, N. Mex.

Utah.—Shipments of fluorspar from Utah in 1942 were 1,018 short tons (an all-time high) compared with 748 tons in 1941.

The Western Fluorite Co., which has done considerable development work at many properties in Beaver County and completed a mill near Milford, was the chief producer in Utah in 1942. The Staats mine, also in Beaver County, operated by Fred Staats, produced substantially less fluorspar than in 1941, chiefly because of a shortage of labor.

The Cougar mine near Milford in Beaver County was being developed by the Tintic Standard Mining Co. in 1942.

Washington.—A small quantity of fluorspar, mined in 1941, was shipped from the Mitchem mine in Ferry County by the Mineral Products Co. in 1942.

FOREIGN TRADE

Imports.—Imports of fluorspar for consumption in the United States during 1942 were 2,151 short tons (1,882 tons containing more than 97 percent and 269 tons containing not more than 97 percent calcium fluoride), valued[5] at $35,529, compared with 7,524 tons (1,516 tons containing more than and 6,008 tons not more than 97 percent calcium fluoride), valued[5] at $80,135. The value assigned to the higher-grade foreign fluorspar averaged $19.69 and $16.98, respectively, in 1941 and 1942, and that of the lower-grade $8.37 and $13.30, respectively. The cost to consumers in the United States also includes duty, loading charges, insurance, consular fee, and freight to consuming plants.

Fluorspar imported for consumption in the United States, 1941–42, by countries[1] 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
1941						
Mexico:						
Laredo	68	$863			68	$863
Maryland			1,621	$14,704	1,621	14,704
New York	1,448	28,987			1,448	28,987
Philadelphia			1,315	12,777	1,315	12,777
	1,516	29,850	2,936	27,481	4,452	57,331
Spain: Philadelphia			3,070	22,772	3,070	22,772
United Kingdom: Rochester			2	32	2	32
	1,516	29,850	6,008	50,285	7,524	80,135
1942						
Canada: St. Lawrence			(2)	10	(2)	10
Mexico:						
El Paso	483	6,860	1	12	484	6,872
Laredo	92	605	268	3,556	360	4,161
New York	1,077	20,541			1,077	20,541
Philadelphia	230	3,945			230	3,945
	1,882	31,951	269	3,568	2,151	35,519
	1,882	31,951	269	3,578	2,151	35,529

[1] For historic table, see Minerals Yearbook, 1941, p. 1401.
[2] Less than 1 ton.

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 1941 and 1942 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 1941 and 1942. 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.

[5] 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."

Imported fluorspar delivered to consumers in the United States, 1941–42, by uses

Use	1941			1942		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	6,102	$143 863	$23.58	269	[1] $6,700	[1] $24.91
Hydrofluoric acid	1,418	38,760	27.33	1,900	53,500	28.16
Miscellaneous	69	1,380	20.00			
	7,589	184,003	24.25	2,169	60,200	27.75

[1] Estimated.

Exports.—Producers of fluorspar reported exports of 9,016 short tons of fluorspar valued at $242,545 in 1942 compared with 12,184 tons valued at $277,782 in 1941. The exports in 1942 by producers comprised 1,714 tons of fluxing gravel, 557 tons of ceramic ground, 4,899 tons of acid grade, and 1,616 tons of special-grade (96 percent CaF_2) jig concentrates, all to Canada, and 230 tons of ceramic ground to Peru. In addition to the fluorspar exported by producers in 1942, brokers reported exports of 4 tons of ceramic ground—3 to Chile and 1 to Uruguay.

Fluorspar reported by producers as exported from the United States, 1938–42

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1938	788	$9,061	$11.50	1941	12,184	$277,782	$22.80
1939	2,976	74,443	25.01	1942	9,016	242,545	26.90
1940	8,482	178,467	21.04				

Tariff reduction.—The trade agreement between the United States and Mexico, signed December 23, 1942, and proclaimed by the President December 28, provided for a duty of $6.30 a long ton ($5.625 a short ton) on fluorspar containing not more than 97 percent calcium fluoride imported into the United States. The former duty was $8.40 a long ton ($7.50 a short ton). The duty on fluorspar containing more than 97 percent calcium fluoride remained at $4.20 a long ton ($3.75 a short ton).

WORLD PRODUCTION

The following table shows world production of fluorspar by countries from 1937 to 1942, insofar as statistics are available. Because of restriction on the publication of statistics by the governments of many countries, few figures for 1940, 1941, and 1942 are available.

World production of fluorspar, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Argentina (shipments)	350	1,406	739	597	2,027	(2)
Australia:						
New South Wales	55	----------	(2)	(2)	(2)	(2)
Queensland	1,410	2,479	20	(2)	(2)	(2)
South Australia	----------	----------	----------	(2)	(2)	(2)
Victoria	----------	804	----------	(2)	(2)	(2)
Canada	136	197	218	4,041	5,020	3,624
Chosen	11,000	[3] 34,207	(2)	(2)	(2)	(2)
France	51,430	51,920	(2)	(2)	(2)	(2)
Germany:						
Anhalt	13,662	10,462	(2)	(2)	(2)	(2)
Baden	13,637	21,350	(2)	(2)	(2)	(2)
Bavaria	62,455	59,919	(2)	(2)	(2)	(2)
Prussia	30,514	22,956	(2)	(2)	(2)	(2)
Saxony	8,074	12,063	(2)	(2)	(2)	(2)
Thuringia	16,117	22,405	(2)	(2)	(2)	(2)
India, British	----------	----------	20	(2)	(2)	(2)
Italy	13,385	12,186	(2)	(2)	(2)	(2)
Newfoundland (shipments)	8,479	8,944	11,227	14,697	11,581	[4] 32,660
Norway	1,692	1,676	2,367	(2)	(2)	(2)
Southern Rhodesia	----------	156	----------	(2)	(2)	(2)
South-West Africa	----------	585	105	(2)	(2)	(2)
Spain	4,250	8,596	(2)	(2)	(2)	(2)
Tunisia	1,676	2,060	2,473	(2)	(2)	(2)
Union of South Africa	3,615	4,736	10,322	7,421	[4] 3,900	[5] 3,527
U. S. S. R.	[4] 70,000	[6]	(2)	(2)	(2)	(2)
United Kingdom	42,837	33,866	[7] 17,521	(2)	(2)	(2)
United States (shipments)	164,408	72,940	165,806	211,917	290,905	326,871
	519,000	456,000	(2)	(2)	(2)	(2)

[1] In addition to countries listed, China and Mexico produce fluorspar but data of output are not available.
[2] Data not available.
[3] Exports.
[4] Estimated.
[5] January to September, inclusive.
[6] Estimate included in total.
[7] January to June, inclusive.

Argentina.—Production of fluorspar in Argentina increased markedly to 2,234 short tons in 1941 from 658 tons in 1940.

Brazil.[6]—The Companhia Brasileira de Alumino controls a promising, newly discovered fluorspar deposit in the southern edge of the sulfide belt of Ribeira de Iguapa Valley. Before this discovery, only minor occurrences of fluorspar were known in the country.

Canada.—Production of fluorspar in Canada has been relatively small in recent years but in 1941 amounted to 5,534 short tons. This output, however, falls far short of consumption; consequently, search for deposits has been under way. The greater part of the fluorspar consumed in Canada is imported from Newfoundland and the United States.

Mexico.—Production figures on fluorspar in Mexico in 1942 are not available, but 5,914 short tons were exported in that year compared with exports of 11,597 tons in 1941 and 10,220 tons in 1940. Most of the fluorspar exported in 1940 and 1941 went to Japan. Before the war the La Azul mine at Taxco, Guerrero, largest producer of fluorspar in Mexico, was under Japanese control; it has since been taken over by the Enemy Property Custodian, who has called for bids to operate the mine. When production is resumed, a substantial increase in output can be expected.

[6] Engineering and Mining Journal, vol. 143, No. 6, June 1942, p. 105.

Newfoundland.—Production of fluorspar in Newfoundland in 1942 is reported to have reached 36,000 short tons.[7] Efforts are being made to increase this output, and it is hoped that production in 1943 will reach 100,000 tons.

Fluorspar is produced in Newfoundland by the St. Lawrence Corporation of Newfoundland, Ltd., and Newfoundland Fluorspar, Ltd., the latter a subsidiary of the Aluminum Co. of Canada, Ltd. Production and shipments by the St. Lawrence Corporation of Newfoundland, Ltd., were 12 and 9 percent, respectively, greater in 1942 than in 1941. The 1942 shipments went to Canadian consumers and comprised 15 percent acid grade, 74 percent metallurgical grade, and 11 percent crude (65 percent CaF_2). The St. Lawrence Corporation of Newfoundland, Ltd., completed a flotation plant late in 1942. Newfoundland Fluorspar, Ltd., which has been doing exploration and development work for several years, began producing in 1942. After hand-picking and crushing at the mine the output, which contains 70 to 80 percent calcium fluoride, is shipped to Arvida, Canada, where the Aluminum Co. of Canada, Ltd., has a flotation plant to mill the ore to acid grade.

Sweden.—For some time explorations have been made regarding possibilities of mining fluorspar at the Branteviks mines in the Province of Skåne in south Sweden. Deposits were discovered near the surface, and test borings have now reached a depth of 50 to 60 meters (164 to 197 feet). Machinery to permit further operations has been ordered.[8]

Aktiebolaget Branteviks Gruvor has begun mining fluorspar on a small scale; the material is to be used in manufacturing light metals in a plant at Sundsvall.[9]

Union of South Africa.—Production of fluorspar in the Union of South Africa was 3,888 short tons during the first 9 months of 1942 (figures for the remaining 3 months not available) compared with about 4,300 tons in the year 1941 and 8,180 tons in 1940.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. Gibbs[10] has described the mine at Ivigtut, grades of ore produced, methods of processing and purification, and various uses of cryolite.

A sizable proportion of the cryolite used in the United States is made from fluorspar. According to Frary:[11]

> The fluorspar is treated with sulfuric acid to produce hydrofluoric acid, and this is neutralized with the proper amounts of soda ash and aluminum hydrate to produce the cryolite, which is a double fluoride of sodium and aluminum (Na_3AlF_6). The artificial cryolite is quite satisfactory and, in fact, considerably lower in objectionable impurities than the natural cryolite usually used. There would be no serious difficulty in getting along with the artificial product if the supply of natural cryolite from Greenland is shut off.

The chief use of cryolite is in the metallurgy of aluminum; comparatively small amounts are used in glass, enamels, abrasives, and insecticides.

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[7] Cole, W. E., Jr., American vice consul, St. John's, Newfoundland, February 9, 1943.
[8] Klath, T. O., commercial attaché, Stockholm, Sweden, March 9, 1942.
[9] Chemical and Engineering News, vol. 20, No. 13, July 10, 1942, p. 858.
[10] Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemical Raw Material: Chem. Ind., vol. 38, May 1936, pp. 471–476.
[11] Frary, F. C., Cryolite from Fluorspar: Steel, vol. 108, No. 26, June 30, 1941, p. 4.

Cryolite was put under complete allocation and use control by General Preference Order M–198, issued by the War Production Board September 18, 1942. Cryolite, both natural and artificial, could not be delivered, received, or used after October 1, 1942, except by specific authorization of the War Production Board. The sole exception to the provision is receipt and use as an insecticide.

Artificial cryolite was manufactured in the United States in 1942 by the Aluminum Ore Co. at East St. Louis, Ill.; this company is building a plant near Bauxite, Ark. A small quantity of artificial cryolite was made in a pilot plant by the Pennsylvania Salt Manufacturing Co. in 1942; it has about completed a commercial plant at Cornwells Heights, Pa.

The following table shows imports of cryolite into the United States in 1941 and 1942.

Cryolite (natural and artificial) imported for consumption in the United States, 1941–42, by countries

Country	1941		1942	
	Long tons	Value	Long tons	Value
Canada	4	$1,125		
Greenland	26,680	1,461,600	64,565	$3,859,875
	26,684	1,462,725	64,565	3,859,875

FELDSPAR

By Robert W. Metcalf

SUMMARY OUTLINE

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SUMMARY

Conversion of many enamel and porcelain plants to the heat treating of steel, to the manufacture of parts or assemblies for war machines, or to other activities more closely allied to successful completion of the war sharply reduced the consumption of feldspar in the enamel and porcelain industries in 1942. Curtailment of plate-glass production also tended to reduce feldspar sales. However, production and shipments of glass containers, which probably represent the most important consumer outlet for feldspar, in 1942 broke all records by increases of 12 and 15 percent, respectively, over 1941, the former record year. Sales of feldspar to glass plants in 1942 were the highest recorded since annual statistics by uses were first compiled (1934) and undoubtedly also the highest in the history of the industry. The 7-percent increase over 1941 in this category, however, was not sufficient to offset the decline in sales to porcelain and enamel manufacturers.

Salient statistics of the feldspar industry in the United States, 1940–42

	1940	1941	1942	Percent of change in 1942
Crude feldspar:				
Domestic sales:				
Long tons	290,763	338,860	307,823	−9.2
Value	$1,271,995	$1,519,456	$1,516,791	−.2
Average per long ton	$4.37	$4.48	$4.93	+10.0
Imports:				
Long tons	12,522	11,253	9,525	−15.4
Value	$80,274	$73,236	$69,797	−4.7
Average per long ton	$6.41	$6.51	$7.33	+12.6
Ground feldspar sold by merchant mills:				
Short tons	285,713	354,417	327,786	−7.5
Value	$3,065,482	$3,782,603	$3,524,969	−6.8
Average per short ton	$10.73	$10.67	$10.75	+.7

Sales of crude spar in 1942 totaled 307,823 long tons, valued at $1,516,791, a decrease of 9 percent in quantity and of 0.2 percent in value from 1941. Sales of ground spar aggregated 327,786 short tons valued at $3,524,969, a decline of about 7 percent in quantity and value from 1941. The output of both crude and ground feldspar in

1942, however, was considerably higher than in any year other than 1941. The average value per ton of crude spar rose 10 percent in 1942, while the downward trend in recent years in realization per ton of ground spar was checked and a small increase recorded.

Crude feldspar imported into the United States in 1942 amounted to 9,525 long tons valued at $69,797, a decrease of 15 percent in tonnage and 5 percent in value from 11,253 tons valued at $73,236 imported in 1941.

Most States produced somewhat less crude feldspar than in 1941, notable exceptions being Arizona, California, and Wyoming. In 1942 South Dakota achieved a new high in output (sales) of ground feldspar. Other States grinding more spar than in 1941 were Arizona, California, and Virginia. Somewhat smaller outputs than in 1941 were reported by New Jersey-Connecticut, North Carolina-Tennessee, Maine, and New Hampshire.

DOMESTIC PRODUCTION

Following the usual practice in the industry, crude feldspar is reported in long tons of 2,240 pounds and ground feldspar in short (net) tons of 2,000 pounds.

Crude feldspar.—Crude feldspar sold in 1942 totaled 307,823 long tons, a 9-percent decrease from the record year 1941 but 6 percent above sales in the highest previous year (1940). The total value ($1,516,791) in 1942 was only slightly less than in 1941.

Crude feldspar sold or used by producers in the United States, 1938–42

[Value at mine or nearest shipping point]

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1938	196,119	$895,081	$4.56	1941	338,860	$1,519,456	$4.48
1939	253,466	1,112,857	4.39	1942	307,823	1,516,791	4.93
1940	290,763	1,271,995	4.37				

Crude feldspar sold or used by producers in the United States, 1940–42, by States

[Value at mine or nearest shipping point]

State	1940		1941		1942	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	2,711	$18,254	4,464	$22,490	5,090	$23,261
Colorado	34,105	123,514	42,326	147,640	33,610	135,569
Connecticut	24,404	128,348	13,693	92,397	12,807	92,076
Maine	18,390	84,796	22,566	116,610	8,835	53,143
Maryland	(1)	(1)	(1)	(1)		
Massachusetts			(1)	(1)		
New Hampshire	38,589	149,031	52,219	200,569	46,544	241,990
New York	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	79,312	426,784	100,016	552,386	93,644	533,448
Pennsylvania	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	54,692	157,323	59,015	170,723	56,499	195,499
Texas			(1)	(1)	(1)	(1)
Virginia	21,705	116,531	(1)	(1)	24,298	140,304
Wyoming	7,833	29,128	11,846	43,484	13,953	50,730
Undistributed[2]	9,022	38,286	32,715	173,157	12,543	50,771
	290,763	1,271,995	338,860	1,519,456	307,823	1,516,791

[1] Included under "Undistributed."

[2] Includes States indicated by "(1)."

States producing crude feldspar in 1942 were the same as in 1941, except that no output in 1942 was reported from Maryland or Massachusetts. The four leading States in 1942, in order of production (North Carolina, South Dakota, New Hampshire, and Colorado), reported decreases of output ranging from 4 percent for South Dakota to 21 percent for Colorado. There were substantial percentage increases, however, in California, Virginia, and Wyoming, as well as in Arizona and Texas; production data cannot be shown for the last two. Sales of crude feldspar in 1942 in Connecticut, Maine, and New York were less than in 1941.

The average sales realization per long ton for crude feldspar increased 10 percent over 1941 to $4.93 in 1942 and was the highest reported since 1937. All States for which figures can be given (except California and Wyoming) show higher average values in 1942 than in 1941. Averages per ton for selected States in both years (1941 in parentheses) follow: North Carolina, $5.70 ($5.52); Virginia, $5.77 ($5.58); South Dakota, $3.46 ($2.89); Maine, $6.02 ($5.17); and Colorado, $4.03 ($3.49).

Ground feldspar.—Ground feldspar sold by merchant mills in 1942 decreased 8 percent in tonnage and 7 percent in value, compared with the peak year 1941, and totaled 327,786 short tons valued at $3,524,969. The tonnage in 1942 was 15 percent above that in 1940, the former record year. Sales by North Carolina and Tennessee mills supplied 26 percent of the total ground spar sold, compared with 27 percent in 1941 and 1940 and 32 percent in 1937. Although producing slightly less ground spar in 1942 than in 1941, South Dakota and Colorado combined furnished 37 percent in 1942 compared with 34 percent in 1941 and 30 percent in 1937. Sales of feldspar of Canadian origin ground in United States mills amounted to 3 percent of the total merchant sales in 1942 compared with 2 percent in 1941, 3 percent in 1940, and 6 percent in 1937.

South Dakota sales of ground feldspar rose 14 percent in 1942 to 68,025 short tons (valued at $483,075)—a record tonnage—giving it first place among the producing States. Tennessee ranked second, followed by Colorado, North Carolina, and New Hampshire. States that produced more ground spar than in 1941, in addition to South Dakota, with percentages of increase, were: Illinois, 0.5 percent; Arizona, 24; California, 37; and Virginia, 38 percent. The output from Tennessee and North Carolina combined decreased 10 percent compared with 1941. All other States reported declines in output of ground feldspar ranging from 12 percent for New Jersey and New York and 15 percent for Colorado to 29 percent for Maine and 34 percent for New Hampshire.

Ground feldspar sold by merchant mills [1] in the United States, 1938–42

Year	Active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
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
1941	29	347,092	3,646,404	10.51	7,325	136,199	18.59	354,417	3,782,603
1942	29	318,209	3,339,462	10.49	9,577	185,507	19.37	327,786	3,524,969

[1] Excludes potters or others who grind for consumption in their own plants.

The downward trend in recent years in average realization for ground feldspar marketed in the United States was checked, at least temporarily, in 1942 when the average for all ground spar sold rose to $10.75 per short ton compared with $10.67 in 1941 and $10.73 in 1940. The average value of ground spar sold was greater in all States except New Jersey, North Carolina, Tennessee, and Virginia. Percentages of increase in average realization ranged from 2 percent for New York and 10 percent for Arizona and California to 18 percent for New Hampshire. The range of average values for individual States in 1942 was $6.75 to $17.77, somewhat narrower than in 1941 when similar figures ranged from $6.34 to $17.92. Average realizations per ton for selected States in 1942 follow: Colorado, $6.75; South Dakota, $7.10; California, $13.07; North Carolina-Tennessee, $12.04; Maine, $14.70; and New Jersey (including marketed spar ground in Connecticut), $17.77.

According to Engineering and Mining Journal, Metal and Mineral Markets, quotations on ground feldspar during 1942 remained the same as in 1941. Potash spar in Maine and North Carolina, 200-mesh, white, in bulk, was quoted at $17 per short ton, f. o. b. mill; and soda spar, similarly prepared, at $19. North Carolina granular glass spar, 20-mesh, white, in bulk, f. o. b. mill, brought $12.50 per ton, with semigranular spar quoted at $11.75. Virginia quotations, as listed in the same journal, were: No. 1, 230-mesh, $18; 200-mesh, $17; glassmakers' spar, No. 17, $11.75, and No. 18, $12.50. Enamelers' spar, either on Spruce Pine, N. C., or Keene, N. H., basis, was quoted at $14 to $16 per ton.

Ground feldspar sold by merchant mills [1] in the United States, 1940–42, by States

State	1940			1941			1942		
	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	2,624	$32,847	3	4,079	$48,292	3	5,578	$72,924
Colorado	3	44,260	282,178	3	61,141	387,338	3	51,684	349,065
Connecticut	1	(3)	(3)	1	(3)	(3)	1	(3)	(3)
Illinois	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
Maine	3	19,580	255,020	3	19,713	270,434	3	14,052	206,633
New Hampshire	2	(2)	(2)	2	(2)	(2)	2	(2)	(2)
New Jersey	3	[3] 21,158	[3] 379,899	3	[3] 25,672	[3] 459,974	3	[3] 22,649	[3] 402,479
New York	4	(2)	(2)	4	(2)	(2)	4	(2)	(2)
North Carolina	3	78,077	934,702	2	95,391	1,179,577	2	86,240	1,037,998
Tennessee	2			2			2		
South Dakota	2	54,783	374,024	2	59,581	407,454	2	68,025	483,075
Virginia	1	(2)	(2)	2	(2)	(2)	2	(2)	(2)
Undistributed [4]	-------	65,231	806,812	-------	88,840	1,029,534	-------	79,558	972,795
	29	285,713	3,065,482	29	354,417	3,782,603	29	327,786	3,524,969

[1] Excludes potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."
[3] Connecticut included with New Jersey.
[4] Includes items indicated by "(2)."

CONSUMPTION AND USES

Crude feldspar.—Most crude feldspar is sold to merchant mills, which obtain their supply from a number of mines or localities. The raw spar is stock-piled and sorted according to grade and source, then blended and ground to specified purity and fineness and sold to ultimate consumers. However, a few pottery and enamel manufacturers have purchased part or all of their feldspar requirements crude and

have ground it as needed in their own mills. Makers of soap, cleansers, and sweeping compounds also mine or purchase crude feldspar, largely from New England, Virginia, and North Carolina, and after grinding or otherwise processing it utilize the abrasive properties of the spar in their products. Manufacturers of artificial teeth annually use a small tonnage of carefully selected crude material, which must be free from all grit and is sold at a substantial premium over No. 1 grade commercial feldspar.

Ground feldspar.—The ceramic industry uses well over 95 percent of the ground feldspar sold by merchant spar mills each year in the United States. Most of the spar, by far, is consumed in the glass, pottery, and enamel trades. The glass industry increased its share of feldspar used to 195,601 short tons or 60 percent of the total ground spar sold, compared with 52 percent in 1941. Sales of spar for use in pottery and in enamel fell sharply in 1942, each outlet having dropped approximately 20,000 tons from 1941; pottery decreased from 36 to 32 percent of the total marketed spar and enamel from 10 to 4 percent. The remainder of the ground feldspar sold by merchant mills was utilized for various ceramic uses other than glass, pottery, and enamel; for soaps and abrasive purposes; and for purposes not specified. Minor uses of feldspar include its employment as a welding-rod coating,[1] and as a cementing material in laying firebrick walls.

Ground feldspar sold by merchant mills in the United States, 1940–42, by uses

Use	1940		1941		1942	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass	149,623	52.4	182,878	51.6	195,601	59.7
Pottery	104,586	36.6	127,140	35.9	106,081	32.4
Enamel	26,420	9.3	34,841	9.8	13,899	4.2
Other ceramic uses	649	.2	563	.2	6,459	2.0
Soaps and abrasives	2,682	.9	1,490	.4	4,396	1.3
Other uses	1,753	.6	7,505	2.1	1,350	.4
	285,713	100.0	354,417	100.0	327,786	100.0

The destinations of ground feldspar from 1939 to 1942, as reported by merchant grinders, are shown in the accompanying table. Shipments during 1942 to California, Illinois, and West Virginia increased considerably over 1941 but to New York only slightly. Other States for which comparisons are possible showed smaller totals than in 1941, although generally quantities compared favorably with those for prior years. In 1942 the largest consuming State was Illinois, with shipments amounting to 50,450 short tons or 15 percent of the total; it was followed by Ohio with 43,950 tons (13 percent), New Jersey with 43,029 tons (13 percent), Pennsylvania with 40,013 tons (12 percent), and Indiana with 38,998 tons (12 percent). Next in order were West Virginia (11 percent), New York (6 percent), and California (4 percent). Shipments to "Other destinations" comprised 4 percent of the total in 1942, including fair-size tonnages to Arkansas, Louisiana, Mississippi, and Texas and small amounts to some 15 or 20 other States.

[1] *See* Ralston, Oliver C., and von Bernewitz, M. W., Minerals Used in Welding: Bureau of Mines Inf. Circ. 7121, 1940, 56 pp.

Ground feldspar shipped from merchant mills in the United States, 1939–42, by destinations, in short tons

Destination	1939 [1]	1940	1941	1942
California	7,590	7,897	10,444	12,224
Illinois	15,948	32,811	44,573	50,450
Indiana	38,189	28,634	39,620	38,998
Maryland	(2)	(2)	(2)	8,745
Massachusetts	(2)	(2)	(2)	3,630
New Jersey	34,309	42,381	44,249	43,029
New York	14,995	13,236	18,326	18,363
Ohio	53,410	50,835	52,270	43,950
Oklahoma	(2)	(2)	(2)	8,002
Pennsylvania	37,466	47,431	54,534	40,013
Tennessee	5,077	5,911	9,697	3,507
West Virginia	19,188	21,889	29,916	35,161
Wisconsin	5,134	6,967	10,517	7,837
Other destinations [3]	25,463	27,721	40,271	13,877
	256,769	285,713	354,417	327,786

[1] Data include 99 percent of total ground feldspar.
[2] Included under "Other destinations"; separate figure for State not available.
[3] Includes Arkansas, Colorado, District of Columbia, Hawaii, Kentucky, Louisiana, Maryland (1939–41), Massachusetts (1939–41), Michigan, Minnesota, Mississippi, Missouri, Oklahoma (1939–41), Puerto Rico, South Carolina, and Texas, and other States (shipments to which cannot be segregated); also small shipments to Canada, England, and Mexico.

NEPHELINE SYENITE

Production of nepheline syenite in 1942 continued active. In the first years it was used, practically all was employed in the manufacture of glass where its high alumina content proves economical and beneficial. In more recent years an increasing proportion of the output has gone into various types of ceramic bodies. The glass-trade material is of granular type, whereas nepheline for pottery use is finely ground. A residue or dust remaining from grinding finds an outlet partly in the enamel and colored-glass trades and partly as a substitute for pumice for grinding and polishing, as a cleanser, and in the heavy-clay industries.

Production in the last 2 or 3 years has come almost entirely from the Methuen Township region in Peterborough County, Ontario. Deposits of similar occurrence extend over into Hastings and Haliburton Counties. The Bancroft-Gooderham district northeast of the Methuen region in Hastings and Haliburton Counties has produced intermittently since 1937. A new Canadian source of nepheline syenite is the property of Port Coldwell Mines & Metals, Ltd., recently reported to be under development[2] at Port Coldwell, Ontario.

The larger part of the Canadian output is shipped into the United States for grinding and consumption, although some nepheline is ground before importation. After considerable increase in 1941 over 1939 and 1940, imports of crude nepheline syenite in 1942, although only slightly above 1941, reached the record figure of 35,990 short tons valued at $120,688. Comparable data are 35,799 tons valued at $112,101 in 1941 and 27,888 tons valued at $87,162 in 1940. Ground nepheline syenite imported into the United States totaled 4 short tons valued at $44 in 1942, which compares with 6 tons valued at $25 in 1940; in 1941, however, 1,359 short tons of ground nepheline valued at $13,695 were shipped into this country. All shipments of crude and ground nepheline originated in Canada.

Prices of nepheline syenite at the end of 1942, according to Canadian

[2] Northern Miner, vol. 28, No. 46, February 4, 1943, p. 8.

Chemistry and Process Industries, were the same as at the beginning of the year: Grade A, 20-mesh, bulk, in carlots, $11.75 per ton f. o. b. Lakefield, Ontario; Grade A, 200-mesh, bulk, in carlots, $16.50 per ton f. o. b. Kingston, Ontario; and Grade B dust, bulk, in carlots, $10.00 per ton, f. o. b. Lakefield, Ontario.

Nepheline syenite prices were included under the Office of Price Administration General Maximum Price Regulation (G. M. P. R.) of April 28, 1942, and also under Maximum Price Regulation (M. P. R.) 327, issued February 16, 1943, and effective February 22, 1943. This latter regulation established as the maximum allowable prices those prevailing in March 1942.

The only known commercial production of nepheline syenite, other than from Canadian deposits, is that from apatite nephelite rock on the Kola Peninsula in northwestern U. S. S. R. Montana pegmatites, said to resemble in part the Kola Peninsula deposits, were described by Pecora.[3]

APLITE

Production of ground "aplite" by Dominion Minerals, Inc., with mill at Piney River, Va., continued at an active rate in 1942, surpassing slightly shipments reported for 1941. New uses, especially for the large quantities of fines produced as a byproduct of milling operations, are being investigated. Among possible new uses may be fillers of various types and a quite recent application—the extinguishing of incendiary magnesium bombs.

The new mill of the Carolina Mineral Co., Erwin, Tenn., subsidiary of the Consolidated Feldspar Corporation, began operations during 1942, grinding material similar to that processed by Dominion Minerals, Inc. The new plant also is located near Piney River, Va.

TECHNOLOGIC DEVELOPMENTS

Considerable data on the fluxing properties of feldspar and nepheline syenite were developed and published in a paper by Earhart.[4] In a study of the effect of fluxes containing mixtures of spodumene and feldspar on semivitreous and vitreous hotel-chinaware bodies, the most effective fluxes were found to be those consisting of 30 to 40 percent spodumene, 40 to 60 percent potash feldspar, and 10 to 20 percent soda feldspar.[5] Formulas for determining the relative amounts of microcline, albite, anorthite, kaolinite, muscovite, and free quartz in the feldspars were published by Koenig.[6] The extent and nature of feldspar-bearing sands in Illinois and the most economical methods of separating and preparing commercial grades of feldspar from them were investigated by the State Geological Survey during 1942.[7]

Feldspar has been found to be effective in extinguishing magnesium

[3] Pecora, William T., Nepheline Syenite Pegmatites, Rocky Boy Stock, Bearpaw Mountains, Montana: Am. Mineral., vol. 27, No. 6, June 1942, pp. 398-424.

[4] Earhart, William H., Use of Washed North Carolina Kaolin as an Ingredient of Porcelain Bodies: Ohio State Univ. Studies, Eng. Exp. Sta. Circ. 42, November 1941, 40 pp.

Schurecht, H. G., Shapiro, J. K., and Zabawsky, Z., Influence of Fluxes of Spodumene and Feldspar Mixtures on Properties of Chinaware Bodies: Jour. Am. Ceram. Soc., vol. 25, No. 11, July 1, 1942, pp. 321-326.

[5] Ko enig, E. W., Calculation of Mineralogical Composition of Feldspar by Chemical Analysis: Jour. Am. Ceram. Soc., vol. 25, No. 14, October 1, 1942, pp. 420-422.

[7] Willman, H. B., Feldspar in Illinois Sands: Illinois State Geol. Survey, Rept. of Investigations 79. Urbana, Ill., 1942, 87 pp.

incendiary bombs,[8] as a result of experiments by W. W. Rubey, geologist, and Michael Fleischer and J. J. Fahey, chemists, Federal Geological Survey. With a melting point of about 2100° F.—lower than that of sand—feldspar quickly forms a protective coating over the molten magnesium which cuts off the supply of air from the magnesium and actually stops it from burning and its flame from spreading. It is superior to mixtures containing salt, pitch, ashes, or fine powders, as it does not burn, give off smoke, blow out, or scatter appreciably from the intense heat of the incendiary material. Feldspar used for this purpose should be ground to pass a 10-mesh screen and be retained by a 200-mesh screen. Finer material tends to clog interstices and prevent the ready escape of gases, which otherwise would erupt with sufficient force to form miniature craters in the feldspar cover and destroy its effectiveness.

Costly equipment or a trained crew is not needed to apply the extinguisher. Feldspar also is relatively inexpensive. Indeed, the waste material produced in grinding commercial grades of spar could readily be screened to suitable size and marketed for this purpose at comparatively low cost, according to the Geological Survey.

In most of the Survey experiments, the rock used consisted largely of soda-lime feldspar: This rock, locally called "aplite," is quarried in Amherst and Nelson Counties, Va., where there is an abundant supply. Potash feldspar, either orthoclase or microcline, is equally effective. Rocks consisting largely of feldspar also give practically as good results as pure feldspar. In the East such materials as syenites, nepheline syenites, or screenings from granite quarrying might be used. Granite, monzonite, rhyolite, and latite are available and quarried for crushed stone in the Pacific Coast area. Screenings from these crushed rocks, although perhaps not as effective as feldspar, could be utilized as magnesium extinguishers.

The United States Department of the Interior, by arrangement with the inventors acting through the Department of Justice, already has taken steps to obtain Government-controlled patent protection for the invention and method of use. Under the patent,[9] commercial development of the material under free licenses will be encouraged by the Department. Consumer prices for material used in extinguishing incendiary magnesium to be sold under the above-noted patent, were established by the Office of Price Administration.[10] Up to February 1943, sales of extinguishers manufactured by license had been made in Baltimore and Philadelphia. Applications for licenses also had been received from potential manufacturers elsewhere in the East, on the West coast, and in the Gulf of Mexico area. Interest in the extinguisher has been shown by airfields and by factories using magnesium in their products.

OTHER DEVELOPMENTS

The property of the Seaboard Feldspar Corporation in Cheshire County, N. H., was acquired in July 1942 by the General Minerals Corporation, 52 William Street, New York City, and operation con-

[8] Department of the Interior Information Service, Press Release, June 14, 1942, 3 pp.
[9] Fahey, Joseph J., Fleischer, Michael, and Rubey, William W. (assigned to U. S. Government), Method and Means for Extinguishing Burning Molten Magnesium and the Like: U. S. Patent 2,294,532, September 1, 1942.
[10] Office of Price Administration, Feldspar Fire Extinguishers: OPA Maximum Price Regulation 321 (effective February 24, 1943), reported in OPA Press Release, February 19, 1943.

tinued during the year. In August 1942, the F. E. Schundler Feldspar Co., Inc., Custer, S. Dak., discontinued business, and the company was dissolved. The Consolidated Feldspar Corporation, Trenton, N. J., also operating a mill at Keystone, S. Dak., acquired the mines and mill of the Schundler firm and operated the plant for the rest of the year. The Bureau of Mines has been informed that a feldspar mill is to be erected in the Llano area at Kingsland, Tex., to process a low-iron spar recently discovered in the Packsaddle Mountain district.

Brief descriptions of feldspar deposits are given and the relative importance of the New York feldspar industry is discussed by Otte.[11] The feldspar occurrences in the Llano County region in Texas were described by Chelf.[12] Two plants of the Consolidated Feldspar Corporation, whose main offices are in Trenton, N. J., were described in the trade press. Hubbell [13] presented a detailed account of the equipment, products, and methods of operation of the corporation plant at Erwin, Tenn., which processes feldspar from the Spruce Pine area of North Carolina; and Moore [14] described operation of the mines and mill near Bedford, Westchester County, N. Y.

IMPORTS [15]

Feldspar.—Crude feldspar imported into the United States in 1942 aggregated 9,525 long tons valued at $69,797—a decrease of 15 percent in tonnage and 5 percent in value compared with 11,253 tons valued at $73,236 imported in 1941; the average value per ton ($6.51 in 1941) increased 13 percent to $7.33 in 1942. All imports originated in Canada. In 1942, as in 1940 and 1941, there were no imports of ground feldspar.

Feldspar imported for consumption in the United States, 1938–42

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1938	7,651	$56,126	----------	----------	1941	11,253	$73,236	----------	----------
1939	7,460	52,141	2	$54	1942	9,525	69,797	----------	----------
1940	12,522	80,274	----------	----------					

Cornwall stone.—Both "unmanufactured" and "crushed or ground" Cornwall stone from the United Kingdom (only source of supply for this material) were actively imported into the United States during 1941; in 1942, however, shipments virtually ceased. The average values (foreign market value) per long ton for unmanufactured material in 1940, 1941, and 1942 were, respectively, $9.20, $11.38, and $13.80 and for crushed or ground Cornwall stone, $12.10, $14.60, and $18.40.

[11] Otte, Herman F., The Expanding Mineral Industry of the Adirondacks: State of New York, Executive Department, Division of Commerce, Pub. 10, Albany, N.Y., February 1943, 102 pp. (Feldspar, pp. 89–95.)
[12] Chelf, Carl, A New Feldspar Deposit in Llano County, Tex.: Univ. of Texas, Bureau of Economic Geology, Mineral Resources Survey Circ. 45, May 1942, 5. pp.
[13] Hubbell, A. H., A Feldspar Grinding Plant in Tennessee: Eng. and Min. Jour., vol. 143, No. 12, December 1942, pp. 67–68.
[14] Moore, R. Carl, Mining and Grinding Feldspar: Rock Products, vol. 45, No. 9, September 1942, pp. 52–53.
[15] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

Cornwall stone imported for consumption in the United States, 1938–42

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1938	513	$4,976	233	$1,797	1941	2,736	$31,138	182	$2,658
1939	1,684	17,233	348	3,965	1942	74	1,021	5	92
1940	2,261	20,812	228	2,758					

WORLD PRODUCTION

World output of feldspar from 1937 to 1942, insofar as data are available, appears in the following table.

World production of feldspar, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Argentina (shipments)	1,346	620	1,051	1,220	2,981	(2)
Australia:						
New South Wales [3]	162	178	(2)	(2)	(2)	(2)
South Australia [3]	669	502	615	1,072	1,081	(2)
Western Australia (exports)	3,031	2,919	3,853	3,561	(2)	(2)
Brazil	8,400	(2)	(2)	(2)	(2)	(2)
Canada (shipments)	19,365	12,753	11,306	19,464	23,623	21,245
Egypt	158	199	74	138	52	(2)
Finland (exports)	3,232	5,046	5,596	(2)	(2)	(2)
France	8,900	(2)	(2)	(2)	(2)	(2)
Germany: Bavaria	9,986	10,419	(2)	(2)	(2)	(2)
India, British	495	702	501	(2)	(2)	(2)
Italy	13,437	13,391	(2)	(2)	(2)	(2)
Norway (exports)	32,555	21,761	21,282	(2)	(2)	(2)
Rumania	2,587	1,690	(2)	(2)	(2)	(2)
Sweden	49,140	45,111	40,792	(2)	(2)	(2)
United States (sold or used)	272,842	199,267	257,534	295,430	344,299	312,764

[1] In addition to countries listed, feldspar is produced in China (Manchuria) and Czechoslovakia. Official figures of Czechoslovak output are not available, but it is estimated that the annual production is approximately 30,000 metric tons (Stat. Comm. Czechoslovak Ceram. Soc.).

[2] Data not available.

[3] Includes some china stone.

ASBESTOS

By Oliver Bowles and F. M. Barsigian

SUMMARY OUTLINE

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SUMMARY

Sales of domestic asbestos in 1942—15,481 short tons—were 37 percent less than those in 1941. The decline was confined to the chrysotile variety, sales of which were smaller both in Vermont and Arizona. The value of total sales was 31 percent lower. Sales of the amphibole variety were slightly higher in both quantity and value than in 1941. Most of the United States production is of the shorter grades of chrysotile. During 1942 domestic production furnished less than 4 percent of domestic requirements.

As in the past, Canada supplied most of the United States needs of unmanufactured asbestos. Canadian chrysotile is of excellent quality and is suitable for most asbestos products, although a few specialties require asbestos from other sources. African chrysotile, which is imported in substantial quantities, is an important supplement to Canadian fibers of spinning grade. India and Soviet Russia are other sources of chrysotile for general use.

Asbestos combines noninflammability with a fibrous structure that makes it the unique source of unburnable fabrics. Because of this peculiar combination of properties it is an irreplaceable material for certain important military uses, although for some common uses substitution is possible. The most important application in the former category is for brake linings and clutch facings on automobile transport equipment. No satisfactory substitute has been found for these uses. As all types of automotive transport must have brakes and clutch facings, it is apparent that the military needs are extensive and of primary importance. Fortunately, any strong, flexible chrysotile of spinnable length is satisfactory for such use, and the extensive asbestos-producing industry of Canada can supply large quantities of satisfactory material. The demands for spinning fibers in this field are relieved to some extent by the substitution of molded for woven brake bands. The molded bands employ shorter grades of fiber, but they can be used only on certain types of brakes. Other important asbestos products are gaskets and packings around steam and com-

pressed-air machinery. These products are also of great military importance because they are used on warships, by the merchant marine, and in even larger quantities at power plants and innumerable munition factories.

Still another important field of usefulness for asbestos is heat insulation. Asbestos is a popular insulating medium; but other materials are substituted for it to some extent, and further substitution in the general insulation field is possible. There are, however, certain types of insulation for which special grades of asbestos are essential if weight is to be conserved and efficiency maintained.

The most widespread occurrences of asbestos in the United States are those of the amphibole type—anthophyllite and tremolite. Hundreds of deposits are known, but production never exceeds a few hundred tons a year because the uses are quite limited. Its resistance to acids renders tremolite useful for making chemical filters; the amphibole varieties are employed also in arc welding and in making insulation products, but the uses are so restricted and relatively so unimportant that they are not classed as critical.

Chrysotile asbestos is the principal variety of commerce and occupies an important place in the war program. The principal world production centers are Quebec (Canada), Rhodesia, Union of South Africa, Swaziland, and Soviet Russia. The Canadian mines and mills supply most of the United States needs, and the quality of the product is satisfactory for most of the important uses. African chrysotile is superior for electric-insulation products that must be low in iron and therefore is regarded as essential to the military program.

Amosite, a variety of asbestos mined only in Africa, consists of long, strong fibers that are superior for making lightweight insulation to be used around steam machinery on warships. Amosite also is preferred for making 85-percent magnesia pipe covering and a block insulation of similar type that contains no magnesia. This variety is therefore regarded as essential to the highest naval efficiency. In June 1942 the War Production Board promulgated Conservation Order M–79 restricting the use of amosite in 85-percent magnesia to certain military applications.

Crocidolite or blue asbestos is regarded as essential because it is superior to other varieties in making asbestos-cement pressure pipes, chemical filters, and acid-resistant packings. Long blue fiber is used also in making gas masks. Blue asbestos is mined chiefly in Africa, but small quantities are obtained in Australia.

Beginning January 1943, fiber obtainable from the two leading producing companies in Africa was purchased on United States Government account by the Metals Reserve Co. and allocated to the various asbestos-products manufacturers. This plan offered certain advantages in control of shipping routes, stimulation of production, and allocation according to the most urgent needs.

Throughout 1942 the Bureau of Mines conducted a monthly canvass for the War Production Board, covering receipts, stocks, and consumption. Stocks of critical grades of African fibers in the hands of consumers at the end of 1942 were adequate for 6 to 8 months' use at the average rate of consumption during the year.

Salient statistics on asbestos for 1941 and 1942 are summarized in the following table.

Salient statistics of the asbestos industry in the United States, 1941–42

	1941		1942	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile	20,144	(1)	13,109	(1)
Amphibole	2,252	(1)	2,208	(1)
Total produced	22,396	(1)	15,317	(1)
Sold or used by producers:				
Chrysotile	22,439	$707,589	13,373	$480,245
Amphibole	1,952	18,164	2,108	18,612
Total sold or used by producers	24,391	725,753	15,481	498,857
Imports (unmanufactured)	419,196	17,909,077	419,414	21,235,266
Exports (unmanufactured)	4,846	325,825	774	134,083
Apparent consumption [2]	[3] 438,741	[3] 18,309,005	434,121	21,600,040
Exports of asbestos products	(1)	4,835,194	(1)	5,114,496

[1] Figures not available.
[2] Quantity sold or used by producers, plus imports, minus exports.
[3] Revised figures.

The following table shows domestic production of asbestos during recent years according to varieties.

Asbestos sold or used by producers in the United States, 1938–42, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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	1,288	9,988	20,060	674,508
1941	22,439	707,589	1,952	18,164	24,391	725,753
1942	13,373	480,245	2,108	18,612	15,481	498,857

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

DOMESTIC INDUSTRY

REVIEW BY STATES

Arizona.—Production of asbestos in Arizona was less than half as great in 1942 as in 1941, according to reports of producers submitted to the Bureau of Mines. Sales, which were about two-thirds those in 1941, were made by the following companies: Arizona Chrysotile Asbestos Co., Arthur Enders, Guy G. Phillips, and Pine Top Asbestos Mines, all of Globe, Ariz.; E. E. Prochnow, Winslow, Ariz.; Fiber & Metal Products Co., Downey, Calif.; Gladding, McBean & Co., 2901 Los Feliz Boulevard, Los Angeles, Calif.; and Johns-Manville Products Corporation, 22 East Fortieth Street, New York, N. Y.

The Johns-Manville Products Corporation completed its new mill at Chrysotile, Ariz., but the output in 1942 was quite limited. When it attains normal operation the mill will afford a means of grading and classifying Arizona asbestos more accurately than has been possible in the past.

Pine Top Asbestos Mines began development of a property in the San Carlos Indian Reservation in May 1942, and shipments of fiber were made later in the year. Plans are under way for systematic development of the property and for erection of a mill.

California.—Kohler & Chase, 26 O'Farrell St., San Francisco, produced short-fiber chrysotile from its property near Monticello, Napa County. This was the only asbestos-mining activity noted in California during 1942.

Georgia.—The only activity reported from Georgia was that of the Powhatan Mining Co., which continued operation of its amphibole asbestos property near Dillard, Rabun County.

North Carolina.—Sales of North Carolina amphibole asbestos, only variety mined in the State, were 20 percent greater in 1942 than in 1941. W. T. Hippey and the Powhatan Mining Co. continued to operate their mines in the Micaville area of Yancey County. The Industrial Minerals Corporation (Asheville) began production from a new property near Newdale, Yancey County, early in 1942 and marketed substantial quantities before the end of the year. According to report, the asbestos-bearing rock mass is at least 200 feet wide and 400 feet long. It gives promise of production on a larger scale than is possible at most amphibole deposits.

Oregon.—A small quantity of tremolite asbestos was produced from a property owned by Mrs. Flora Winsenberg (Azalea, Oreg.) near Rogue River, Jackson County.

Vermont.—The Vermont Asbestos Mines Division of the Ruberoid Co. (500 Fifth Ave., New York, N. Y.), largest producer of asbestos in the United States, continued to operate its open-pit mine and well-equipped mill near Eden, Lamoille County. Shingle stock and molded brake-lining fiber are important products, but several shorter grades are produced in large quantities. The volume of output was somewhat lower than in 1941.

TRENDS IN CONSUMPTION

Trends in the asbestos-products industries during recent years are indicated in the following table.

Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1937–42

Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—		Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—	
		Manufactured [1]	Exported [2]			Manufactured [1]	Exported [2]
1937	316,263	$96,347,570	$3,047,078	1940	262,199	(4)	$3,473,248
1938	187,150	(4)	2,533,916	1941	[3] 438,741	(4)	4,835,194
1939	255,547	97,944,735	3,354,920	1942	434,121	(4)	5,114,496

[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 the Department of Commerce.
[3] Revised figures.
[4] Data not available.

Under normal conditions the consumption of asbestos is governed to quite an extent by the number of automobiles manufactured, be-

cause all kinds of automotive transport equipment require asbestos brake bands and clutch facings. During 1942 the manufacture of automobiles was virtually suspended and therefore ceased to be a market indicator. Activity in building construction also influences asbestos sales, because asbestos heat-insulation and fireproofing materials as well as asbestos-cement building materials (such as shingles, siding, and wallboard) are used extensively. Private building declined greatly in 1942, but military construction (including defense housing) was very active and was responsible for large sales of asbestos products. Industrial activity, which maintained a very high level, involved extensive power-plant construction. Large quantities of packings, gaskets, boiler lagging, and pipe covering were consumed in these plants and in multitudes of munition factories. Asbestos is an essential raw material for ship construction, and the rapid expansion of the Navy and Merchant Marine accounted for a large proportion of the sales of high-grade fibers during 1942. Figure 1 shows the relationship of asbestos consumption to building construction and industrial activity for a period of years. It is evident that asbestos consumption is related more closely to industrial activity than to building construction.

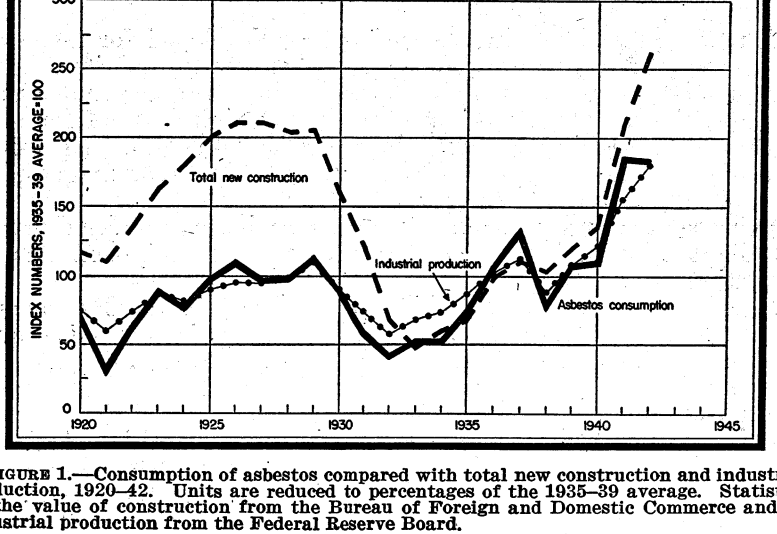

FIGURE 1.—Consumption of asbestos compared with total new construction and industrial production, 1920–42. Units are reduced to percentages of the 1935–39 average. Statistics on the value of construction from the Bureau of Foreign and Domestic Commerce and on industrial production from the Federal Reserve Board.

MARKET CONDITIONS

Over-all market demands for asbestos, which surpassed in 1941 all previous records, declined slightly in 1942. Needs in the automobile industry were confined largely to replacements, but loss of market in this field was compensated by the growing demands of the war program. Civilian uses of the more critical grades were restricted to insure adequate supplies for war needs. The demand for spinning fibers was very strong and threatened to outstrip the supply during the latter part of the year.

PRICES

Prices for asbestos are quoted upon 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; Vermont prices are f. o. b. mines, Hyde Park, Vt.

Prices of all Canadian fibers remained at the levels of 1941, as quoted in Minerals Yearbook for that year, until April 1942, when all grades except Crude No. 1 were advanced as follows and remained constant thereafter: Crude No. 1, $650–$750; Crude No. 2 and sundry crudes, $165–$385; spinning fibers, $124–$233; magnesia, and compressed sheet fibers, $124–$146.50; shingle stock, $62.50–$85; paper stock, $44–$49; cement stock, $28.50–$33; floats, $19.50–$21; and shorts, $14.50–$26.50. Canadian prices are in United States dollars.

African and Russian fibers were not quoted during 1942.

In April 1942 prices of all grades of Vermont fibers were advanced substantially from 1941 figures. Quotations from April to the end of the year were as follows: Shingle stock, $62.50–$65.50; paper stock, $44–$53; waste, $33; shorts, $14.50–$28.50; and floats, $19.50.

NEW DEVELOPMENTS

A new type of block insulation has been developed for uses similar to those of 85-percent magnesia. It consists of amosite asbestos with a binder but contains no magnesia—an advantage under present conditions, when there is an abnormally high demand for magnesia to be used in making refractories and metallic magnesium. The new product compares favorably with 85-percent magnesia in thermal conductivity, shrinkage, and strength.

Venezuela's new asbestos mill near Tinaquillo was under construction in 1942 but owing to difficulties in securing equipment was not completed.

Blue asbestos is now mined in a small way in the Hammersley Ranges of Western Australia. Hand-cobbed fiber is of excellent quality, commanding about $300 a ton at American ports. Supplies from this source are not great because the deposits are in very rough country where transportation facilities are inadequate.

It is reported that Germany is obtaining small quantities of asbestos in Norway. The small pre-war output of Finland, Italy, and Czechoslovakia would be entirely inadequate for German war needs. No data are available on the increased output from the small known sources of asbestos in Central Europe or the extent of reserve stocks held by Germany, and only meager information is at hand on substitute materials.

An asbestos-graphite lightweight molded product has been developed recently and sold under the trade name "seybolite." It is highly resistant to moisture, acids, alkalies, and fire. Suggested uses include molded seamless conduits, chemical containers, and fireproof panels for ships, trucks, and airplanes.

A new lightweight asbestos fabric sold under the trade name "asbeston" is taking the place of critical metals in aircraft fittings, such as carburetor-intake attachments, heater-hose nozzles, and defrosters.

FOREIGN TRADE [1]

The following table shows imports of unmanufactured asbestos into the United States in 1941 and 1942. The volume of imports in 1942 was virtually unchanged from 1941. Imports from Africa were only slightly lower than in 1941 even though ship sinkings caused several serious losses. As most of the African fibers are of strategic grades, it is highly desirable to maintain imports at undiminished levels. Canadian imports fell a little below those of 1941, but the value of imports was more than 3 million dollars higher, due chiefly to advance in prices; larger purchases of the better grades of fibers probably accounted for some of the increase.

Asbestos (unmanufactured) imported for consumption in the United States, 1941–42, 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
1941								
Africa:								
Union of South Africa	21,447	$2,075,360					21,447	$2,075,360
"Other British"	8,234	1,273,203					8,234	1,273,203
Australia	62	12,769					62	12,769
Bolivia	22	2,504					22	2,504
Brazil					4	$142	4	142
Canada	3,362	889,291	163,631	$9,401,893	222,398	4,240,759	389,391	14,531,943
India, British	35	12,646					35	12,646
United Kingdom	1	510					1	510
	33,163	4,266,283	163,631	9,401,893	222,402	4,240,901	419,196	17,909,077
1942								
Africa:								
Union of South Africa	20,424	1,940,143					20,424	1,940,143
"Other British"	8,665	1,386,782					8,665	1,386,782
Australia	35	6,879					35	6,879
Bolivia	16	2,093					16	2,093
Canada	2,959	1,146,778	165,088	11,407,510	218,600	5,063,349	386,647	17,617,637
India and Dependencies (British India)	17	9,255					17	9,255
U. S. S. R.	673	56,552	2,937	215,925			3,610	272,477
	32,789	4,548,482	168,025	11,623,435	218,600	5,063,349	419,414	21,235,266

[1] Asbestos, n. e. s., containing not over 15 percent foreign matter.

The following table shows imports and exports of unmanufactured asbestos for the 5-year period 1938–42.

Asbestos (unmanufactured) imported for consumption in and exported from the United States, 1938–42

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
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
1941	419,196	17,909,077	4,846	325,825
1942	419,414	21,235,266	774	134,083

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

The following table shows exports of asbestos products in 1941 and 1942.

Manufactured asbestos products exported from the United States, 1941–42, by kinds

Product	1941		1942	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded, short tons	(1)	$1,150,386	1,810	$1,706,624
Not molded, linear feet	1,277,562	285,192	749,449	283,900
Clutch facing, number	1,006,371	364,420	1,431,512	558,190
Paper, millboard, and roll board, short tons	1,540	212,157	679	102,660
Pipe covering and cement, do	1,187	136,501	1,063	135,158
Textiles, yarn, and packing, do	1,556	1,356,793	1,017	1,154,241
Asbestos roofing, squares	82,149	334,246	97,668	169,331
Other asbestos manufactures, except roofing, short tons	4,431	679,466	3,000	778,547
Magnesia and manufactures, do	2,155	316,033	1,305	225,845
		4,835,194		5,114,496

[1] Quantity not recorded.

WORLD PRODUCTION

The following table shows production of asbestos throughout the world, by countries, from 1937 to 1942, insofar as figures are available.

World production of asbestos, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Argentina			110	150	84	(2)
Australia:						
South Australia	123	49	46	119	152	(2)
Tasmania	2	4			(2)	(2)
Western Australia	43	123	279	364	(2)	(2)
Bolivia	21	21	[3] 2	[3] 71	[3] 211	[3] 58
Brazil		120	45	500	[3] 13	(2)
Canada [4]	371,967	262,894	330,642	313,504	433,492	398,669
China	(2)	(2)	(2)	100	(2)	(2)
Chosen	70	(2)	(2)	(2)	(2)	(2)
Cyprus (exports)	11,892	5,668	9,970	9,652	(2)	(2)
Finland [5]	7,260	(2)	(2)	(2)	(2)	(2)
France	250	(2)	(2)	(2)	(2)	(2)
Greece	2	85	(2)	(2)	(2)	(2)
India, British	102	90	266	[6] 1	[6] 32	[6] 15
Indochina	5		(2)	(2)	(2)	(2)
Italy	6,393	6,860	(2)	(2)	(2)	(2)
Japan (approximate)	1,000	1,000	1,000	1,000	(2)	(2)
Kenya Colony		5	(2)	(2)	(2)	(2)
New Zealand	(2)	(2)	(2)		54	(2)
Southern Rhodesia	51,722	53,352	52,900	[7] 22,127	(2)	(2)
Swaziland			7,233	18,873	(2)	(2)
Turkey	157	668	88	(2)	(2)	(2)
Uganda		53	(2)	(2)	(2)	(2)
Union of South Africa	25,975	21,025	20,003	24,849	[8] 25,400	[8] 31,000
U. S. S. R.	125,000	86,000	(2)	(2)	(2)	(2)
United States (sold or used by producers)	10,958	9,471	14,024	18,198	22,127	14,044
Venezuela	(2)	(2)	(2)	20	(2)	(2)

[1] In addition to countries listed, asbestos is produced in Bulgaria, Czechoslovakia, and Madagascar.
[2] Data not available.
[3] Exports.
[4] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1937, 3,611 tons; 1938, 2,975 tons; 1939, 3,535 tons; 1940–42, data not available.
[5] Includes asbestos flour.
[6] Imports into United States.
[7] January to May, inclusive.
[8] Preliminary.

CANADA

Canadian mines and mills were operating virtually at capacity during 1942. Supplies of mill fibers were ample for United States requirements, but a possible shortage of No. 2 crude was threatened during the latter part of the year. It is claimed that the percentage of crude fibers recovered in the Quebec mines is declining, and the cause of the decline is attributed to the method of mining. Several of the larger mines now employ the block-caving method, which involves undermining great masses of asbestos-bearing rock and removing the broken stone from tunnels underneath the rock mass. The block of stone is shattered under the stress of forces set up as it settles unevenly; and as the fiber veins are planes of weakness, shatter cracks tend to follow the veins, breaking them up in such a manner that much of the fiber—formerly hand-cobbed as crudes—is mixed with the rock and recovered later as mill fiber. The United States is so dependent on Canada for its high-grade fibers that all such trends must be followed closely.

The following figures have been released by the Department of Mines, Province of Quebec, for strictly confidential use.

Sales of asbestos in Canada, 1941–42, by grades

	1941			1942		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	2,845	$980,217	$344.54	2,890	$1,233,184	$426.71
Fibers	223,767	14,812,871	66.20	199,829	15,339,128	76.76
Shorts	251,234	5,675,752	22.59	236,741	6,090,971	25.73
	477,846	21,468,840	44.93	439,460	22,663,283	51.57
Rock mined	7,712,367			8,233,516		
Rock milled	6,366,670			6,795,459		

AFRICA

Southern Rhodesia.—The Shabani mine has been an important producer for many years and is probably producing at near maximum capacity. Other smaller mines add to the supply. Because of war restrictions, no figures of output have been released since May 1940.

Union of South Africa.—The Union of South Africa is unique in that it produces five kinds of asbestos—chrysotile, crocidolite, amosite, anthophyllite, and tremolite. The last two varieties are produced in small amounts, for local use only. Some years ago there was a large production of chrysotile from the Amianthus and Munnik Myburgh mines in the Kaapsche Hoop district of eastern Transvaal. The mines are now virtually worked out, but the loss from these sources is more than compensated by production from the recently developed Havelock mine in Swaziland, which has an annual output exceeding 24,000 tons of high-grade fiber.

Although exports of amosite and blue asbestos were considerably higher in 1942 than in 1941, stocks at the mills were maintained at normal levels. Added equipment has increased mill capacity.

The best blue fiber (crocidolite) occurs in the Prieska and Kuruman districts of Cape Province, where the largest production is centered. A small output is obtained in the Pietersburg district of Transvaal. The workings are shallow, and the product is less desirable than the Cape blue.

The following table shows production during recent years. Production in 1942 exceeded all previous records.

Asbestos produced in the Union of South Africa, 1938–42, by sources

Year	Short tons				Total value [1]
	Transvaal	Cape Province	Natal	Total	
1938	16,505	6,484	[2] 187	[2] 23,176	£416,401
1939	15,827	6,144	79	22,050	517,535
1940	21,011	6,381	([3])	[3] 27,392	492,125
1941	[4] 18,028	[4] 5,408	([3])	[5] 28,000	([6])
1942	[7] 20,440	[7] 5,281	([3])	[5] 34,000	([6])

[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] Data for Natal not available.
[4] January to October, inclusive.
[5] Preliminary.
[6] Data not available.
[7] January to September, inclusive.

The following table shows the tonnage of each variety produced from 1938 to 1942, insofar as data are available.

Asbestos produced in the Union of South Africa, 1938–42, by varieties and sources, in short tons

Variety and source	1938 [1]	1939 [2]	1940 [2]	1941	1942
Amosite (Transvaal)	8,793	11,299	17,767	[3] 15,886	[4] 18,675
Chrysotile (Transvaal)	[5] 5,573	[5] 612	646	[3] 1,408	[4] 1,469
Blue (Transvaal)	2,326	3,983	2,520	[3] 675	[4] 231
Blue (Cape)	6,484	6,144	6,381	[3] 5,408	[4] 5,281
Anthophyllite (Transvaal)	----------	12	78	[3] 59	[4] 65
	23,176	22,050	27,392	[6] 28,000	[6] 34,000

[1] Data from Union of South Africa, Department of Mines, Monthly Reports.
[2] Data from Union of South Africa, Department of Mines, Quarterly Reports.
[3] January to October, inclusive.
[4] January to September, inclusive.
[5] Includes 187 tons in 1938 and 79 tons in 1939 produced in Natal.
[6] Preliminary.

SOVIET RUSSIA

Nearly all the Russian asbestos produced originates in the Bajenova district of the Urals, where there are both mines and mills. No production statistics are available since 1938, when an output of 86,000 metric tons was reported. Under the third Five-Year-Plan, an expansion of production capacity to 220,000 metric tons a year was contemplated. Such an objective was expected to be attained in 1942. The bulk of the output would, as heretofore, be used in domestic asbestos-products plants. Among world producers the Soviet Union stands next to Canada on a tonnage basis, but, like Canada, a large share of the output consists of the shorter grades.

Canada's shorter grades find ready market in nearby United States, but in Soviet Russia the short fibers are consumed by large domestic asbestos-products manufacturing industries. The Russian industry probably has expanded greatly to provide brake bands and clutch facings for the Union's growing automotive transport system and to furnish gaskets, packings, and heat insulation for its numerous immense munition factories. Russian reserves are estimated at 18,000,000 tons of fiber.

OTHER COUNTRIES

In addition to the blue asbestos in Western Australia, mentioned under New Developments, other deposits have been discovered on the Australian Continent. A deposit of asbestos—probably chrysotile as it occurs in serpentine rock—has been found on the western shore of Macquarie Harbor about 18 miles from Strahan, Tasmania. The occurrences are conveniently situated for transport, being 4 miles from the Gordon River, which is navigable. Preliminary prospecting and testing have been conducted over an area of 300 acres.

Extensive occurrences of high-grade asbestos are reported on South Island, New Zealand, but are too inaccessible for development at present. Presumably, the necessary fiber will be obtained from Australian mines. One asbestos-cement-products plant is operated in New Zealand, and a second plant is contemplated because of a shortage of roofing and other building materials.

Considerable interest has centered recently on asbestos occurrences in Latin America. Reference has been made under New Developments to a large deposit of chrysotile in Venezuela. A deposit of blue asbestos has been known for many years in Bolivia and has been worked in a small way at intervals, but the quality is inferior to that of African blue. Small tonnages of asbestos are produced in Argentina for local use.

According to recent reports an asbestos-cement-products industry will soon be established in the State of Minas Gerais, Brazil. The factory presumably will be located at an asbestos mine that is about to be developed, but information regarding a more exact location is not yet available. A sample of the asbestos submitted to the Bureau of Mines appeared to consist of strong, flexible fibers of tremolite, but they were positively identified by the Geological Survey as anthophyllite. The occurrence of this variety of asbestos in fibers comparable in strength with chrysotile or high-grade tremolite is very unusual. Asbestos-cement board will be one of the chief products of the new factory; and, although anthophyllite found in the United States is unsuitable for such use, the Brazilian product seems to have suitable qualities. The entire output of the mine probably will be used in the local plant.

Samples of chrysotile of good strength and flexibility were received by the Bureau of Mines in 1942 from a deposit reported to be in the Department of Junin, Peru, on the eastern slope of the Andes.

During 1942 the Bureau of Mines received samples of fair-quality chrysotile asbestos from deposits in Mexico, somewhere in the vicinity of the Laredo-Mexico City highway. The asbestos-bearing rock is said to be an outcrop of serpentine 10 kilometers long and 1.5 kilometers wide, in which more than 20 fiber veins occur. Some of the samples

examined by the Bureau of Mines consisted of cross-fiber veins of spinning fiber comparable in quality with Canadian asbestos, except that they were stained and discolored. This condition probably was due to surface alteration.

Chrysotile asbestos was discovered in Turkey in 1934. According to Turkish authorities, the deposit is between Karakose and Kogizman in the vilayet of Agri. Because of remoteness and technical difficulties, it has not been developed. Short-fiber asbestos suitable only for asbestos-cement products and insulation is produced in small quantities in the Eskisehir region. It is reported that small shipments were made to Germany and Hungary in 1942.

A small output of asbestos was reported from the Macheria deposit, Algeria, in 1942. No information is available on the variety or quality of the fiber.

Cyprus normally produces several thousand tons of short-fiber chrysotile a year, and as there is virtually no local market the entire output is exported. Shipping conditions were quite difficult in the Mediterranean Sea during 1942, and presumably the Cyprus industry has been relatively inactive. As no new data have been obtained, the table that appeared in Minerals Yearbook, 1941, has not been repeated in this chapter.

BARITE, WITHERITE, AND BARIUM CHEMICALS

By CHARLES L. HARNESS AND K. G. WARNER [1]

SUMMARY OUTLINE

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SUMMARY

The war and other factors caused substantial declines in the use of barite in certain industries but fostered expansion in other ways, so that the net demand remained high. More crude barite was produced in 1942 (449,873 short tons) than during any previous year except 1941 (483,391 tons). The quantity of crude barite sold or used by producers in 1942—429,484 tons valued at $2,673,002—was exceeded only by 1941 sales—503,156 tons valued at $3,134,234.

The largest single loss in markets for ground barite was in rotary oil-well drilling muds, reflecting a general decline in well-drilling activity in the United States. Demand for drilling muds in Trinidad and Venezuela was active, but sufficient shipping space was not available to meet requirements. Consumption of barite for lithopone and blanc fixe manufacture also decreased, owing to the curtailed use of the finished products in paints and civilian white goods, such as linoleum, oilcloth, and rubber goods.

The quantity of crude barite consumed in making barium chemicals reached an all-time high in 1942. However, the tonnage of chemicals produced declined slightly owing to the reduced output of lithopone, which requires less barite per unit weight than other barium chemicals. Sales of barium carbonate, principally for use in case-hardening steel and in preventing efflorescence in structural brick, increased substantially, as did sales of barium nitrate for flares and barium peroxide for hydrogen peroxide manufacture.

Imports of crude barite in 1942 were 4,680 short tons from Canada and Cuba compared with 456 in 1941, all from Cuba. Imports of witherite (from Great Britain) were 3,066 tons in 1942 compared with 4,790 in 1941. Exports of barite from the United States are not reported separately.

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

Salient statistics of the barite, witherite, and barium chemical industries in the United States, 1938–42

	1938	1939	1940	1941	1942
Barite:					
Crude:					
Produced short tons	335,433	365,870	390,462	483,391	449,873
Sold or used by producers:					
Short tons	309,663	383,609	409,353	503,156	429,484
Value: [1]					
Total	$2,004,521	$2,344,103	$2,596,743	$3,134,234	$2,673,002
Average	$6.47	$6.11	$6.34	$6.23	$6.22
Imports for consumption:					
Short tons	24,845	11,588	7,391	456	4,680
Value: [2]					
Total	$151,235	$55,985	$41,342	$2,518	$34,756
Average	$6.09	$4.83	$5.59	$5.52	$7.43
Apparent new supply [3] short tons	334,508	395,197	416,744	503,612	434,164
Domestic percent	92.6	97.1	98.2	99.9	98.9
Reported consumption (total) short tons	364,985	391,683	404,388	490,833	449,424
Ground (and crushed):					
Sold or used by producers:					
Short tons	161,422	170,695	184,390	234,877	178,765
Value	$2,786,823	$2,902,973	$3,697,806	$4,606,832	$3,611,745
Imports for consumption:					
Short tons	1,700	1,590	314		
Value	$15,466	$14,999	$3,299		
Witherite:					
Imports for consumption:					
Short tons	2,115	3,819	3,584	4,790	3,066
Value	$43,568	$64,106	$70,126	$107,238	$60,824
Barium chemicals:					
Sold or used by producers: [4]					
Short tons	165,680	183,748	198,201	245,952	207,434
Value	$12,085,012	$12,791,269	$12,868,417	$16,949,120	$17,678,769
Imports for consumption:					
Short tons	4,519	3,205	191	317	365
Value	$254,874	$172,490	$9,045	$15,944	$103,156
Exports of lithopone:					
Short tons	1,734	4,845	14,298	21,527	17,036
Value	$153,567	$392,798	$1,112,362	$2,079,229	$1,732,898

[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] 1938–41: 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. 1942: Includes barium chemicals made from barium chemicals and imported barite and witherite purchased in the open market. The data have been adjusted to remove duplication.

BARITE

CRUDE

PRODUCTION

Total mine output of crude barite in 1942—449,873 short tons—was greater than in any previous year except 1941, when a record quantity—483,391 tons—was mined. Excellent demand maintained mining activity at high levels in the Southern, Midwestern, and Western barite-mining districts throughout the year.

When imports of German barite began to decline in 1938, production in the Southern district (Alabama, Georgia, South Carolina, Tennessee, and Virginia) expanded to meet requirements on the East coast. These requirements totaled about 220,000 tons annually, including about 180,000 tons of domestic origin, chiefly from the Southern district, and about 40,000 tons of crude imported barite, mostly from Germany. The German barite found a ready market on the East coast despite an import duty of $4 a ton. In meeting wartime demands, production of crude barite in the Southern district in 1942 exceeded all previous years except 1941. In the Midwestern district

(Missouri and Arkansas) production increased slightly, as losses in well-drilling-mud markets were compensated by increased demands of lithopone and barium chemical plants in Illinois and Missouri. In the Western district barite output declined slightly, owing to decreased use of barite in California well drilling, but requirements for the manufacture of barium chemicals at Modesto, Calif., remained substantial. Barite was produced in Nevada and New Mexico; the output in the latter State was held in stock.

Crude barite sold or used by producers in the United States, 1941–42, by States

State	1941		1942	
	Short tons	Value	Short tons	Value
Georgia	104,446	$553,445	86,636	$483,261
Missouri	212,718	1,337,756	146,270	943,131
Tennessee	104,511	779,565	83,291	624,584
Other States [1]	81,481	463,468	113,287	622,026
	503,156	3,134,234	429,484	2,673,002

[1] 1941: Arkansas, California, Colorado, Nevada, South Carolina, Texas, and Virginia; 1942: Alabama, Arkansas, California, Nevada, South Carolina, and Virginia.

Hubbell[2] prepared interesting articles on two of the largest producers of barite in the United States—L. A. Wood Co., Sweetwater, Tenn., and New Riverside Ochre Co., Cartersville, Ga. The L. A. Wood Co. operates seven open-pit mines in the Sweetwater district—the Stephens, Harmon, Garrison, Pond Creek, Fork Creek, Roy, and Calhoun. Each of the mines has its own washing plant, including log washers and jigs. The output of the mines is accumulated at a railroad yard for loading. The yard is equipped with a kiln for decrepitating some of the material to facilitate screening out iron oxide, thus yielding a purer product for glass use. The firm, under the name of the Barytes Mining Co. (Cartersville, Ga.), also mines barite from an open pit in north Georgia. Two grades of barite are produced at the Georgia mine—one about 96 percent barium sulfate, the other about 92 percent.

New Riverside Ochre Co. mines barite from five open pits in the Cartersville (Ga.) area. The crude material is dug with five caterpillar-mounted shovels and moved from the pits to the plant in trucks. Overburden ranges from a film to over 60 feet. Working benches are operated at about 15 feet. Approximately 8 tons of barite-bearing material are needed to produce 1 ton of washed barite. Treatment at the washing plant includes log washing, screening, crushing, jigging, and tabling. Three grades are produced: (1) A low-grade product containing about 92 percent barium sulfate and 5 percent iron oxide for use in oil-well drilling muds; (2) a 96-percent grade, maximum 1.0 percent iron oxide, for lithopone manufacture; and (3) glass grade, 98 percent barium sulfate, maximum 0.3 percent iron oxide. In making the glass grade, iron oxide is removed by magnetic separation.

Zapp[3] examined barite occurrences in the Llano (Tex.) area and

[2] Hubbell, A. H., Barytes—Nonmetallic Product of Eastern Tennessee: Eng. and Min. Jour., vol. 144, No. 1, January 1943, pp. 63–65. New Riverside—Producer of Barytes in Georgia: Eng. and Min. Jour., vol. 143, No. 10, October 1942, pp. 62–65.

[3] Zapp, Alfred, Barite in Northern Llano County: University of Texas Mineral Resource Survey Circ. 35, September 25, 1941, 6 pp.

found that, although barite did not appear to occur commercially in the locality, core drilling might reveal larger deposits.

PRICES

The opening 1942 quotation for crude barite from Georgia was $8 a long ton, f. o. b. mine, rising to $9 in April 1942, according to E&MJ Metal and Mineral Markets. From 1935 to 1940 the price was $7 a long ton. Missouri crude barite, 93 percent $BaSO_4$, was quoted at $6 to $6.35 a long ton, f. o. b. mine, in January 1942, rising to $6.75 to $7.25 a long ton in April. Missouri crude, 95 percent $BaSO_4$, maximum 1 percent iron oxide, was quoted at $6.25 to $7.00 a long ton in January but rose to $7 to $7.50 in April.

The average value, f. o. b. mine shipping point, of crude barite for the entire United States, as shown by compilations from reports to the Bureau of Mines, was $6.22 in 1942 compared with $6.23 in 1941.

CONSUMPTION

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States, 1938–42, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite [1]	Lithopone	Barium chemicals			Ground barite [1]	Lithopone	Barium chemicals	
1938	193,728	117,007	54,250	364,985	1941	243,846	153,982	93,005	490,833
1939	192,112	141,556	58,015	391,683	1942	200,443	144,821	104,160	449,424
1940	200,899	136,885	66,604	404,388					

[1] Includes some crushed barite.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States in 1942, by States

State	Product manufactured	Plants [1]	Barite used (short tons) [2]
Missouri	Ground barite and chemicals	3	68,529
California	Ground barite, lithopone, and chemicals.	8	39,207
Delaware and New Jersey	do	6	60,939
Illinois	do	6	51,777
Colorado	Chemicals	1	
Ohio	do	1	
West Virginia	do	3	
Kansas	Lithopone	1	
Maryland	do	1	
Pennsylvania	do	1	
Georgia	Ground barite and chemicals	2	228,972
New York	Ground barite	1	
Arkansas	do	2	
South Carolina	do	1	
Tennessee	do	2	
Texas	do	1	
Louisiana	do	1	
		41	449,424

[1] A plant producing more than 1 product is counted but once in arriving at State totals.
[2] Includes some crushed barite.

WORLD PRODUCTION

Canada.—Barite output more than doubled in 1942 over 1941.[4] Of the total production, 16,667 short tons, Nova Scotia produced 14,849 and British Columbia 1,818. The Nova Scotia mine, at Walton, Hants County, is comparatively new, having begun shipments in 1941. It is operated by Canadian Industrial Minerals, Ltd., a subsidiary of Springer Sturgeon Gold Mines, Ltd. According to The Northern Miner,[5] the firm ships most of its output to Trinidad for oil-well drilling mud. About two-thirds of the Nova Scotia sales is ground barite and the remainder crude barite. The British Columbia deposit is 23 miles southeast of Golden; most of the output is shipped to a grinding plant at Montreal. The deposit has been known for a number of years, but until recent road construction was undertaken by the British Columbia Government it was inaccessible to trucks. Trenching indicates a large tonnage of a pure white barite, analyzing about 98 percent barium sulfate.

Cuba.—Shipments of barite from Cuba, going mainly to Trinidad and the United States, declined somewhat in 1942 compared with 1941,[6] probably owing to lack of shipping space. Cuban barite is produced in the Provinces of Oriente and Pinar del Rio. The latter area is the chief source, as the Oriente deposits are somewhat inaccessible. The Cuban output is ground at Regla near Habana.

Eire.—Barite is mined in western Ireland from a vertical fissure vein about 7 feet wide that cuts Carboniferous limestone, it is reported.[7] Benbulben Barytes, Ltd., operating the mine, ships crude, ground, and micronized barite, principally to Great Britain for use in lithopone manufacture and as a paint extender. The material analyzes about 96 to 98 percent barium sulfate, the impurities being chiefly silica.

Germany.—Before 1939 Germany was the chief producer of barite, supplying nearly half the world output. German production in 1937 was 452,388 and in 1938, 480,877 metric tons. Subsequent data are not available, but loss of export markets for crude and ground barite and barium chemicals has probably curtailed current output. Prussia is the chief producing State, followed by Baden. The barite occurs chiefly in veins and is recovered by underground mining.

Italy.—Annual production, which comes from about 40 deposits, is said to exceed 50,000 tons. The principal workings are near Trent, on the Island of Sardinia, in the Val D'Aosta, in Valassina, and in Tuscany.

United Kingdom.—Production of barite in the United Kingdom has increased greatly since 1939, owing mainly to cessation of imports from Germany. Large deposits of barite are available in Ayrshire, Devonshire, Shropshire, and Derbyshire, but it is said that production cannot meet demand.[8]

Much witherite is substituted for barite in England (see Witherite section of this chapter).

[4] Canadian Mining Journal, vol. 64, No. 2, February 1943, pp. 60–61.
[5] Northern Miner, vol. 29, No. 6, April 29, 1943, p. 17.
[6] Bureau of Mines Mineral Trade Notes, Confidential Series 7, January 1943, p. 17.
[7] Bureau of Mines Mineral Trade Notes, Confidential Series 2, August 1942, pp. 23–24. Confidential Series 4, October 1942, p. 24.
[8] Chemical and Engineering News, vol. 20, No. 7, April 10, 1942, p. 467.

World production of barite, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Algeria	2,137	3,069	(2)	(2)	(2)	(2)
Argentina			768	2,680	4,174	(2)
Australia:						
New South Wales	268	322	(2)	(2)	(2)	(2)
South Australia	2,736	2,909	3,886	3,672	3,631	(2)
Tasmania	77			(2)	(2)	(2)
Victoria	71			(2)	(2)	(2)
Brazil (exports)	600	(2)	(2)	(2)	(2)	(2)
Canada			(2)	307	6,043	15,120
Chosen	8,400	(2)	(2)	(2)	(2)	(2)
Cuba	3,849		12,000	16,105	13,223	(2)
Egypt	51	20	31	61	30	(2)
France	19,850	(2)	(2)	(2)	(2)	(2)
Germany:						
Austria	855	373	(2)	(2)	(2)	(2)
Baden	21,653	36,305	(2)	(2)	(2)	(2)
Bavaria	11,832	26,748	(2)	(2)	(2)	(2)
Prussia [3]	410,634	401,906	(2)	(2)	(2)	(2)
Saxony	432	230	(2)	(2)	(2)	(2)
Thuringia	6,790	15,315	(2)	(2)	(2)	(2)
Württemburg	192		(2)	(2)	(2)	(2)
Greece	39,343	34,700	24,055	(2)	(2)	(2)
India, British	15,941	8,205	9,404	(2)	(2)	(2)
Indochina	45	50	155	185	(2)	(2)
Italy	45,202	48,169	(2)	(2)	(2)	(2)
Norway	70			(2)	(2)	(2)
Portugal	113	24	25	20	(2)	(2)
Southern Rhodesia		91	50	(2)	(2)	(2)
Spain		500	8,606	9,936	(2)	(2)
Union of South Africa	570	491	439	691	[4] 1,326	[5] 448
United Kingdom	74,485	77,543	(2)	(2)	(2)	(2)
United States	327,380	304,298	331,910	354,219	438,523	408,116

[1] In addition to the countries listed, barite is produced in China, Czechoslovakia, Eire, Japan, and U. S. S. R., but data on production are not available.
[2] Data not available.
[3] Official figures which, it is reported, cover only output of mines included under the mining law.
[4] January to October, inclusive.
[5] January to September, inclusive.

GROUND (AND CRUSHED)

SALES

All principal uses of ground (and crushed) barite sold or used by producers declined in 1942, and the total, though comparing favorably with pre-1940 output, was 24 percent less than the record 1941 sales. In its individual consumption outlets, demand for use in well drilling dropped 24 percent, in paint 40 percent, in glass 3 percent, and in rubber 35 percent.

Ground (and crushed) barite sold or used by producers in the United States, 1938–42

	1938	1939	1940	1941	1942
Plants	14	13	16	16	19
Short tons	161,422	170,695	184,390	234,877	178,765
Value	$2,786,823	$2,902,973	$3,697,806	$4,606,832	$3,611,745

Ground (and crushed) barite sold or used by producers, 1940–42, by consuming industries

Industry	1940		1941		1942	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Well drilling	138,055	75	154,760	66	117,380	66
Paint	11,056	6	31,009	13	18,484	10
Glass	12,697	7	22,615	10	21,895	12
Rubber	4,283	2	9,800	4	6,334	4
Undistributed	18,299	10	16,693	7	14,672	8
	184,390	100	234,877	100	178,765	100

Virtually all barite is ground or crushed before use, but "ground (and crushed) barite" is generally held to mean barite ground for use other than in barium chemicals or lithopone, and such meaning is adhered to in this chapter. Nearly all ground barite is used for its physical rather than its chemical properties, except for the quantity consumed in glass batches.

As in years past, rotary oil-well drilling muds absorbed the greater part of the ground-barite output in 1942, although the number of wells drilled was considerably less than in 1941. The following table shows the relation between wells drilled and ground barite consumed in drilling muds.

Ground barite consumed in drilling wells in the United States, 1938–42

Year	Wells drilled [1]	Ground barite used (short tons)		Year	Wells drilled [1]	Ground barite used (short tons)	
		Total	Per well drilled			Total	Per well drilled
1938	26,712	126,697	4.74	1941	29,070	154,760	5.32
1939	25,987	125,560	4.83	1942	17,934	117,380	6.55
1940	28,124	138,055	4.91				

[1] Oil, gas, and dry wells drilled in United States, as recorded in chapters of this series on Crude Petroleum and Petroleum Products.

Barite has several functions in drilling muds, the principal one being to confine gas and oil to their respective formations during drilling. Barite drilling muds also seal the walls of the hole and lubricate the drilling mechanism.

Foreign demand for barite drilling muds has expanded considerably since 1938, particularly in Trinidad and Venezuela. American, Cuban, and Canadian producers competed in these markets in 1942. The Southern and Midwestern districts generally supply most of the ground barite exported from the United States for well drilling, shipping 10,000 to over 20,000 tons annually, depending on foreign demand, through Mobile, Ala., New Orleans, La., and other Gulf ports.

One of the newer uses for crushed barite is in glassmaking, where it acts as a flux in the glass batch, permitting lower furnace temperature or increased output at the usual temperature. Barium compounds, particularly precipitated barium carbonate, are used in optical, bottle, and flat glasses, not only as fluxes but to impart density and brilliance to the finished product. As barium glasses corrode

ordinary glass pots, special types of pots are generally required. According to a communication received by the Bureau of Mines from a large glass producer, the specifications of glass-grade barite are somewhat as follows: Barium sulfate, not less than 96 percent; moisture, not over 3 percent; iron oxide, not over 0.4 percent; titanium oxide, not over a trace; no particles coarser than 16-mesh; not over 3 percent plus 20-mesh; not over 40 percent minus 100-mesh; not less than 15 percent minus 100-mesh.

Ground barite has certain advantages as a paint extender. It has low oil absorption and fair sanding properties and contributes to a dense, nonporous film. Barite is added to inside paints to aid easy working with the brush; owing to the low oil absorption, considerable quantities can be incorporated without bodying. Its low tinting strength makes it a good base for colored as well as white pigments.

Ground barite is also used as a filler for paper, paper board, wallpaper, rubber goods, linoleum, and oilcloth. A recent novel use is in weighting concrete ballast for drydock caissons. Barium cements containing as much as 50 percent barium oxide have high specific gravity. This suggests their possible use, in conjunction with such heavy aggregates as barite, in making heavy concrete blocks to be substituted for pig iron in ships' ballast.

PRICES

The price quoted in Chemical Industries for ground barite, carlots, 350-pound barrels, works, was $27.65 a short ton in 1942, the same as in 1941.

FOREIGN TRADE

There were no imports of ground barite in 1941 and 1942. Imports for 1938–40 are shown in the salient statistics table of this chapter. Exports of ground barite are not reported separately.

WITHERITE

PRODUCTION

The Baroid Sales Division of the National Lead Co., which operates a mine near El Portal, Calif., is the only producer of witherite in the United States. Figures on output are not available for separate publication but are combined with those of barite.

Deposits of witherite in North America were reviewed in the chapter of this series in Minerals Yearbook, 1941.

Nearly the entire world production of witherite is centered in northern England. Sources, preparation, and uses of witherite have been reviewed by Muddiman [9] and Michell.[10] Jameson [11] reviewed methods of analyzing witherite.

In British paint formulas, ground witherite has been substituted for ground barite for mixing with ultramarine blue to make a green pigment, and it is claimed that such substitution improves the product.[12]

[9] Muddiman, E. W., Witherite: Jour. Oil Col. Chem. Assoc., vol. 25, 1942, pp. 127–142; British Chem. and Physiol. Abs., B, I, III, October 1942, p. 416.

[10] Michell, F. B., Barite and Witherite: Mine and Quarry Eng., vol. 7, 1942, pp. 37–40, 44; Chem. Abs., vol. 36, No. 11, June 10, 1942, p. 3123.

[11] Jameson, F. L., Examination of Natural White Pigments: Paint Mfr., vol. 12, 1942, pp. 145–146, 153; Chem. Abs., vol. 36, No. 21, November 10, 1942, p. 6817.

[12] Bureau of Foreign and Domestic Commerce, Foreign Commerce Weekly, vol. 9, No. 10, December 5, 1942, p. 33.

PRICES

According to Chemical Industries, the price of ground witherite in 1942 remained constant at $43 a short ton in carlots, bags, works, for the 90-percent grade, the same price as in 1941.

IMPORTS

Receipts of witherite were 3,066 short tons valued at $60,824 in 1942, all from Great Britain, compared with 4,790 tons valued at $107,238 in 1941. Exports of witherite, if any, are not reported separately.

Witherite, crude, unground, imported for consumption in the United States, 1938–42

[Value at port of shipment]

Year	Short tons	Value	Year	Short tons	Value
1938	2,115	$43,568	1941	4,790	$107,238
1939	3,819	64,106	1942	3,066	60,824
1940	3,584	70,126			

BARIUM CHEMICALS

SALES

War conditions increased the demand for certain barium chemicals in 1942 but curtailed the production of others, particularly those whose principal uses were closely connected with civilian consumption.

All barium chemicals in the United States are derived from barite, except a small quantity obtained from witherite. Barite is crushed and roasted with coal, coke, or petroleum-coke breeze in a rotary kiln for

Barium chemicals sold or used by producers in the United States, 1938–42 [1]

Chemical	1938	1939	1940	1941	1942
Lithopone: [2]					
Plants	11	11	11	9	9
Short tons	125,746	142,759	151,802	176,642	137,320
Value	$9,975,012	$10,461,102	$10,197,897	$12,550,193	$10,828,924
Blanc fixe (precipitated barium sulfate):					
Plants	7	6	6	6	5
Short tons	19,428	18,653	22,247	29,352	21,278
Value	$921,203	$898,198	$1,250,303	$1,806,882	$1,403,689
Artificial barium carbonate (chemically precipitated):					
Plants	4	5	5	5	7
Short tons	9,543	12,478	13,339	17,477	18,174
Value	$459,901	$617,799	$616,331	$785,486	$1,012,522
Other barium chemicals: [3]					
Plants	5	7	7	7	11
Short tons	10,963	9,858	10,813	22,481	30,662
Value	$728,896	$814,170	$803,886	$1,806,559	$4,433,634
Total barium chemicals:					
Short tons	165,680	183,748	198,201	245,952	207,434
Value	$12,085,012	$12,791,269	$12,868,417	$16,949,120	$17,678,769

[1] 1938–41: 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. 1942: Includes barium chemicals made from barium chemicals and imported barite and witherite purchased in the open market. The data have been adjusted to remove duplication.

[2] Does not include cadmium lithopone.

[3] Figures cover chemicals, in order of value, as follows: 1938: Chloride, dioxide, sulfide, hydroxide, and oxide; 1939: Chloride, dioxide, hydroxide, sulfide, and oxide; 1940: Chloride, dioxide, hydroxide, sulfide, oxide, and nitrate; 1941: Chloride, sulfide, dioxide, hydroxide, nitrate, oxide, and tribarium aluminate; 1942: Nitrate, 11,489 tons, $2,483,115; chloride, 13,414 tons, $960,876; dioxide, 2,844 tons, $666,232; hydroxide, 2,335 tons, $267,572; sulfide and oxide, 580 tons, $55,839.

about 4 hours, yielding black ash, which contains about 80 percent barium sulfide. The black ash is leached with hot water to give barium sulfide liquor. There were 21 producers of black ash in 1942, compared with 18 in 1941. The Bureau of Mines does not report the output of black ash, as this is regarded as an intermediate barium chemical. Where possible only finished barium chemicals not used in the manufacture of other barium chemicals are reported.

Production of lithopone, long a major outlet for barite, declined in 1942 to 137,320 short tons, the lowest figure since 1938. There were nine producers in 1942, as in 1941. Paint remained the largest use of lithopone, but increasing military uses of paint did not compensate for losses in civilian paint markets caused by reduced construction of civilian dwellings and the shortage of painters for general maintenance work. Lithopone paint markets were also said to have been adversely affected by a growing use of titanium pigments in the white-pigment field. Shortages of linseed and other drying oils used with lithopone in the manufacture of linoleum and oilcloth held down production of these two commodities, which ordinarily consume 17,000 to 20,000 tons of lithopone annually. The declining production of rubber white goods has forced a corresponding decrease in the amount of lithopone needed for this purpose.

Lithopone[1] *sold or used by producers, 1940–42, by consuming industries*

Industry	1940		1941		1942	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	117,075	77	132,691	75	109,216	80
Floor coverings and textiles	18,738	13	21,114	12	15,775	11
Rubber	3,387	2	3,547	2	1,047	1
Other	12,602	8	19,290	11	11,282	8
	151,802	100	176,642	100	137,320	100

[1] Does not include cadmium lithopone.

Manufacturers of lithopone generally purchase washed and jigged barite analyzing about 96 percent barium sulfate, 1 to 2 percent Fe_2O_3, less than 1.75 percent silica, and no more than traces of zinc, lead, and fluorides. The barite is crushed and roasted with coal to form black ash as described above. The solution of barium sulfide obtained from black ash is reacted with a solution of zinc sulfate, whereby lithopone (barium sulfate intimately mixed with zinc sulfide) is precipitated; it is then dried, roasted, quenched in water, ground, bagged, and sold.

Lithopone has been suggested as a carrier pigment for luminous paints.[13]

The demand for blanc fixe declined owing to curtailment in use of white paint, rubber goods, linoleum, and oilcloth, its major outlets. Blanc fixe is made by reacting a solution of sodium sulfate with a solution of barium sulfide, precipitating barium sulfate (blanc fixe) and leaving a valuable byproduct—sodium sulfide—in solution. Blanc fixe is also a byproduct of the manufacture of hydrogen peroxide by the barium peroxide-sulfuric acid process. Five producers of

[13] Chemical and Engineering News, vol. 20, No. 8, April 25, 1942, p. 529.

blanc fixe reported to the Bureau of Mines in 1942 compared with six in 1941.

Barium carbonate production expanded to meet added demands in several fields. There were seven producers in 1942, five in 1941. This barium chemical is generally made by adding a solution of soda ash to one of barium sulfide, thereby precipitating insoluble barium carbonate, leaving byproduct sodium sulfide in solution. Probably the most important direct wartime use of barium carbonate is in salt baths for case-hardening bomb shells, tools, and other steel parts. Before the war witherite, being less costly, was employed for this purpose rather than precipitated barium carbonate; however, reduced imports of witherite have broadened, at least temporarily, the demand for the synthetic material. The action of barium carbonate as a carbon carrier in steel hardening is not precisely known, but when it is mixed with powdered coke and heated with iron parts at 1,700° F., the coke is gradually oxidized and the carbon content of the surface grains of the iron is increased, thus case-hardening the product. Other barium compounds, notably barium peroxide, are said to be capable of similar use. Barium carbonate is an intermediate in the manufacture of certain other barium chemicals, particularly barium peroxide and barium nitrate. In making the peroxide, barium carbonate is calcined with coke, yielding the oxide, which is then heated with air or oxygen under pressure, yielding a mixed barium peroxide-oxide. The percentage of peroxide obtained depends on the efficiency of the process used. Although most hydrogen peroxide is today made by electrolytic oxidation methods, substantial quantities of barium peroxide are still used to make hydrogen peroxide. There were three producers of barium peroxide in 1942, two in 1941. Barium carbonate can be used in glassmaking, as previously mentioned. The carbonate and other barium compounds are used in brickmaking to prevent formation of scum.

Barium nitrate is generally obtained by treating the carbonate with nitric acid. The nitrate is used in green signal flares and in explosives. In 1942, five firms reported production of barium nitrate compared with three in 1941.

Barium chloride, which may be crystallized from a solution of barium sulfide and calcium chloride, is used to purify salt brines for chlorine and sodium hydroxide manufacture, in making coatings for photographic paper, in the manufacture of extended titanium pigments, in color lakes, in finishing white leather, and in purifying beet-sugar juice. Three firms produced barium chloride in 1942, as in 1941.

Barium hydroxide was produced by four companies in 1942 (four in 1941), principally for use in beet-sugar purification and for refining animal and vegetable oils.

PRICES

Range of quotations on barium chemicals, 1940–42 [1]

	1940	1941	1942
Lithopone:			
Domestic, ordinary, delivered, bags, pound	$0.03⅜	$0.0385–$0.04¼	$0.04¼
Do. barrels, do.	.03¾	.041 – .04½	.04½
High strength, bags, do.	.05		
Do. barrels, do.	.05¼		
Titanated, bags, do.	.05¼	.05¼ – .056	.056
Do. barrels, do.	.05½	.05½ – .0585	.0585
Barium carbonate, precipitated, 200-pound bags, works, short ton	$45.00 –62.50	45.00 –65.00	$55.00 –65.00
Barium chlorate, 112-pound kegs, New York, pound	.20 – .45	.45	.60
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, drums, pound	.10 – .12	.10	.10
Barium hydrate, 500-pound barrels, do.	.05½ – .07	.05½ – .07	.06 – .07
Barium nitrate, barrels, do.	.09½ – .10½	.08½ – .12½	.10½ – .12½
Barium sulfate, precipitated (blanc fixe), 400-pound barrels, works [2], short ton	50.00 –80.00	35.00 –46.50	40.00 –46.50

[1] Chemical Industries (formerly Chemical Markets), New York (monthly).
[2] Lowest price for pulp grade, highest for high-grade precipitated.

FOREIGN TRADE

Barium chemicals imported for consumption in the United States, 1938–42

[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
1938	3,932	$207,121	100	$13	106	$5,102	(1)	$32
1939	2,641	130,893	350	51	38	1,891		
1940								
1941	(2)	9	4,032	208	15	865		
1942					28	1,357		

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
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
1941					292	10,791			8	4,071
1942	36	15,770	(3)	1	147	9,361			154	76,667

[1] 110 pounds. [2] 112 pounds. [3] 53 pounds.

Lithopone exported from the United States, 1938–42

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1938	1,734	$153,567	$88.56	1941	21,527	$2,079,229	$96.59
1939	4,845	392,798	81.07	1942	17,036	1,732,898	101.72
1940	14,298	1,112,362	77.80				

POTASH

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

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GENERAL CONDITIONS

Production and sales of domestic potassium salts continued to increase in 1942, with a record output of over a million and a quarter short tons of marketable potassium salts (1,267,455 short tons) containing 679,206 tons of equivalent K_2O. (See fig. 1.) The still

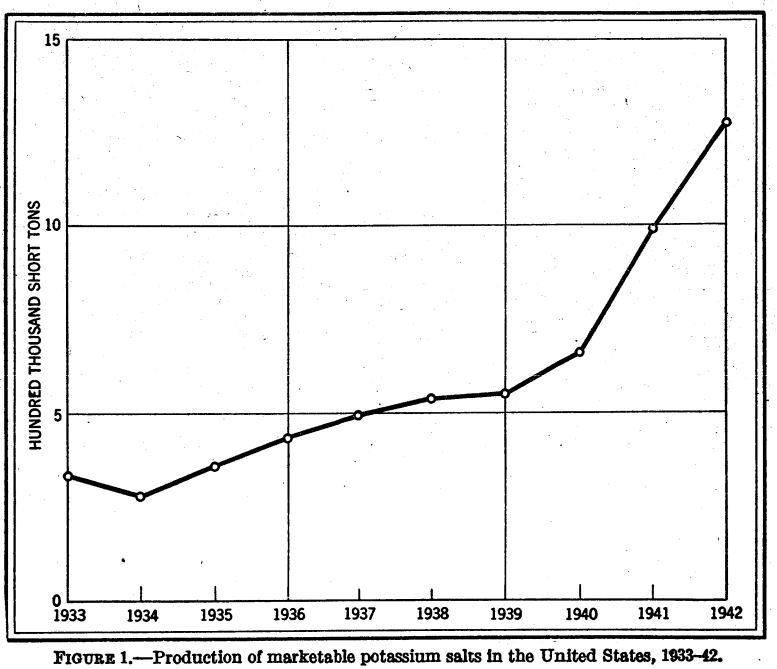

Figure 1.—Production of marketable potassium salts in the United States, 1933–42.

larger quantity sold (1,277,317 tons) carried 680,831 tons of equivalent potash (K_2O). Stocks in producers' hands at the close of the year continued to decline. Exports considerably exceeded imports. Domestic consumption was the highest on record—about 628,000 tons of K_2O. For the second year the United States has proved itself to be self-sufficient as to potash.

American potash producers are reported to have sold virtually their entire output to March 1943 early in 1942. Late in 1942,

according to trade journals, efforts of consumers, who had not adequately covered their requirements in the preceding spring, to obtain additional supplies created a tight market, which was alleviated irregularly by imports of muriate of potash from the U. S. S. R. on a lend-lease assignment to the Defense Supplies Corporation.

To assure equitable distribution of available domestic potash from producers to their immediate customers, largely the fertilizer companies, the War Production Board, on February 27, 1943, placed the distribution of domestic potash salts (muriate of potash, sulfate of potash, sulfate of potash-magnesia, and run-of-mine potash) under allocation control (General Preference Order M-291). This order was based upon the claim that the requirements for the defense of the United States had created a shortage in the supply of potash for defense, for private account, and for export. The order, effective April 1, 1943, covers three allocation periods: (1) April and May 1943, (2) the following 10 months, and (3) April and May 1944.

German control of a considerable part of the domestic potash production was exposed late in 1942.

General discussions of the domestic potash industry by Turrentine [1] and Kieffer [2] appeared in 1942. In 1943, a new book by Turrentine [3] described the development of the American potash industry since 1926 and supplemented his earlier book.[4] Domestic reserves of potash were described by Mansfield.[5]

Salient statistics of the potash industry in the United States, 1940–42

	1940	1941	1942
Production:			
Potassium salts (marketable)—short tons	658,249	986,458	1,267,455
Approximate equivalent, K_2O—do	379,679	524,875	679,206
Sales by producers:			
Potassium salts—do	677,892	994,843	1,277,317
Approximate equivalent, K_2O—do	393,058	531,346	680,831
Value at plant	$12,562,050	$17,368,237	$22,962,518
Average per ton	$18.53	$17.46	$17.98
Imports:			
Fertilizer materials—short tons	274,473	49,337	15,895
Approximate equivalent, K_2O—do	115,241	13,185	2,915
Value	$5,148,852	$1,023,927	$418,787
Chemical materials—short tons	14,564	12,918	5,433
Approximate equivalent, K_2O—do	3,449	2,633	1,444
Value	$2,411,919	$4,702,971	$1,784,674
Exports:			
Fertilizer materials—short tons	93,060	91,950	84,402
Approximate equivalent, K_2O—do	55,836	50,573	50,641
Value	$3,141,170	$2,592,697	$2,184,044
Chemical materials—short tons	14,180	12,883	13,306
Approximate equivalent, K_2O—do	7,000	6,300	6,500
Value	$3,096,909	$2,972,137	$3,611,294
Consumption:			
Apparent consumption:[1]			
Potassium salts—short tons	859,689	952,265	1,200,937
Approximate equivalent, K_2O—do	448,912	490,291	628,049
Actual sales for consumption:			
Approximate equivalent, K_2O—do	449,376	490,531	627,294

[1] Quantity sold by producers, plus imports, minus exports.

[1] Turrentine, J. W., Wartime Contribution of the American Potash Industry: Ind. and Eng. Chem., ind. ed., vol. 34, No. 12, December 1942, pp. 1422–1426.
[2] Kieffer, D. C., Potash (in 1941): Mineral Ind., vol. 50, 1942, pp. 445–461.
[3] Turrentine, J. W., Potash in North America: Am. Chem. Soc. Mono. Ser., Reinhold Publishing Corporation, New York, 1943, 186 pp.
[4] Turrentine, J. W., Potash: A Review, Estimate, and Forecast: John Wiley & Sons, New York, 1926, 188 pp.
[5] Mansfield, G. R., American Potash Reserves: Ind. and Eng. Chem., ind. ed., vol. 34, No. 12, December 1942, pp. 1417–1421.

PRODUCTION AND SALES

Domestic production of marketable potassium salts has increased each year since 1934, recent annual increments being much larger than those in the earlier years (see figure 1); in 1941 a 50-percent increase is shown over 1940, and in 1942 a 28-percent increase over 1941. Production in 1942 was 1,267,455 short tons, with an average K_2O content of 55.59 percent, compared with 53.21 percent K_2O reported for 1941. Production of equivalent potash (K_2O) in 1942 exceeded that of 1941 by 154,331 tons. Sales of potassium salts were over a million and a quarter tons in 1942 and contained 680,831 tons of equivalent potash (K_2O)—also a 28-percent increase over 1941. Sales exceeded production in 1942, and producers' stocks were drawn upon to meet the demand. The average value per ton of sales increased to $33.73 in 1942 from $32.69 in 1941. Production of 50 percent muriate was only a little larger than in 1941, but there was a 45-percent increase in the quantity of sulfate of potash and sulfate of potash-magnesia produced, as shown in the accompanying table of production by grades.

Potassium salts produced in the United States, 1941–42, by grades, in short tons

	1941	1942
Muriate of potash: 60 percent K_2O minimum	663,608	878,997
50 percent K_2O minimum	85,398	85,680
Manure salts, run-of-mine	154,979	183,404
Sulfate of potash and sulfate of potash-magnesia	82,473	119,374
	986,458	1,267,455

The potash industry of the United States is overwhelmingly a western one, more than 99½ percent of the 1942 output in terms of K_2O having come from California, New Mexico, and Utah. Nearly 81 percent of the equivalent potash (K_2O) production came from the deeply buried Permian saline sedimentary deposits of New Mexico and 19 percent from the saline lake brines of California and Utah, whereas less than 0.5 percent was recovered as a byproduct of manufacturing processes (cement and distillery operations in Maryland). The potash salts sold in 1942 were largely refined or processed products.

The potash-producing companies in the United States in 1942 were: The American Potash & Chemical Corporation, 122 East 42d Street, New York City (plant at Trona, on Searles Lake, Calif.); United States Potash Co., Inc., 30 Rockefeller Plaza, New York City (mine and plant near Carlsbad, N. Mex.); Potash Company of America, Carlsbad, N. Mex. (mine and plant near Carlsbad, N. Mex.); International Minerals & Chemical Corporation, 20 North Wacker Drive, Chicago, Ill. (mine and plant near Carlsbad, N. Mex.); Bonneville, Ltd., 540 West Seventh South, Salt Lake City, Utah (plant near Wendover, Utah); North American Cement Corporation, 41 East 42d Street, New York City (plant at Security, Md.); and U. S. Industrial Chemicals, Inc., 60 East 42d Street, New York City (plant at Baltimore, Md.).

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Potassium salts produced, sold, and in producers' stocks in the United States, 1938–42

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)
1938	9	534,945	316,951	9	498,189	286,437	$9,748,290	6	158,540	87,440
1939	6	546,757	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
1941	7	986,458	524,875	7	994,843	531,346	17,368,237	7	26,374	9,712
1942	7	1,267,455	679,206	7	1,277,317	680,831	22,962,518	7	14,158	6,041

PRICES

The General Maximum Price Regulation (Federal Register, April 30, 1942, pp. 3153–3158), issued April 28, 1942, under authority vested in the Price Administrator by the Emergency Price Control Act of 1942 and effective May 11, 1942, fixed potash prices at their March 1942 maximum.

Price lists for the 1942–43 fertilizer season were released by the major potash companies on dates ranging from May 29 to June 15, 1942. Most of the new schedules applied to the 12 months from June 1, 1942, to May 31, 1943. The Potash Company of America, however, released a schedule for the 10 months June 1, 1942, to March 31, 1943. The following base prices were reported by various producing companies.

Muriate of potash (62 to 63 percent), 62 percent K_2O minimum.	53½ cents per unit K_2O.
Muriate of potash, 60 percent minimum	53½ cents per unit K_2O.
Muriate of potash, granular (50 to 52 percent), 50 percent minimum.	56 cents per unit K_2O.
Manure salts:	
22 percent K_2O minimum	20 cents per unit K_2O.
25 percent K_2O minimum	21 cents per unit K_2O.
Sulfate of potash, 90 to 95 percent K_2SO_4—basis 90 percent K_2SO_4.	$36.25 per short ton.
Sulfate of potash-magnesia, 40 percent K_2SO_4 minimum, 18.50 percent MgO.	$26.00 per short ton.

Basing points for the New Mexico companies for muriate of potash were designated to be ex-vessel Atlantic and Gulf ports within the United States, and for the American Potash & Chemical Corporation ex-vessel principal continental United States ports. Prices for manure salts, where stated, were based upon Carlsbad, N. Mex., only. Sulfate of potash and sulfate of potash-magnesia prices quoted by the International Minerals & Chemical Corporation were ex-vessel Atlantic and Gulf ports within the United States. At buyers' option, muriate of potash could be purchased f. o. b. Carlsbad, N. Mex., at 11.2 cents per unit K_2O below ex-vessel price, and f. o. b. Trona, Calif., for 8 cents per unit K_2O below net ex-vessel price at Pacific coast ports.

Seasonal discounts offered by the Potash Company of America, the American Potash & Chemical Corporation, and the International Minerals & Chemical Corporation were 8 percent on orders accepted through June 30, 1942, for delivery in equal monthly installments from June 1, 1942, through March 1943, and 4 percent additional upon

completion of contracted deliveries; no discounts were allowed on orders placed after June 30, 1942. The United States Potash Co. allowed 8 percent discount from ex-vessel prices on orders placed for June delivery and on those placed before July 1, 1942, for equal monthly tonnage deliveries from June 1, 1942, to March 31, 1943, and 4 percent additional credit upon completion of contracted deliveries; on orders placed after June 30, 1942, but before October 1, 1942, for equal monthly tonnage deliveries from October 1, 1942, to March 31, 1943, it allowed 4 percent from ex-vessel prices and 2 percent additional credit upon completion of delivery of the contracted tonnage; no discounts were allowed on orders placed after September 30, 1942.

A 6-percent increase in freight rates went into effect in March 1942. The Office of Price Administration requested potash producers to absorb that part of the increase necessary to maintain ex-vessel prices at the established level. Later, a 3-percent tax on the transportation of property was imposed by section 620 of the Revenue Act of 1942, and the potash companies were also required to absorb this increase in a similar manner. In both instances, however, the buyer was required to pay the increased charges on potash sold at f. o. b. Carlsbad prices.

In February 1942, the Office of Price Administration issued a temporary order freezing retail prices of certain potash salts at levels prevailing from February 16 to February 20, 1942. These temporary price maximums were made permanent by Maximum Price Regulation 135—Mixed Fertilizers, Superphosphate, and Potash (Federal Register, April 30, 1942, pp. 3187–3189), issued and effective April 28, 1942. The prices of muriate of potash, sulfate of potash, manure salts, or any other substance containing K_2O when marketed or sold to consumers for use in growing crops and plants, and not for resale, were fixed at the above-mentioned February 1942 prices.

CONSUMPTION

In 1942 the United States and its possessions consumed potash salts containing approximately 628,000 short tons of K_2O, which were largely, though not entirely, of domestic origin. The following table, in which information from various sources has been combined, indicates a domestic consumption of 627,294 short tons.

Apparent consumption, calculated by subtracting exports (57,141 tons) from the sum of imports (4,359 tons) and producers' sales (680,831 tons), was 628,049 tons of K_2O in 1942. The difference in consumption figures obtained by these two methods is almost negligible.

Apparent domestic consumption of potassium salts, in terms of equivalent potash (K_2O), and its relationship to sales of domestic producers for a period of years are shown in figure 2.

A break-down of domestic deliveries of American potash by the major domestic producers according to use, as shown in the accompanying table, indicates that 90 percent in 1942 went to the fertilizer industry and 10 percent for chemicals. The picture is not quite complete, however, because no comparable break-down is available for imports or for sales of the minor domestic producers.

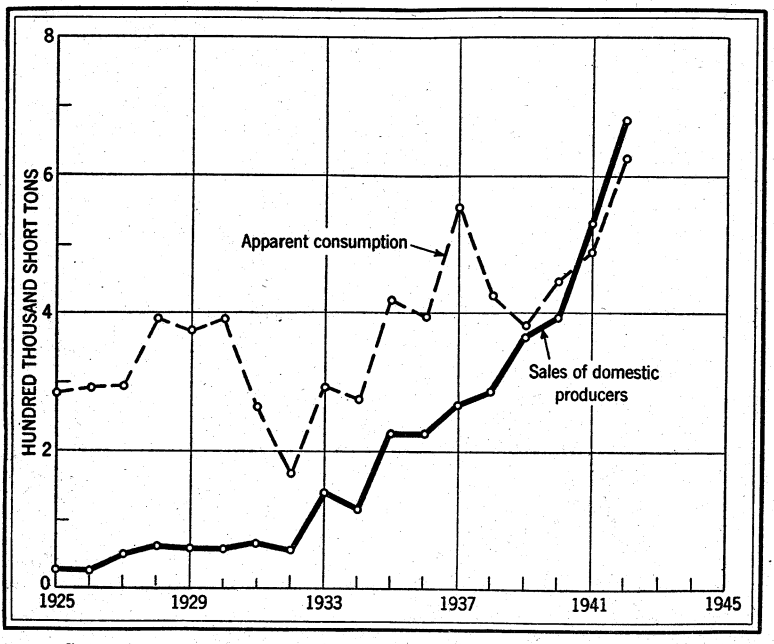

FIGURE 2.—Comparison of apparent domestic consumption of potash (K_2O) and sales of domestic producers of potash in the United States, 1925–42.

Sales of primary potash in the United States for consumption and export, 1940–42, in short tons of K_2O

	1940	1941	1942
Deliveries of potash of domestic origin by major companies, as from reports of American Potash Institute—			
In United States and possessions:			
Agricultural	321,414	435,940	558,356
Chemical	37,815	51,531	63,844
For export	23,707	24,807	37,955
	382,936	512,278	660,155
Imports for consumption plus sales of minor domestic producers	129,276	35,126	24,280
	512,212	547,404	684,435
Total exports	62,836	56,873	57,141
Actual sales for consumption in the United States	449,376	490,531	627,294

REVIEW BY STATES

California.—In 1942 the American Potash & Chemical Corporation (122 East 42d Street, New York City), only producer of potash in California, used the highly complex brine of Searles Lake, in the southeastern part of the State, as its raw material and produced both agricultural and chemical grades of potassium chloride, as well as potassium sulfate and potassium bromide, in its plant at Trona. Its total output of marketable potash salts was greater in 1942 than in 1941, when a long strike seriously affected production. Recent technical developments at the Trona plant are described by Robertson.[6]

German ownership of most of the capital stock and control of this company was disclosed by the Alien Property Custodian when he

[6] Robertson, G. R., Expansion of the Trona Enterprise. Plant of the American Potash and Chemical Corporation: Ind. and Eng. Chem., ind. ed., vol. 34, No. 2, February 1942, pp. 133–137.

announced, on October 20, 1942, the vesting in him of 90.79 percent of the capital stock of the company owned by German nationals. The property vested consisted principally of 474,726 shares, registered in the names of Consolidated Gold Fields of South Africa, Ltd., Gold Fields American Development Co., Ltd., New Consolidated Gold Fields, Ltd., and Administratickantoor Diligentia, all of which are beneficially owned by Wintershall A. G., Germany (dominant factor in the German potash industry) and Salzdetfurth A. G., Germany (second-largest potash company in Germany).

Maryland.—In Maryland, two companies have for several years produced a few thousand tons of byproduct potash annually for agricultural use. One of these, the North American Cement Corporation (41 East 42d Street, New York City), recovered a few thousand tons of impure sulfate of potash from cement-kiln flue dust in 1942 at its Security plant near Hagerstown, Md. U. S. Industrial Chemicals, Inc. (60 East 42d Street, New York City), continued to manufacture a byproduct potash-bearing material by incinerating waste residue from distillation of industrial alcohol from fermented molasses at its Fairfield plant, Baltimore. Blackstrap molasses has been used as raw material for several years but is no longer available; therefore, it has become necessary to use grain as a substitute source of alcohol. All grain residues will be recovered as distillers' dried grains and sold as such; consequently, no potash will be recovered.

New Mexico.—Mine production of the Carlsbad potash district has been climbing steadily. In 1940 it passed 1,200,000 short tons of ore, in 1941 it reached 2,270,000 tons, and in 1942 the three companies operating in the area mined 3,035,549 tons of sylvinite and langbeinite with an average equivalent K_2O content of 21.52 percent. All the companies mined sylvite (potassium chloride), and one—the International Minerals & Chemical Corporation— also mined langbeinite (a potassium-magnesium sulfate). The greater part of the production was sylvite, most of which was processed to yield 60 percent or higher-grade K_2O muriate. Potassium sulfate and potassium-magnesium sulfate were produced from langbeinite by the International Minerals & Chemical Corporation in the refinery at its mine near Carlsbad. Potassium sulfate also was produced by the Potash Company of America at plants in Oklahoma and Texas; this company also produced potassium hydroxide and potassium chlorate from sylvite at a plant at its mine near Carlsbad.

The Union Potash & Chemical Co., the most recent company to undertake potash mining in the Carlsbad area, merged with its parent company, the International Minerals & Chemical Corporation (formerly the International Agricultural Corporation), March 31, 1942. On October 31, 1941, a contract was completed with the Defense Plant Corporation whereby magnesium chloride cell feed would be produced from a waste potassium-magnesium-bearing brine, containing about 16 percent magnesium chloride, by a process developed by the International Minerals & Chemical Corporation. The magnesium chloride will be obtained by evaporation and selective crystallization, and the dried product will be shipped to a magnesium-metal plant at Austin, Tex., operated by the International concern. The potash-bearing solution remaining after removal of the magnesium chloride will be returned to the potash refinery, and the potassium salts previously wasted will be recovered. The magnesium chloride plant was under construction in 1942.

At the Potash Company of America plant an additional 2,400-horsepower Diesel engine was recently installed. Late in 1942 a 5-year contract was reported to have been concluded between the company and the City of Carlsbad, whereby the city would drill a well and supply water to a point near the Bataan Bridge over Pecos River. The company will pump the water to its mine for domestic and industrial uses formerly supplied by tank haulage.

One effect of the war is the loss to the company of cocoanut-oil soap, its principal flotation agent and previously imported, but satisfactory substitutes are said to have been developed. The company electrolytic plant was inactive for part of the year.

Utah.—In Utah three types of potash occurrences are being exploited—potassium-bearing brines, hydrothermal deposits of the potassium sulfate alunite, and bedded deposits of the potassium chlorides carnallite and sylvite. Only the first type is in commercial production, but the alunite deposits are being developed intensively, and the bedded chloride deposits are being tested.

Bonneville, Ltd. (540 West Seventh South, Salt Lake City), only potash producer in Utah in 1942, is obtaining potassium chloride from the potassium-bearing brine that saturates the thin, crystalline salt mass of Salduro Marsh, near the western edge of former Lake Bonneville in the Great Salt Lake Desert in northwestern Utah. The company output has increased each year since it began operating in 1938. Production was nearly 25 percent greater in 1942 than in 1941.

Interest in the alunite (a hydrous basic potassium aluminum sulfate) deposits of the Marysvale district, Piute County, has revived, particularly with regard to the aluminum content rather than the potassium content, which was considered more important during the First World War. Both vein and replacement alunite deposits occur. The vein deposits lie in Alunite Ridge between the forks of Cottonwood Creek. The replacement deposits are more numerous and are distributed much more widely. Total reserves of both types exceed 11 million tons of pure alunite, of which the vein deposits account for only 1,336,600 tons.[7] Mining operations in the Marysvale district in 1942 were concentrated at the White Horse mine (a replacement-type deposit) northeast of Marysvale, where an open-pit mine is being developed by Kalunite, Inc., Marysvale. Operations in 1942 comprised development work, preparation of the mine and crushing plant for production, road construction, completion of a bridge over Sevier River, and erection of buildings at the mine. The alunite ore will be sent to Salt Lake City for processing. None was treated in 1942, except in the laboratory. A plant to obtain alumina and potassium sulfate from alunite was being erected in 1942 in Salt Lake City. The Kalunite process to be used in this plant consists in (1) dehydrating the alunite, driving off the water of crystallization and then dissolving the product in dilute cyclic sulfuric acid and potassium sulfate solutions to form potash alum; (2) autoclaving the potash alum to a hydrous basic potassium aluminum sulfate; (3) calcining this sulfate to drive off sulfur oxides, thereby producing a mechanical mixture of alumina and potassium sulfate; and (4) leaching this soluble potassium sulfate from the insoluble alumina.

The Bureau of Mines carried out exploratory work (diamond drilling, trenching, test pitting, and sampling) on alunite deposits in the

[7] Thoenen, J. R., Alunite Resources of the United States: Bureau of Mines Rept. of Investigations 3561, 1941, 48 pp.

vicinity of Marysvale in 1942 and early in 1943 but temporarily suspended it February 25, 1943. The work, which was done on the Mineral Products, Yellow Jacket, Close In, White Horse, and Winkleman claims, indicated a large tonnage of alunite.

A study of the beneficiation of the replacement (disseminated) alunites from this region is included in a report by Gabriel and Dasher.[8]

In the Grand County potash field of eastern Utah in 1942 a well—known as Defense Plant Corporation-Utah Magnesium Corporation Reeder No. 1—was core-drilled by the Bureau of Mines with the cooperation of the Geological Survey, as agents for the financing Defense Plant Corporation, in the SE¼SW¼SE¼ sec. 4, T. 22 S., R. 19 E., about 7½ miles west-southwest of Thompson on the Denver & Rio Grande Railroad and about 1½ miles south of Crescent Junction. Material was moved on location May 1, 1942, and the well was spudded in on May 6 and completed August 3, 1942, at 4,207 feet.

The well is within the narrow, complexly strike-faulted zone along the crest of the long northwest-trending Salt Valley anticline, here plunging northwestward under Cretaceous cover. It started[9] in the Cretaceous Mancos shale and bottomed in the Paradox formation of the Pennsylvanian (Carboniferous). The well shows an abnormal geologic section, possibly due to an upthrust of the plastic salt-bearing Paradox formation into the fault zone. About 3,000 feet of sediments of Jurassic, Triassic, Permian, and Pennsylvanian age, normally expected to be present in this well, are missing. The Paradox formation extended from 2,091 feet to the bottom of the well. The section between 3,318 and 3,588 feet contained 91.6 feet of carnallite with an average assay of 39.5 percent carnallite. Individual carnallite beds were 1 foot to 13.5 feet thick and assayed 10 to 80 percent carnallite. There were two sylvite sections, the first extending from 3,419 to 3,518 feet, with 42 feet of sylvite averaging 24 percent sylvite, and the second from 4,152 to 4,157.5 feet and containing 5.5 feet of sylvite with an average of 41.3 percent of the mineral.

The normal thickess of neither the salt series nor the potash beds in this region is known. The salt core shows folding, flowage, and widely varying abnormal dips of the salt, as would be expected in squeezed and upthrust plastic salt beds. The wells of the district give no definite proof of the thickness or potassium content of the undisturbed saline beds of the region and little information as to their extent and distribution within the fault zone.

Late in 1942 the Potash Company of America (Carlsbad, N. Mex.) entered into a prospecting agreement with the Utah Magnesium Corporation, whereby the former is to drill a number of deep wells and to prospect the holdings of the latter company near Crescent Junction on which the above Defense Plant Corporation well was drilled.

FOREIGN TRADE[10]

The latest published information regarding United States exports and imports of potash salts in 1941 (chapter of Minerals Yearbook, 1941) covered only the period from January to September. In this chapter, figures for the full year 1941 as well as for the year 1942 are given.

[8] Gabriel, Alton, and Dasher, John, Beneficiation of Alunite: Bureau of Mines Rept. of Investigations 3610, 1942, 20 pp.

[9] Bureau of Mines, Thompson Magnesium Well, Grand County, Utah: War Minerals Report 12, 1942, 39 pp., 6 figs.

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

Imports.—The United States, formerly a large potash-importing nation, now imports only a few thousand tons of potash salts annually under World War conditions. In 1941—the first year in which domestic production of potash exceeded national demand—imports had fallen to 62,255 short tons. In 1942 they dropped to 21,328 tons.

Late in February 1943 the Alien Property Custodian announced the vesting in him (Vesting Order 929, February 22, 1943) of all outstanding capital stock of the German-owned Pioneer Potash Co. This company had been incorporated in the United States to import and sell potash of German origin following the dissolution and liquidation of the N. V. Potash Export My., Inc., at the outbreak of war between France and Germany. The stock of the Pioneer Potash Co. was registered in the name of and was owned by N. V. tot Financiering van Industrieele Ondernemeingen Finindo, a corporation organized under the laws of the Netherlands, all of whose issued and outstanding capital stock is owned by Verrekeningskantoor ("Leata"), a Netherlands corporation of Amsterdam, Holland. All the issued and outstanding capital stock of this company is owned by the Deutsches Kalisyndicat G. b. m. H. (German potash trust).

Details as to the quantity, average grade, and declared value of the various potash salts imported into the United States in 1941 and 1942, and the approximate K_2O equivalent of the imports, are shown in the following tables.

Potash materials imported for consumption in the United States, 1941–42

Material	Approximate equivalent as potash (K_2O) (percent)	1941				1942			
		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:									
Muriate (chloride)	56.4	14,671	8,274	52.3	$296,367	1,564	882	20.2	$40,195
Potassium-sodium nitrate mixtures, crude	14.0	34,541	4,836	30.6	725,846	14,272	1,998	45.9	377,703
Other potash fertilizer material [1]	60.0	125	75	.5	1,714	59	35	.8	889
Total fertilizer		49,337	13,185	83.4	1,023,927	15,895	2,915	66.9	418,787
Used chiefly in chemical industries:									
Bicarbonate	46.0					1,309	602		52,794
Bitartrate:									
Argols	20.0	12,680	2,536		4,606,751	4,051	810		1,701,901
Cream of tartar	25.0	22	6		14,427	(2)	(2)		1
Carbonate	61.0	5	3		1,235				
Caustic	80.0	12	10		4,284	(2)	(2)		1
Chlorate and perchlorate	36.0	139	50	16.6	46,232	35	13	33.1	8,733
Ferricyanide (red prussiate)	42.0	(2)	(2)		360	(2)	(2)		158
Iodide	28.0	(2)	(2)		14				
Nitrate, refined	46.0	(2)	(2)		130	(2)	(2)		1
Permanganate	29.0	13	4		4,352				
All other	50.0	47	24		25,186	38	19		21,085
Total chemical		12,918	2,633	16.6	4,702,971	5,433	1,444	33.1	1,784,674
Grand total		62,255	15,818	100.0	5,726,898	21,328	4,359	100.0	2,203,461

[1] Chiefly wood ashes from Canada.
[2] Less than 1 ton.

Potash materials imported for consumption in the United States, 1941–42, by countries, in short tons

[Figures in parentheses in column headings indicate, in percent, approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (56.4)	Bitartrate		Caustic (80)	Carbonate (61)	Potassium-sodium nitrate mixtures, crude (14)	Chlorate and perchlorate (36)	All other [1]	Total	
		Argols or wine lees (20)	Cream of tartar (25)						Short tons	Value
1941										
Algeria		816							816	$329,200
Argentina		3,747							3,747	1,154,142
Brazil		136							136	56,264
Canada	16	15					2	125	158	11,563
Chile		341	17			34,541	14		34,913	845,011
China					3			5	8	2,183
France							31		31	2,870
Germany							2		2	704
Hong Kong					2				2	503
Japan							62	13	75	38,001
Mexico		35							35	336
Morocco		815							815	400,877
Palestine	1,000								1,000	28,058
Peru		18							18	3,226
Portugal		3,264							3,264	1,463,069
Spain	13,655	3,493	5						17,153	1,357,011
Sweden				12			6		18	5,123
Switzerland							22		22	4,887
United Kingdom								42	42	23,870
	14,671	12,680	22	12	5	34,541	139	185	62,255	5,726,898
1942										
Algeria		1,403							1,403	830,716
Argentina		1,042							1,042	195,521
Brazil		247							247	156,435
Canada	7	29	[2]	[2]			2	63	101	18,463
Chile		242				14,272		[2]	14,514	437,475
Mexico		22							22	1,471
Morocco (French)		626							626	224,382
Netherlands								1	1	335
Peru		3							3	1,491
Portugal		249							249	119,701
Spain		188							188	96,561
Switzerland							33		33	7,722
U. S. S. R.	1,557								1,557	39,816
United Kingdom [3]								1,342	1,342	73,372
	1,564	4,051	[2]	[2]		14,272	35	1,406	21,328	2,203,461

[1] Approximate equivalent as potash (K_2O)—1941: 55 percent; 1942: 47 percent.
[2] Less than 1 ton.
[3] United Kingdom of Great Britain and Northern Ireland.

Exports.—Substantial quantities of potash-bearing materials were exported from the United States even in former years when this country was a large importer of potash. Japan was the principal buyer in 1939 but was exceeded by Canada in 1940 and 1941. In 1942, 81 percent of the total exports of potash-bearing materials went to Canada.

Reinstated in this chapter is a table of exports by countries, omitted from the 1941 chapter for reasons of censorship.

Details regarding the exports of certain potassium-bearing fertilizer materials, by countries and by four subclasses, became available in the latter half of 1941. Such figures for 1942 are shown in a succeeding table.

Potash materials exported from the United States, 1938–42

Year	Fertilizer		Chemical		Year	Fertilizer		Chemical	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1938	84,137	$2,599,772	2,616	$485,672	1941	91,950	$2,592,697	12,883	$2,972,137
1939	136,750	4,446,853	3,579	807,987	1942	84,402	2,184,044	13,306	3,611,294
1940	93,060	3,141,170	14,180	3,096,909					

Potash materials exported from the United States in 1942, by countries, in short tons

Country	Fertilizers				
	Chloride	Sulfate	Potassic fertilizer materials [1]	Other	Total
Argentina	268	(2)		1	269
Australia	(2)	28			28
Bahamas				15	15
Barbados	1,331				1,331
Brazil	(2)	1		224	225
Canada	32,795	5,475	15,478	22,414	76,162
Colombia		544			544
Cuba	1,942	1,396	1,859	114	5,311
Mexico	46	25		106	177
Mozambique	45				45
Panama				100	100
Union of South Africa	23				23
U. S. S. R.		157			157
Other countries	6	7		2	15
Total: Short tons	36,456	7,633	17,337	22,976	84,402
Value	$1,189,979	$349,468	$344,683	$299,914	$2,184,044

Country	Chemicals							
	Potassium iodides	Bichromate and chromate	Hydroxide (caustic potash)	Acetate and mixtures	Bicarbonate and mixtures	Carbonate and mixtures	Bitartrate and mixtures	Chlorate and mixtures
Argentina	4	253	408		(2)	147	21	4
Australia	1	50	650		1	662		114
Brazil	14	137	102		(2)	15	1	59
Canada	2	208	1,305		10	207	47	1
Chile	(2)	55	35		(2)	25		11
Colombia	8	17	3		(2)	26	4	55
Cuba	5	1	7	1	(2)	1	3	82
Egypt	(2)	111	83			8	2	76
India [3]	3	64	121		(2)	(2)	3	499
Mexico	9	190	247		2	78	1	423
Netherlands Indies	(2)	43	(2)			9	(2)	1
New Zealand	(2)	22	18		1	3	(2)	71
Union of South Africa	4	63	34			4	(2)	(2)
U. S. S. R.			42	1				
United Kingdom [4]			129			932		
Uruguay	2	36	40			3	(2)	(2)
Venezuela	5	11	19			1	5	2
Other countries	19	31	211		4	49	15	89
Total: Short tons	76	1,292	3,454	2	18	2,170	102	1,487
Value	$222,362	$317,799	$546,202	$1,644	$7,343	$313,889	$120,884	$920,405

See footnotes at end of table.

Potash materials exported from the United States in 1942, by countries, in short tons—Continued

Country	Chemicals—Continued							
	Chromium sulfate (chrome alum)	Cyanide and mixtures	Nitrate and mixtures	Perchlorate and mixtures	Permanganate and mixtures	Rochelle salts	Other	Total
Argentina	6	19	110		1	1	56	1,030
Australia	2	1	2		6		9	1,498
Brazil	2	22	880		6	2	38	1,278
Canada	4	4	987	(2)	63	50	433	3,321
Chile	10	2	(2)		2	1	94	235
Colombia	6	(2)	82		1	2	4	208
Cuba	2	(2)	10		2	8	20	142
Egypt	1	(2)	(2)			2	2	285
India [3]		11	(2)				32	733
Mexico	3	8	206		3	8	40	1,218
Netherlands Indies	1						1	55
New Zealand						(2)	1	116
Union of South Africa	(2)	(2)	(2)		2		47	154
U. S. S. R.	(2)		959				111	1,113
United Kingdom [4]			(2)			25	9	1,095
Uruguay	7	2	7		(2)	(2)	4	101
Venezuela	(2)	(2)	55		1	2	5	106
Other countries	10	2	111		16	2	59	618
Total: Short tons	54	71	3,409	(2)	103	103	965	13,306
Value	$16,767	$42,454	$511,892	$567	$64,820	$96,138	$428,128	$3,611,294

[1] Containing 27 percent or more potassium oxide (K_2O) equivalent, n. e. s., (25 percent K_2O content equivalent basis).
[2] Less than 1 ton.
[3] India and Dependencies (British India).
[4] United Kingdom of Great Britain and Northern Ireland.

Potash materials exported from the United States, 1941–42, by countries

Country	Fertilizers				Chemicals			
	1941		1942		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	172	$10,292	269	(1)	815	$183,724	1,030	(1)
Australia			28	(1)	1,198	194,354	1,498	(1)
Barbados	3,970	151,695	1,331	(1)			(2)	(1)
Brazil	2,693	115,038	225	(1)	909	271,434	1,278	(1)
Canada	48,721	1,203,628	76,162	(1)	3,688	517,350	3,321	(1)
Chile	2	136	1	(1)	220	77,515	235	(1)
Colombia			544	(1)	230	96,761	208	(1)
Cuba	4,047	125,309	5,311	(1)	87	45,621	142	(1)
Egypt			(2)	(1)	443	102,877	285	(1)
India [3]	150	10,410			474	160,969	733	(1)
Japan	25,075	673,028			1	250		
Mexico	73	2,998	177	(1)	588	169,651	1,218	(1)
Netherlands Indies	821	31,176			261	108,119	55	(1)
New Zealand	1,458	75,749	(2)	(1)	60	19,532	116	(1)
Philippine Islands	1,806	64,395			166	84,537		
Union of South Africa	790	39,946	23	(1)	433	114,610	154	(1)
U. S. S. R.			157	(1)			1,113	(1)
United Kingdom [4]	594	23,961			1,810	319,406	1,095	(1)
Uruguay	3	227	2	(1)	42	11,273	101	(1)
Venezuela	10	669			61	20,381	106	(1)
Other countries	1,565	64,040	172	(1)	1,397	473,773	618	(1)
	91,950	2,592,697	84,402	$2,184,044	12,883	2,972,137	13,306	$3,611,294

[1] Data not yet compiled on annual basis.
[2] Less than 1 ton.
[3] India and Dependencies (British India).
[4] United Kingdom of Great Britain and Northern Ireland.

WORLD PRODUCTION

Little information is available regarding the production of potash in foreign countries during recent years—for 1942, only figures for the United States, and for 1941, only those for the United States and Palestine. Since publication of the world-production table in Minerals Yearbook, 1941, a few additional figures for earlier years have become available; they are shown in the accompanying table.

Four nations dominate the world potash industry—Germany, United States, Soviet Russia, and Spain. Germany, now as heretofore, the dominant producer of western Europe as well as of the world, has bettered its position by the acquisition of the French and Polish potash industries and now holds all the important potash deposits of the western part of Europe except those of Spain. Soviet Russia, with its large reserves in the Solikamsk region, controls the potash industry of eastern Europe. In the Western Hemisphere the United States is by far the largest and almost the only potash producer. Its annual production, in terms of equivalent potash (K_2O), in 1942 exceeded the latest known K_2O output (1938) of France, at that time probably the second-largest producer in the world. The United States probably was the second-largest world producer in 1942; however, the relative position of the U. S. S. R. cannot be determined as statistics of its production are not available.

World production of potash minerals and equivalent K_2O, 1938–42, by countries, in metric tons[1]

[Compiled by B. B. Waldbauer]

Country and mineral[1]	1938		1939		1940		1941		1942	
	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	485,291	287,532	496,007	283,223	597,150	344,437	894,895	476,156	1,149,810	616,162
South America: Chile, crude potassium nitrate	(2)	(2)	(2)	(2)	62,208	8,585	(2)	(2)	(2)	(2)
Europe:										
France (Alsace), crude potassium salts	3,374,811	581,790	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Germany, crude potassium salts:										
Carnallite[3]	1,874,375	1,861,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Kainite, sylvinite, and hartsalz	14,567,896									
Italy, alunite	2,778	333	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Poland, crude potassium salts:										
Kainite	120,100	12,010	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Sylvite	427,200	93,984	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Langbeinite	19,644	2,358	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Spain, crude potassium salts	[4] 49,572	(2)	143,393	(2)	291,373	(2)	(2)	(2)	(2)	(2)
U. S. S. R., crude potassium salts	(2)	[5] 122,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Asia:										
China, potash	[6] 14	(2)	[6] 4	(2)	3,317	(2)	(2)	(2)	(2)	(2)
Chosen, alunite	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
India (British), nitrate of potash	[5] 8,200	[5] 4,000	8,697	4,175	(2)	(2)	(2)	(2)	(2)	(2)
Palestine, crude potassium salts[7]	58,118	29,059	[8] 63,527	31,764	88,961	(2)	101,681	(2)	(2)	(2)
Africa: Eritrea, niccoli salts[9]	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Australia, alunite	445	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)

[1] In addition to countries listed Iran is reported to produce a small quantity of potash salts, but statistics of production are not available.
[2] Data not available.
[3] Includes some natural kieserite.
[4] Salable.
[5] Estimated production (Imperial Institute, London).
[6] Exports of potassium carbonate.
[7] Extracted from waters of Dead Sea.
[8] Exports.
[9] Extracted from waters of Red Sea.

MICA

By G. Richards Gwinn and K. G. Warner

SUMMARY OUTLINE

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Total consumption of block and sheet mica	1467	World production	1474
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SUMMARY

Production of all kinds of mica except splittings increased in 1942. Although the over-all increase of sheet and punch (4 percent over 1941) was not as great as expected in view of the intense stimulation exercised to supply growing war needs, the quantity of the better grades increased substantially.

In June 1942, the Colonial Mica Corporation, a nonprofit organization, was designated by the Metals Reserve Co. as its agent to purchase strategic mica for the war industries, and in December 1942 this corporation was designated as the sole buyer of domestic strategic mica.

Splittings, which are used in a great variety of built-up mica products, are imported chiefly from India, although small quantities have been split mechanically in the United States, and an increasing quantity has been imported from Mexico. The Mexican splittings consist chiefly of Indian block mica re-exported to Mexico, where cheap labor is available for the manufacturing process.

The accompanying table of salient statistics gives the outstanding features of the mica industry during the past 5 years.

Approximately 65 percent of the total quantity of good-stained and better grades, sizes 5, 5½, and 6, are used for military radio condensers and magnetos, and up to the present time it has not been shown that lower than good-stained can be used in these products.

Stocks of good-stained and better mica on hand December 31, 1942, were sufficient for 8½ months at the average rate of consumption during 1942. A break-down by sizes and qualities, however, shows that although the supply of grades poorer than good-stained is ample, the supply of good-stained and better grade of sizes 5, 5½, and 6 is not keeping pace with consumption. However, in the event of a critical situation it would be possible, though uneconomical, to use the larger sizes instead of the smaller to relieve the shortage.

Salient statistics of the mica industry in the United States, 1938–42

	1938	1939	1940	1941	1942
Domestic mica sold or used by producers:					
Total uncut sheet and punch:					
Pounds	939,507	813,708	1,625,437	2,666,453	2,761,844
Value	$139,333	$138,963	$291,685	$566,858	$725,030
Average per pound	$0.15	$0.17	$0.18	$0.21	$0.26
Scrap:[1]					
Short tons	20,257	24,672	22,386	32,500	43,262
Value	$256,382	$311,895	$314,565	$442,789	$671,165
Average per ton	$12.66	$12.64	$14.05	$13.62	$15.51
Total sheet and scrap:[1]					
Short tons	20,727	25,079	23,199	33,833	44,643
Value	$395,715	$450,858	$606,250	$1,009,647	$1,396,195
Total ground:[1]					
Short tons	27,086	30,924	27,984	43,419	46,979
Value	$924,554	$1,156,333	$1,016,628	$1,532,351	$1,653,358
Consumption of splittings:[2]					
Pounds	1,667,806	3,423,044	4,918,861	7,297,628	6,636,639
Value	$612,465	$1,089,683	$1,725,522	$2,832,939	$2,835,421
Imports for consumption:					
Total uncut sheet and punch:					
Pounds	391,125	902,598	1,534,188	2,016,852	3,244,857
Value	$113,403	$271,072	$576,565	$1,119,584	$2,136,797
Scrap:					
Short tons	4,450	4,279	3,061	1,251	2,179
Value	$28,590	$29,493	$22,611	$12,791	$25,879
Total sheet and scrap:					
Short tons	4,646	4,730	3,828	2,259	3,801
Value	$141,993	$300,565	$599,176	$1,132,375	$2,162,676
Manufactured:					
Short tons	1,115	1,550	3,860	6,041	7,479
Value	$522,426	$758,745	$1,884,952	$3,282,656	$6,882,199
Total imports:					
Short tons	5,761	6,280	7,688	8,300	11,280
Value	$664,419	$1,059,310	$2,484,128	$4,415,031	$9,044,875
Exports (all classes of mica):					
Short tons	1,772	1,827	903	1,163	1,001
Value	$183,889	$226,364	$191,550	$280,810	$303,526

[1] Includes mica recovered from kaolin and mica schists, as follows: 1938, 6,550 tons, $86,602; 1939, 10,011 tons, $108,899; 1940, 9,674 tons, $138,148; 1941, 15,583 tons, $185,486; 1942, 20,481 tons, $315,807.
[2] Exclusive of a nominal quantity of splittings produced in the United States and South America.

DOMESTIC PRODUCTION

Sheet mica.—Production in the United States increased to 2,761,844 pounds in 1942, valued at $725,030, compared with 2,666,453 pounds, valued at $566,858 in 1941. Eighty-eight percent of this, or 2,425,645 pounds, valued at $282,900, consisted of punch mica.

North Carolina, the largest producer in the United States, supplied 60 percent of the total punch and 61 percent of the larger sheet in 1942, compared with 61 and 54 percent, respectively, in 1941; and although this represents an advance in production, it failed to meet expectations.

South Dakota, which produced a large quantity of sheet and punch mica in 1941, increased its output in 1942 and became the second-largest producing State with an output of 399,224 pounds, valued at $75,687. Production in both Connecticut and New Hampshire declined in 1942.

The change in preparation from half-trim to three-quarter or full-trim of a large part of the mica produced had an important bearing on the increase in output. Because of better preparation, the yield per pound to the consumer was higher in 1942 than in any previous year. The increase in amount of usable mica per pound received was large enough so that although the quantity produced in New Hamp-

shire and Connecticut decreased, the value of the material was greater than in any previous year.

Mica sold or used by producers in the United States, 1930–42

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
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	665,755	39,207	147,953	99,756	813,708	138,963	24,672	311,895	25,079	450,858
1940	1,405,305	116,087	220,132	175,598	1,625,437	291,685	22,386	314,565	23,199	606,250
1941:										
Connecticut	157,816	11,135	95,009	118,761	252,825	129,896	201	3,983	327	133,879
New Hampshire	368,794	36,172	26,113	28,932	394,907	65,104	171	3,700	369	68,804
North Carolina	1,440,349	124,355	174,514	194,428	1,614,863	318,783	18,234	268,596	19,041	587,379
South Dakota	285,888	28,589	12,805	9,336	298,693	37,925	1,611	27,616	1,760	65,541
Other States [2]	89,390	6,696	15,775	8,454	105,165	15,150	12,283	138,894	12,336	154,044
	2,342,237	206,947	324,216	359,911	2,666,453	566,858	32,500	442,789	33,833	1,009,647
1942:										
Connecticut	196,377	14,231	25,106	16,570	221,483	30,801	200	4,443	311	35,244
New Hampshire	290,288	26,320	52,651	31,675	342,939	57,995	303	7,234	474	65,229
North Carolina	1,451,340	180,904	203,555	324,730	1,654,895	505,634	24,145	485,560	24,972	991,194
South Dakota	363,909	39,845	35,315	35,842	399,224	75,687	2,545	44,579	2,745	120,266
Other States [2]	123,731	21,600	19,572	33,313	143,303	54,913	16,069	129,349	16,141	184,262
	2,425,645	282,900	336,199	442,130	2,761,844	725,030	43,262	671,165	44,643	1,396,195

[1] Includes small quantities of splittings in certain years.
[2] 1941: Alabama, Arizona, California, Colorado, Georgia, Maine, New Mexico, New York, Pennsylvania, South Carolina, Vermont, Virginia, and Wyoming. 1942: Alabama, California, Colorado, Georgia, Idaho, Maine, Massachusetts, New Mexico, South Carolina, Texas, Vermont, and Virginia.

Scrap mica.—Production of scrap mica increased to 43,262 short tons valued at $671,165, compared with 32,500 tons valued at $442,789 in 1941. Besides mine scrap, this tonnage included mica recovered from washing kaolin or kyanite or by milling schist, which amounted to 20,481 short tons valued at $315,807, compared with 15,583 tons valued at $185,486 in 1941.

Ground mica.—Production of ground mica in 1942 reached 46,979 short tons valued at $1,653,358, compared with 43,419 tons valued at $1,532,351 in 1941.

Production of wet-ground mica decreased. Most of this is used in war materials, such as paints, protective coatings on tents and tarpaulins, plastics, and welding rods.

Dry-ground mica, which constitutes about 77 percent of all ground mica, is used chiefly in the roofing trade as a backing for rolled asphalt roofing and shingles to prevent sticking and, often, as a decorative surfacing for these materials. A small proportion of the finely ground material may be incorporated into the body of the roofing itself. Ground phlogopite mica is used as an ingredient in certain types of molded electrical insulation, in which it is bonded with natural or synthetic resins, gums, asphalts, rubber, silicate cements, or lead borate.

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The history of the scrap- and ground-mica industries over a series of years is indicated in figure 1.

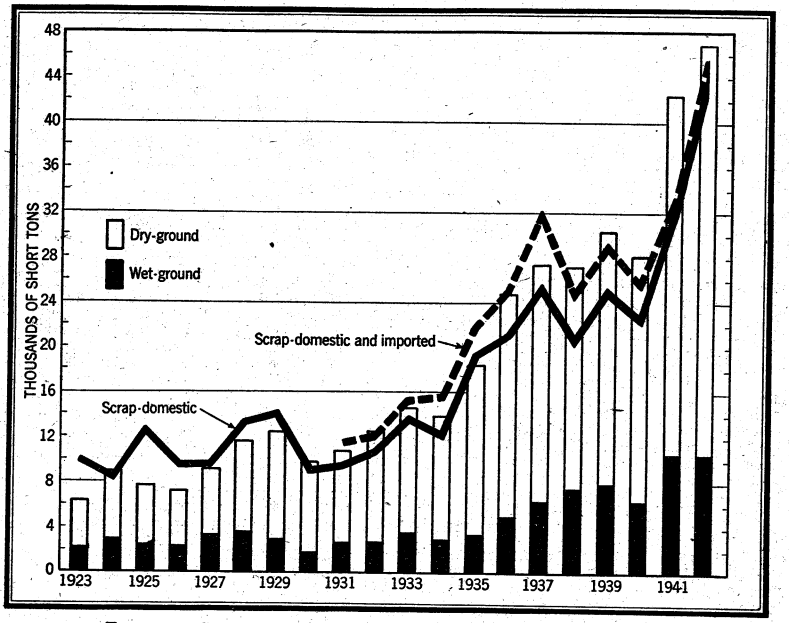

FIGURE 1.—Scrap and ground mica sold in the United States, 1923–42.

Ground mica sold by producers in the United States, 1938–42, by methods of grinding

Year	Dry-ground [1]		Wet-ground		Total [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	31,914	733,559	[1] 11,505	[1] 798,792	43,419	1,532,351
1942	36,369	805,163	10,610	848,195	46,979	1,653,358

[1] Includes mica from kaolin and schists; some from sericite schist included in wet-ground in 1941.

Ground mica sold by producers in the United States to various industries, 1941–42

Industry	1941			1942		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Roofing [1]	25,178	58	$498,946	28,342	60	$561,205
Wallpaper	3,219	8	256,067	2,168	5	168,178
Rubber	3,476	8	223,182	1,754	4	115,563
Paint	4,020	9	253,294	6,819	14	418,548
Miscellaneous [2]	7,526	17	300,862	7,896	17	389,864
	43,419	100	1,532,351	46,979	100	1,653,358

[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, and other purposes.

TOTAL CONSUMPTION OF BLOCK AND SHEET MICA

Government stimulation of domestic production and imports began to function efficiently in 1942. Monthly statistics of consumption and stocks of specific grades of block mica were first collected by the Bureau of Mines for July 1940.

Almost all strategic mica is consumed in the production of aircraft and tank magnetos, spark plugs, military radios, and sound-detection equipment.

Urgently needed strategic grades of Indian mica have been im-

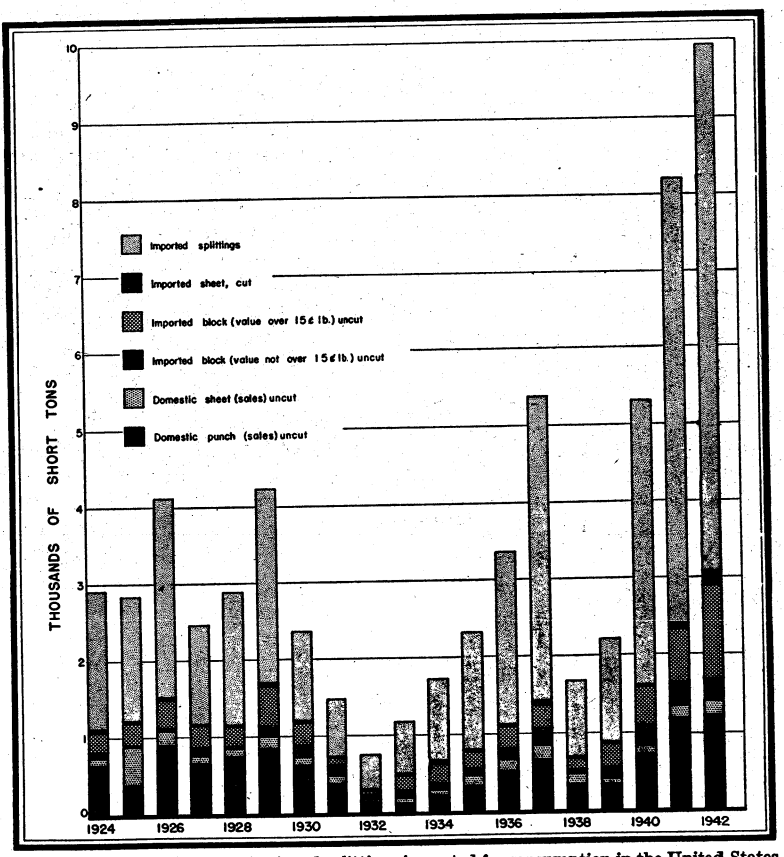

FIGURE 2.—Block and sheet mica (cut) and splittings imported for consumption in the United States, and sales of domestic sheet and punch mica, 1924–42.

ported by air since September 1942. Conservation orders and shortages of materials for commodities that were manufactured chiefly for civilian consumption curtailed the demand for splittings and enabled industry and the Government to accumulate adequate stock piles of muscovite and phlogopite splittings.

In 1942, as in 1941, condenser mica was in greatest demand; and as demand outgrew production and import of the better grades, the quality of the mica allocated for this use was lowered to include good-stained material.

Figure 2 summarizes graphically the situation with respect to imports and domestic production. As reported by the Mica-Graphite

Division of the War Production Board, good-stained and better comprise about 60 percent of all imports, and sizes 5, 5½, and 6 of both imported and domestic material are in greatest demand. Stocks of good-stained and better at the end of the year were sufficient for 8½ months at the average rate of consumption in 1942, although stocks of specific size groups ranged from 11 to only 2.8 months' supply. Domestic production furnished approximately one-tenth of the total new supply for the year of good-stained and better and one-eighth of all qualities. However, with the improvement in trimming, as well as increase in production, it is expected that the percentage of the total supply furnished by domestic production will increase.

MICA SPLITTINGS

Consumption of splittings fell below the record high of 1941, and Government stocks increased from 4,928,000 pounds on January 1, 1942, to 11,374,000 pounds by the end of the year. Industrial stocks remained relatively constant although slightly below the 1941 level. The decline in total consumption of splittings, which began in the third quarter of 1941, continued through the first quarter of 1942. However, beginning with the second quarter of 1942 and throughout the rest of the year the consumption of splittings, muscovite and amber combined, increased. Consumption of amber splittings alone reached a peak in the second quarter of the year and then declined gradually throughout the rest of the year, whereas the consumption of muscovite splittings increased in each quarter.

Grade 6 loose splittings, which are produced in three qualities—first, second, and third—constituted 81 percent of the total consumption of muscovite splittings during the fourth quarter of 1942. In the corresponding quarter of 1941 this size made up 80 percent of the total. Nearly equal amounts of first- and third-quality splittings were consumed, but consumption of No. 2 quality was greater than that of Nos. 1 and 3.

Consumption and stocks of mica splittings in the United States, 1938–42, by sources, as reported by the consumers

Year	India		Canada		Madagascar		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption: [1]								
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
1941	6,473,459	2,334,432	179,783	131,350	644,386	367,157	7,297,628	2,832,939
1942	5,998,614	2,415,709	117,295	79,752	520,730	339,960	6,636,639	2,835,421
Stocks in consumers' hands Dec. 31:								
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
1941	9,212,891	3,434,336	115,529	81,988	223,235	134,143	9,551,655	3,650,467
1942	8,202,240	3,367,788	257,591	178,082	321,529	201,274	8,781,360	3,747,144

[1] Exclusive of a nominal quantity of splittings produced in the United States and South America.

Before 1942, production of splittings in the Western Hemisphere was confined largely to phlogopite splittings produced by hand in Canada and small quantities of phlogopite imported from Canada and

split mechanically in the United States. However, in 1942 splittings were produced in Mexico from block mica, most of which originated in India and Brazil.

The table of imports for consumption in 1942 includes 6,720 pounds of splittings imported from Japan. This is part of a shipment received in the foreign-trade zone at Staten Island in 1940

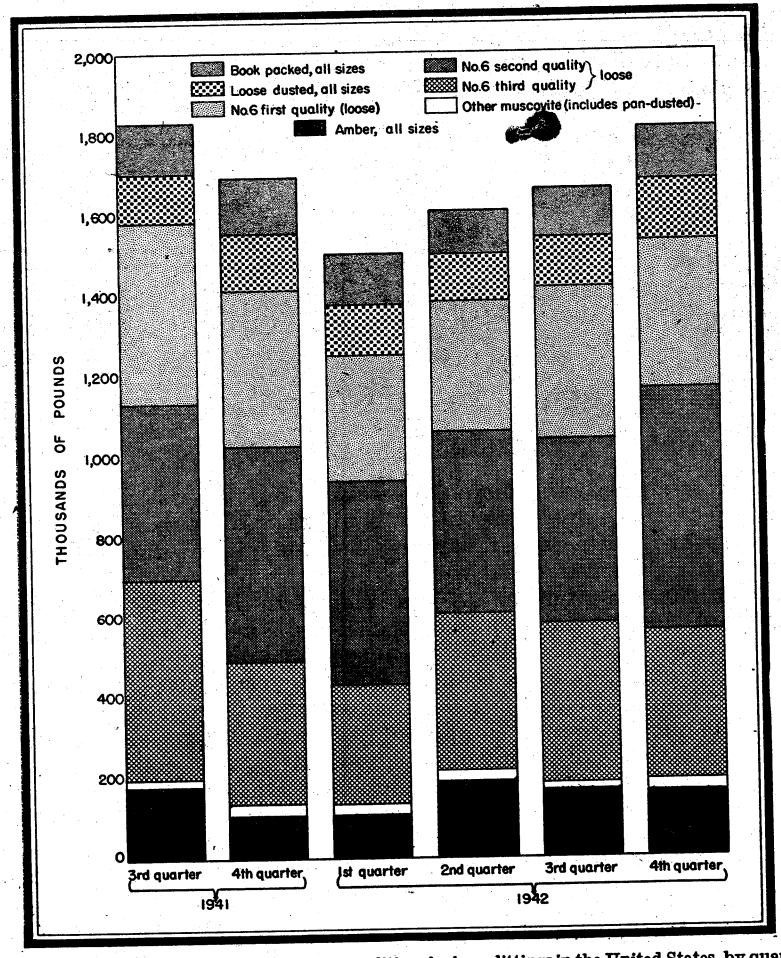

FIGURE 3.—Consumption of specified sizes and qualities of mica splittings in the United States, by quarters, July 1941 to December 1942.

and remained there. The 6,720 pounds represent that portion of the shipment released to the industry in March 1942.

The new 1942 supply was more than enough to meet requirements for the year. Stocks held at the end of 1942 by the Government and industry were adequate for about 3 years at the 1942 rate of domestic consumption. Consumption of splittings from July 1941 through December 1942 is summarized graphically, on a quarterly basis, in figure 3.

BUILT-UP MICA

Curtailment in the manufacture of electrical appliances and other consumers' durable goods, together with restrictions imposed on mica through conservation orders, caused the demand for built-up products to decline in the latter half of 1941 and the first quarter of 1942. However, as production of military equipment increased, demand for this material rose, particularly for making certain electric-generator and motor parts in which it is the standard irreplaceable insulating material. Consumption of built-up mica, therefore, began to increase after the first quarter and continued to do so during the remainder of the year.

Built-up mica produced in the United States, 1941–42, by kinds of product[1]

Product	1941		1942	
	Pounds	Value	Pounds	Value
Molding plate	1,874,000	$1,854,000	1,599,000	$1,552,000
Segment plate	2,317,000	2,599,000	2,045,000	2,367,000
Heater plate	539,000	789,000	212,000	303,000
Flexible (cold)	706,000	754,000	649,000	743,000
All other (tape, etc.)	1,199,000	2,089,000	1,628,000	2,794,000
	6,635,000	8,085,000	6,133,000	7,759,000

[1] Partly estimated.

POSSIBLE SUBSTITUTES

Every effort is being made to conserve our supplies of high-grade sheet mica by stipulating use of the smallest possible sizes, by requiring use of lower qualities wherever possible, by minimizing spoilage and wastage, and by finding substitutes.

Under rules established by the American Institute of Electrical Engineers, mica is not required in class "A" insulation but has been used to a considerable extent because of a greater margin of safety with particular reference to heat and fire resistance. In induction motors, varnished cloth has been substituted for mica, and a cloth-base, phenolic, laminated compound has been substituted as insulation between the decks of strip-wound commutating field coils. Such substitutes may serve in particular applications as indicated, but a substitute for the high-grade mica now required in certain types of military equipment has not been found. Several promising new materials are in process of development, and although each has characteristics similar to those of mica, none possesses the particular combination of characteristics enjoyed by mica. The War Production Board estimates that substitutes, when and if they are fully developed and approved by the Armed Services, may replace 10 to 15 percent of the mica now required in certain fields. However, none of the substitutes for high-grade mica have yet passed the laboratory stage.

PRICES

Mica is marketed in a confusing variety of sizes (grades) and classes (qualities) ranging in value from a fraction of a cent a pound for small, stained, imperfect flakes or scrap to over $20 a pound for exceptionally large, flat, clear, crystal sheets. Not only does marketable mica vary greatly in size, from small punch to 8 by 10 inches and larger, but for each grade there are at least nine different qualities, ranging from clear to black-stained.

Prices for Indian mica were raised because of increasing cost of insurance and ocean transportation. Prices for domestic punch and circle mica were increased in an effort to stimulate domestic production. These two classes were chosen on the theory that since they represented the bulk-line product, an increase in the price of these classes would afford the maximum encouragement to miners. However, this was not satisfactory because the value of the other sizes increased and that of punch and circle mica remained stationary.

The Colonial Mica Corporation, agent for the Metals Reserve Co., then set up a schedule of prices they would pay miners for strategic grades of mica. Mica thus purchased was allocated to processors and manufacturers at the current market price. To get the maximum amount of strategic material, this corporation also bought nonstrategic mica or assisted miners in marketing this low-grade material.

The price scale on which Colonial Mica purchased strategic mica was a base price only. Mica poorer than No. 1 grade was subject to a discount from this scale, the exact amount of which depended on the judgment of Colonial Mica Corporation buyers. The base price was revised several times during the year.

It was hoped that production of nonstrategic grades of mica would increase with increase in strategic grades, but most miners brought in only the highest-price material, leaving the lower-grade sheet, punch, and scrap on the mine dumps. Therefore, on November 19, 1942, new maximum prices for nonstrategic punch and sheet mica were issued by the Office of Price Administration under Order No. 141, section 3 (b), of the General Maximum Price Regulation. They ranged from 12 cents a pound for punch to $2 per pound for sheet mica 6 by 8 inches. This step failed to remedy matters, which became so acute by January 1943 that several mica grinders were forced to close their plants temporarily. A meeting of industrialists and representatives from the Office of Price Administration was called by the War Production Board, and the scale of prices for nonstrategic grades of mica was revised in an effort to relieve the fast-developing shortage. The new scale was released on March 20, 1943, by the Office of Price Administration. Nonstrategic punch and sheet mica, scrap mica, and crude mica schist were removed from price control. The maximum price of domestic ground mica, mica schist, water-washed mica, and micronized mica was raised $5 per short ton.

Trade-journal quotations and average sales value of domestic uncut sheet mica per pound in 1942

Size	Trade-journal quotations [1]		Average value [2]	
	Dec. 18, 1941	Dec. 3, 1942	Clear	Stained or spotted
Punch	$0.10–$0.15	$0.15–$0.20	$0.141	$0.091
1½ by 2 inches	.45– .65	.75– 1.00	1.044	.885
2 by 2 inches	.60– .85	1.50– 1.75	1.615	.514
2 by 3 inches	1.30– 1.50	2.50– 2.75	2.445	.767
3 by 3 inches	1.90– 2.05	2.75– 3.50	2.978	.922
3 by 4 inches	2.15– 2.25	3.75– 4.25	3.575	1.196
3 by 5 inches	2.60– 2.75	4.75– 5.00	4.180	1.511
4 by 6 inches	3.60– 3.70	5.75– 6.25	5.205	1.688
6 by 8 inches	5.25– 6.00	6.50– 8.00	7.119	2.891
8 by 10 inches	8.50– 9.50	9.50–10.50	13.466	4.757

[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 35 percent discount.
[2] Calculated from reports of 1942 sales by domestic producers to the Bureau of Mines.

Recommended selling prices of domestic uncut sheet mica per pound by the Colonial Mica Corporation, 1942 [1]

[Prices per pound, packed, ex warehouses]

Size	Grade	No. 1			No. 2			No. 3 (BS)
		Full kt.	¾ kt.	½ kt.	Full kt.	¾ kt.	½ kt.	½ kt.
Punch								$0.12
1 by 1½ inches				$0.80			$0.45	.18
1½ by 2½ inches	No. 6	$0.80	$0.65		$0.55	$0.40		
Circle	No. 5½	1.80	1.45		.90	.70		
1½ by 2 inches	No. 5	2.40	1.90	1.20	1.50	1.15	.90	.25
2 by 2 inches				2.00			1.50	.45
2 by 3 inches	No. 4	4.30	3.20	2.50	2.75	2.05	1.85	.60
3 by 3 inches	No. 3	5.00	3.75	2.75	3.15	2.50	2.00	.75
3 by 4 inches				3.25			2.50	1.00
3 by 5 inches	No. 2	5.80	4.60	4.00	4.00	3.25	3.00	1.30
4 by 6 inches	No. 1	7.50	6.00	5.50	4.80	4.00	4.10	1.60
	No. A-1	9.00	7.50		6.00	5.00		
6 by 8 inches	Special	12.00	9.00	7.00	7.75	6.00	5.25	2.00

[1] Data from War Production Board, Mica-Graphite Division, Mica Release 5, November 14, 1942.

FOREIGN TRADE [1]

Imports.—In 1942, total imports of all kinds of mica increased to 11,280 short tons valued at $9,044,875, compared with 8,300 tons valued at $4,415,031 in 1941. This was spread over all grades of mica. Waste and scrap phlogopite imports nearly doubled, and those of untrimmed phlogopite increased 41 percent. The higher grades of sheet mica also increased substantially. Further details on imports, by kinds and sources of origin, may be found in the following tables.

Exports.—Exports of both unmanufactured and manufactured mica were lower in 1942 than 1941, owing to greater requirements of our war industries and the shortage of shipping space.

Mica imported for consumption in the United States in 1942, 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, 10 percent)		Other			
	Phlogopite (duty, 15 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									230,030	$148,575
Argentina							242,688	$26,180	359,646	212,323
Bolivia									2,910	3,245
Brazil							237,221	29,749	966,502	627,101
Canada	4,357,536	$25,879			232,431	$32,799	72,521	9,222	118,302	86,629
Chile									516	1,158
Guatemala							233	33	809	418
India and Dependencies							25,982	3,473	720,024	945,116
Mexico							4,515	666	5,564	1,804
Peru							12,157	1,222	2,497	1,367
United Kingdom [1]									10,309	5,717
Total: 1942	4,357,536	25,879			232,431	32,799	595,317	70,545	2,417,109	2,033,453
1941	2,434,080	12,452	67,383	$339	164,870	21,904	473,749	60,363	1,378,233	1,037,317

[1] United Kingdom of Great Britain and Northern Ireland.

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

Mica imported for consumption in the United States in 1942, 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:								
Gold Coast					11,325	$29,445	11,325	$29,445
Madagascar	651,764	$192,540					651,764	192,540
Bolivia			119	$127			119	127
Brazil			71,629	33,184	389,587	1,015,236	461,216	1,048,420
Canada	114,574	82,318	300	170	117	478	114,991	966
Chile			79	206			79	206
Guatemala	228	154					228	154
India and Dependencies	10,228,470	2,995,872	1,884,105	1,208,737	110,236	286,234	12,222,811	4,490,843
Japan			6,720	2,225			6,720	2,225
Mexico	121,117	71,345	11,073	21,391			132,190	92,736
Nigeria			1,600	50			1,600	50
United Kingdom [1]	5,430	6,941	500	788			5,930	7,729
Total: 1942	11,121,583	3,349,170	1,976,125	1,266,878	511,265	1,331,393	13,608,973	5,947,441
1941	11,140,588	2,681,563	534,069	432,141	14,810	39,272	11,689,467	3,152,976

Country	Manufactured—Cut or stamped to dimensions, shape, or form (duty, 40 percent)		Manufactured—Other					
			Mica plates and built-up mica (duty, 40 percent)		All manufactures of which mica is the component material of chief value (duty, 40 percent)		Ground or pulverized (duty, 15 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	39,631	$99,992	1,488	$514				
Canada	4,355	8,797			285	$556	934,645	$7,598
Guatemala	621	494						
India and Dependencies	355,834	809,912	82	879	2,400	898		
United Kingdom [1]			8,604	5,118				
Total: 1942	400,441	919,195	10,174	6,511	2,685	1,454	934,645	7,598
1941	161,751	106,164	27,874	13,866	4,850	7,025	197,750	2,625

[1] United Kingdom of Great Britain and Northern Ireland.

Mica and manufactures of mica exported from the United States in 1942, by countries

Country	Unmanufactured		Manufactured			
			Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Canada	400,268	$4,270	737,675	$29,064	99,956	$184,210
Cuba			17,148	861	2,973	1,199
Mexico			15,025	913	28,979	9,856
Other North America			152	23	1,724	4,879
South America:						
Argentina			31,598	1,233	837	3,997
Brazil			400	21	5,978	9,417
Chile					2,881	5,633
Venezuela			350,000	8,997	232	299
Other South America			6,000	282	750	1,770
Europe:						
U. S. S. R.					3,416	6,926
United Kingdom [1]			198,360	6,520		

[1] United Kingdom of Great Britain and Northern Ireland.

Mica and manufactures of mica exported from the United States in 1942, by countries—Continued

Country	Unmanufactured		Manufactured			
			Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
Asia:						
China					3,006	$9,839
India and Dependencies			40,000	$900	1,540	1,827
Netherlands Indies			24,200	1,160	1,030	1,891
Other Asia					12	114
Africa			24,500	736	1,376	2,877
Oceania					2,224	3,812
Total: 1942	400,268	$4,270	1,445,058	50,710	156,914	248,546
1941	432,775	5,141	1,759,176	56,207	134,932	219,462

WORLD PRODUCTION

Aside from India, where the military situation and transport are the chief problems and their future status is unpredictable, our foreign supplies have come largely from Brazil. New sources are being developed, and particular efforts are being made to expedite production in India and Brazil. The Board of Economic Warfare has sent specialists and engineers to the other Americas in search of new deposits and to advise local producers on mining and preparation of mica for marketing. The following table shows world production by countries from 1937 to 1942 so far as statistics are available.

World production of mica, 1937–42, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
North America:						
Canada (sales)	857	470	969	819	1,582	1,857
Mexico (exports)	(2)	(2)	(2)	39	36	44
United States (sold or used by producers) [3]	23,626	18,803	22,751	21,046	30,693	40,499
South America:						
Argentina	[4] 225	[4] 250	[4] 298	[4] 442	[5] 550	[6] 441
Bolivia (exports)	9	4	----------	1	3	3
Brazil (exports)	330	521	435	1,117	867	866
Peru	5	24	9	4	8	10
Europe:						
Italy	24	122	(2)	(2)	(2)	(2)
Norway (exports)	42	104	25	(2)	(2)	(2)
Rumania	27	22	18	(2)	(2)	(2)
Sweden	68	131	126	(2)	(2)	(2)
Asia:						
Ceylon (exports)	1	(7)	(7)	2	(2)	(2)
Chosen	[5] 70	(2)	(2)	(2)	(2)	(2)
India, British (exports)	15,106	8,896	10,104	[8] 7,067	[8] 11,521	14,398
Africa:						
Madagascar	583	677	(2)	531	479	(2)
Nigeria	----------	3	(2)	(2)	(2)	(2)
Portuguese East Africa	----------	----------	17	(2)	(2)	(2)
Rhodesia:						
Northern	4	4	2	(2)	(2)	(2)
Southern	17	13	6	(2)	(2)	(2)
Tanganyika Territory	71	37	36	10	(2)	(2)
Union of South Africa: Transvaal	1,740	1,116	972	1,252	[9] 920	[9] 1,062
Oceania:						
Australia:						
Northern Territory	42	52	32	35	26	(2)
South Australia	43	17	56	70	(2)	(2)
Western Australia	----------	----------	(7)	1	(2)	(2)
New Zealand	(2)	(2)	1	----------	(2)	(2)

[1] In addition to the countries listed, mica is also produced in Australia (Queensland and New South Wales), Eritrea, Kenya, and U. S. S. R., but data on production are not available.
[2] Data not available.
[3] Includes following quantities recovered from kaolin and schists: 1937, 9,558 tons; 1938, 5,942 tons; 1939, 9,082 tons; 1940, 8,776 tons; 1941, 14,137 tons; 1942, 18,580 tons.
[4] Rail and river shipments. [5] Official estimate. [6] Exports. [7] Less than 1 ton.
[8] Fiscal year ended March 31 of year following year stated. [9] January to October, inclusive.

Argentina.—All of the mica produced is muscovite and is classified as 80 percent stained and 20 percent clear. However, only about 5 percent is clear mica by Indian standards of grading. The United States and the United Kingdom of Great Britain and Northern Ireland received all exports of mica from Argentina in 1942. In 1940 and 1941, Japan, Germany, and Italy imported large amounts of Argentina mica. Japan took all classes and grades, but Germany and Italy imported only the stained and better grades. A large proportion of the Italian quota in 1941 was sent to that country by airplane; it has been reported that the ship carrying most of the German imports for 1941 was intercepted by the British.

Australia.—Production has been limited almost entirely to muscovite from deposits in Northern Territory. Small quantities for grinding have been produced in Queensland, New South Wales, South Australia, and Western Australia. Most of the splittings come from India, although there is a small domestic splittings industry. In 1941 the Minister of Trade and Customs acquired all mica produced in Northern Territory, and in 1942 control and distribution of mica passed to the Comptroller of Mineral Products. Prices are fixed by the Commonwealth Price Commission. Consumption of clear and slightly stained mica increased in 1942, and it was necessary to import mica to satisfy domestic demands.

Brazil.—Mica comes chiefly from eastern Minas Gerais, although a small quantity of good-quality material also is mined in Baía and São Paulo. Mining methods are primitive, and considerable effort has been made to increase production by applying more efficient methods of mining and transportation. In 1942 Brazil exported 866 metric tons of mica, of which the United States received 776 tons and the United Kingdom the remainder.

Canada.—Canada, which has been one of the two important world sources of phlogopite mica, entered the field of muscovite producers in 1942. Extensive deposits of white mica have been found near Eau Claire, Nipissing County, Ontario.

Arrangements have been completed between the United States and Canada for the Colonial Mica Corporation of New York to act as sole buyer of the strategic grades of mica from these properties. The production of phlogopite mica was essentially the same as in 1941.

Ceylon.—Here the right to mine mica is sold by authorized Government agents, and the areas must be approved by the Government mineralogist. Charges for mining are to be 5 percent of the value of the mica removed. The entire output for 1942 was bought by the British Ministry of Supply for use by the United Nations Joint Mica Commission.

India.—India is the most important producer of strategic mica (muscovite sheet and splittings), supplying about 75 percent of total world production of this grade. The producing areas are concentrated chiefly in the eastern part of the country, although a few small phlogopite deposits in the Travancore district of southwestern India are being developed.

Indian block mica has been shipped chiefly to the United Kingdom and the United States, the two countries at times having taken three-fourths of the total of such exports even before the war. Japan bought heavily from India up to 1940, when an unofficial but effective embargo was placed against such shipments. It is believed that

a large portion of Japanese purchases was for reshipment to Italy and Germany. During the first quarter of 1941 only enough low-grade mica was shipped to Japan to prevent official protests, and in July 1941 the embargo, still not announced, again went into effect. At the same time restrictions on shipments of mica to the United States were relaxed to the extent of omitting inspection of shipments at the mine, which simplified procedure and provided for quicker and more efficient handling.

Exports of mica from India in 1942 (which are the only available measure of production), as reported by the Bureau of Foreign and Domestic Commerce, were 14,398 metric tons, of which 13,155 tons were block and splittings and the remaining 1,243 tons consisted of ground, scrap, or waste. The United States received 5,451 metric tons of the Indian production, the United Kingdom of Great Britain and Northern Ireland 8,809 tons, and Australia and the other Allied Nations the remaining 138 tons.

Madagascar.—Madagascar continued as the largest source of strategic phlogopite mica, but the United States received imports only in March and April. The principal deposits are in the extreme south end of the island. However, because of adequate stocks and restricted use, there was mica enough of this type to satisfy present requirements and to maintain an adequate stock pile.

Mexico.—Mica has been produced in Mexico for only a relatively short time, although the existence of deposits has been known for a long time. Most of the deposits are of the phlogopite variety, although some biotite and muscovite also have been found. Production for the latter half of 1942, the only period for which statistics are available, was 44 metric tons of phlogopite, all of which was exported to the United States.

New Zealand.—Muscovite-mica deposits of considerable size were discovered in south Westland (west coast of the South Island) at an altitude of 4,000 to 5,000 feet. Samples were of excellent quality, and access roads are being constructed, as there is an assured though small domestic market for the finished product.

Peru.—Mica is the youngest mining enterprise in Peru, where deposits have been found along the Pacific coast and have been developed in an area 14 miles long by 7 miles wide. It has been estimated that with present mining equipment, plus access roads and trucks, 20 tons of trimmed mica can be produced monthly.

Portugal.—Production in Portugal is mainly scrap mica from numerous small deposits and a small amount of good-quality amber sheet mica in small sizes. The estimated annual production is 350 short tons of scrap and 40 tons of amber sheet.

U. S. S. R.—Information on production of mica in the U. S. S. R. is very meager. Production statistics have not been available since 1935. Deposits are widely distributed and have been found in Archangel (Karelia), on the Kola Peninsula, in the Volyn provinces on the Black Sea coast, in the Urals, and in Siberia. The Siberian deposits in the Mama River district, the northern Baikal region, and Transbaikalia are said to furnish the major portion of the muscovite production. It is estimated that the Soviet Republic produces enough mica to meet its requirements.

SALT

By F. E. Harris and K. G. Warner

SUMMARY OUTLINE

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SUMMARY

Salt has contributed substantially to the war program; and, as might be expected with intensification of the war, a high record of production was attained in 1942, although the increase over 1941 was not nearly so great as that of 1941 over 1940. Gains occurred in all three types of salt output, the greatest being in salt of brine—9 percent; output of rock salt gained 7 percent and evaporated salt 6 percent. The increase in total salt was 8 percent. Demands of the chemical industry and for the manufacture of magnesium metal caused the largest increases in output of salt in 1942.

Salient statistics of the salt industry in the United States, 1935–39 (average) and 1940–42

	1935–39 (average)	1940	1941	1942
Sold or used by producers:				
Manufactured (evaporated)—short tons	2,507,374	2,782,741	3,330,106	3,517,832
In brine—do	4,205,587	5,311,671	6,771,436	7,373,165
Rock salt—do	1,947,254	2,265,548	2,619,087	2,802,287
Total:				
Short tons	8,660,215	10,359,960	12,720,629	13,693,284
Value [1]	$23,405,612	$26,474,619	$33,620,376	$38,144,234
Average per ton [1]	$2.70	$2.56	$2.64	$2.79
Imports for consumption:				
For curing fish—short tons	[2] 21,250	[2] 12,965	7,426	[2] 6,434
Value	[2] $43,722	[2] $25,174	$30,058	[2] $17,667
In bags, barrels, etc.—short tons	1,385	1,024	1,110	367
Value	$11,813	$6,601	$12,156	$4,138
In bulk—short tons	24,131	16,413	6,896	953
Value	$55,876	$59,029	$17,021	$7,496
Total:				
Short tons	46,766	30,402	15,432	7,754
Value	$111,411	$90,804	$59,235	$29,301
Exports:				
Short tons	90,214	147,044	123,195	118,424
Value	$521,652	$699,340	$807,925	$892,160
Apparent consumption [3]—short tons	8,616,767	10,243,318	12,612,866	13,582,614

[1] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.
[2] Includes salt in bags, sacks, barrels, or other packages—1938: 93 tons valued at $673; 1940: 6 tons, $12; 1942; 122 tons, $1,200.
[3] Quantity sold or used by producers plus imports minus exports.

Of the dry salt produced in the decade 1932–42, evaporated salt has averaged 56 percent and rock salt 44 percent of the annual totals, the proportions having been maintained rather consistently throughout the period.

Increased demand was experienced not only by the largest producers but also by many of the smaller operators, who reported active demand throughout the year. Wage increases ranged from 10 to 50 percent. No strikes were reported, but labor was scarce, particularly in the less-populated areas. Cost of material was reported to be high; in one locality the price of bags increased 300 percent. Many operators, particularly the smaller, stated that rising wages and costs of materials handicapped their business, inasmuch as the selling price was unchanged. Several plants closed, temporarily at least, the time of reopening to depend on the ability to obtain labor and on the selling price.

PRODUCTION

Salt was produced in 86 plants of 64 companies in 1942, operating in 14 States and Puerto Rico, compared with 83 plants of 65 companies in 1941. Of these plants, 66 produced evaporated salt and 20 rock salt; 11 of the plants in 7 States produced all the brine.

The International Salt Co. leads in rock-salt production as well as in total dry salt output. Morton Salt Co. leads in output of evaporated salt and is second in total dry salt production. Leslie Salt Co. is the largest producer of solar salt. Morton Salt Co. has some rock-salt interests, and International Salt Co. also produces some evaporated salt.

States.—Michigan again led in total production of salt as well as in output of the evaporated type, and New York led in rock-salt production; together, these States supplied 49 percent of the Nation's output of commercial salt. Grouped as a section, the Middle West (Kansas, Michigan, and Ohio) supplied 55 percent.

Salt sold or used by producers in the United States, 1940–42, by States

State	1940			1941			1942		
	Quantity		Value	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total	
California	469,354	4	$2,200,640	484,632	4	$2,290,265	546,320	4	$2,494,485
Kansas	684,053	7	2,710,847	781,014	6	3,254,828	860,083	6	3,809,321
Louisiana	1,132,594	11	2,804,406	1,242,242	10	3,251,492	1,332,129	10	3,381,856
Michigan	2,863,035	28	7,479,905	3,620,649	29	10,975,872	3,946,591	29	12,583,964
New Mexico	13,915	(1)	41,573	16,641	(1)	51,514	13,956	(1)	47,265
New York	2,117,671	20	6,523,775	2,719,586	21	7,416,734	2,722,670	20	8,158,147
Ohio	2,080,133	20	2,781,599	2,510,096	20	3,367,544	2,711,188	20	3,864,588
Oklahoma	(2)	(2)	(2)	10,743	(1)	42,737	8,305	(1)	35,132
Puerto Rico	11,724	(1)	62,645	14,444	(1)	72,220	18,198	(1)	103,071
Texas	402,165	4	792,214	656,569	5	1,713,508	821,111	6	2,202,527
Utah	71,472	1	191,263	107,079	1	196,413	110,871	1	290,040
West Virginia	144,312	1	701,953	143,780	1	792,104	140,216	1	822,794
Other States [3]	369,532	4	183,799	413,154	3	195,145	461,646	3	351,044
	10,359,960	100	26,474,619	12,720,629	100	33,620,376	13,693,284	100	38,144,234

[1] Less than 0.5 percent.
[2] Included under "Other States."
[3] 1940: Colorado, Oklahoma, and Virginia; 1941: Colorado and Virginia; 1942: Colorado, Nevada, and Virginia.

Methods of manufacture.—As in the past, the salt was obtained from natural brine of wells and ponds, by forcing water into salt beds and withdrawing it as brine, from sea water, and from bedded deposits that are mined. Salt is evaporated by several methods, as given in the accompanying table.

Salt sold or used by producers in the United States, 1941–42, by methods of manufacture

Method of manufacture	1941		1942	
	Short tons	Value	Short tons	Value
Evaporated:				
Bulk:				
Open pans or grainers	501,236	$4,100,293	500,758	$4,607,104
Vacuum pans	2,192,142	12,596,983	2,234,633	13,916,501
Solar	454,397	1,577,740	542,087	2,238,604
Pressed blocks	182,331	1,505,040	240,354	2,228,062
Rock:				
Bulk	2,562,386	8,300,562	2,734,797	9,054,447
Pressed blocks	56,701	461,265	67,490	569,014
Salt in brine (sold or used as such)	6,771,436	5,078,493	7,373,165	5,530,502
	12,720,629	33,620,376	13,693,284	38,144,234

Rock salt.—The output of rock salt came from 20 plants in 8 States, chiefly New York, Louisiana, Kansas, Michigan, and Texas, in order of output; California, New Mexico, and Utah also produced.

Rock salt sold by producers in the United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	1,901,861	$6,252,081	1941	2,619,087	$8,761,827
1939	2,035,157	6,496,807	1942	2,802,287	9,623,461
1940	2,265,548	7,384,839			

Evaporated salt.—Sixty-six plants in 13 States and Puerto Rico supplied evaporated salt, as given in the accompanying table, compared with 61 plants in 12 States and Puerto Rico in 1941.

Evaporated salt sold or used by producers in the United States, 1941–42, by States

State	1941		1942	
	Short tons	Value	Short tons	Value
California	455,038	$2,171,889	463,357	$2,286,815
Kansas	279,115	2,119,917	335,188	2,628,892
Louisiana	38,138	294,558	62,825	460,919
Michigan [1]	1,129,714	6,027,100	1,154,732	6,846,862
New York	438,451	4,006,454	425,216	4,355,825
Ohio	481,364	2,817,183	464,841	3,413,416
Oklahoma	10,743	42,737	8,305	35,132
Puerto Rico	14,444	72,220	18,198	103,071
Texas	232,643	1,190,684	304,403	1,584,008
Utah	99,426	172,954	103,334	256,124
West Virginia [1]	143,780	792,104	140,216	822,794
Other States [2]	7,250	72,256	37,217	196,413
	3,330,106	19,780,056	3,517,832	22,990,271

[1] Includes a quantity of salt contained in brine for chemical use reported as evaporated salt with value as evaporated salt.
[2] 1941: Colorado and New Mexico; 1942: Colorado, Nevada, and New Mexico.

Pressed blocks.—Hydraulically compressed blocks from both evaporated and rock salt totaled 307,844 short tons valued at $2,797,076 in 1942. They were produced by 8 rock-salt and 20 evaporated-salt plants.

Some of the blocks for domestic consumption contain small amounts of chemicals for their medicinal value. Blocks of iodized salt are produced for conditioning cattle, although the demand for salt of this type is not nearly so great as for those to which sulfur and other chemicals have been added. Some of the blocks contain potassium. At one of the potash mines where salt is a byproduct sold to another company for distribution, some of the salt, which contains about 20 percent potash, is made into blocks simply by pouring a strong brine over a boxful of the salt, which has been ground to ¼-inch mesh and under. When dry the blocks are too hard to be broken by hand, although they will disintegrate when out of the boxes and exposed to weathering and must be sold in the containers.

Pressed-salt blocks sold by original producers of the salt in the United States, 1938–42

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1941	182,331	1,505,040	56,701	461,265	239,032	1,966,305
1942	240,354	2,228,062	67,490	569,014	307,844	2,797,076

Salt content of brine.—Salt in brine produced at 11 plants in various parts of the country increased from 6,771,436 short tons in 1941 to 7,373,165 tons in 1942. Most of the brine was used as the source of basic chemicals. The Federal Reserve Board index for chemicals rose from 137 in 1941 to 173 in 1942.

STOCKS, SEASONAL DEMANDS, AND CAPACITY FOR PRODUCTION OF COMMERCIAL SALT

In general practice, salt producers do not attempt to keep large stocks on hand. However, the practice varies somewhat according to the types of salt sold.

Most evaporated salt is shipped as rapidly as it is refined and packed. The plants have bins only to accommodate near-future requirements to guard against temporary delays from interruptions in their plants. At those evaporated-salt plants where storage is provided, it is reported that the bins have a capacity of only 1,000 to 6,000 tons, which may represent requirements for only 4 or 5 days, or at the most a month's supply.

A notable exception is the storehouses on the shore of Lake Michigan, where several plants stock their salt in the winter awaiting water transportation. Here the supply may total 10,000 to 40,000 tons of evaporated salt stored during the off-peak shipping season.

Solar salt presents a somewhat different problem. Here the salt necessarily must be stored in great piles in the open. For climatic reasons, solar salt is harvested from ponds chiefly in the last 3 months

of the year. The salt, stacked in huge piles, the steep sides of which become crusted and impervious to rain, represent 9 to 11 months' supply.

Rock-salt producers find that the best and cheapest way to store salt is in the ground, and surface stocks are virtually nonexistent. Therefore, at most mines the salt either is shipped out as rapidly as it is mined, crushed, and screened, or "finished," or it is blasted down in a room in the mine and left there until needed above ground. Such underground piles may be enough for 6 to 8 months' supply. One of the mines that normally in the past had about 35,000 tons of various grades shipped the salt in 1942 as mined. Surface bins are merely for loading, and the salt may be in them only 4 or 5 days or less. One operator that "stores" in the mine has loading bins of about 1,000 tons, which is less than a day's production. Exceptionally small bins of 100 to 250 tons capacity are maintained to store various sizes of the screened rock salt to satisfy demands for sizes not being made currently.

In the matter of seasonal demands, most salt producers say that in the second half of the year the demand for both evaporated and rock salt is heavier than in the first half. Some have slightly higher demands in the spring and fall but not enough to affect their supplies appreciably.

A Bureau of Mines study reveals that plant capacity for rock-salt production totals about 5,200,000 tons and for evaporated salt about 4,400,000 tons. Therefore, it is evident that in 1942 the rock-salt facilities operated at 54 percent and evaporated salt at 80 percent of capacity. (These capacities are predicated on well-ordered production systems and do not make allowance for idleness during break-downs, delays in obtaining critical materials for repairs, or other causes.)

Theoretically it is easier to expand the capacity for rock salt than that for evaporated salt, as it becomes chiefly a matter of how speedily the loose material can be hoisted to the surface.

In some solar salt playas and marshes there is an unlimited supply of crude salt that requires only loading. Most of these, however, are not near marketing centers or shipping points, and the transportation makes a commodity costly that is very cheap at the source.

RESOURCES

Fortunately for the United States, when it is involved in a war that depends so much on chemicals in one form or another, the country has an inexhaustible supply of salt and a well-established chemical industry.

The Middle West has huge underground stores of salt within three of its States. Kansas has many millions of tons in reserve. Michigan has deposits in three separate sections; wells annually supply thousands of tons of strong salt brine, and in addition there are rock-salt mines. Ohio has no rock-salt mines, but it apparently has a plentiful salt supply although the brine raised is not as strong as that of Michigan.

The Pacific coast depends largely on the ocean, and therefore its supplies of solar salt are unlimited. Additional resources in California are the desert playas and rock-salt deposits.

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In the South the huge domes of almost pure salt in Louisiana and Texas can supply requirements for a long time. The domes usually range from 1.2 to more than 2 miles in diameter and are thousands of feet in thickness.

The East, although not destitute of salt, is the least fortunate of all sections of the United States. New York, the leading source, has large deposits of rock salt that yield mined salt and brine for making chemicals and evaporated salt after recrystallization. However, these sources are about 200 miles inland. In the past the eastern seaboard has obtained salt from Canada and the West Indies; but, with difficulties in shipping because of the war, imports from these former sources have dwindled in the past few years. The western part of Virginia has supplies of natural brine, which is used solely for the manufacture of chemicals. West Virginia has resources of brine from which it produces evaporated salt.

Some States have large deposits of good salt, but economic conditions do not favor their development. For instance, New Mexico has numerous salt deposits but only a few small, scattered plants to supply local demands. Enormous reserves are present, but no large-scale consuming industries are near enough to encourage development.

DISTRIBUTION AND CONSUMPTION

Although the figures in the accompanying table cover original shipments from the producers and do not show reshipments, they indicate approximate salt consumption in the various States.

Distribution (shipments) of evaporated and rock salt in the United States, 1941–42, by States of destination, in short tons

Destination	1941		1942	
	Evaporated	Rock	Evaporated	Rock
Alabama	7,613	32,790	8,432	58,835
Arizona	10,350	3,031	11,814	2,673
Arkansas	9,262	26,968	8,011	28,144
California	275,417	29,594	277,696	54,578
Colorado	29,086	12,774	39,535	23,349
Connecticut	16,574	6,796	16,020	7,239
Delaware	4,599	23,655	3,921	11,361
District of Columbia	5,517	1,511	5,361	2,060
Florida	6,243	24,389	7,618	25,601
Georgia	19,145	50,647	17,766	55,541
Idaho	11,181	1,398	13,949	1,653
Illinois	259,413	163,994	257,710	184,395
Indiana	80,798	58,066	90,534	61,002
Iowa	98,653	88,771	116,022	99,564
Kansas	39,225	211,447	51,543	175,486
Kentucky	38,195	17,654	38,036	29,673
Louisiana	4,833	71,012	5,670	76,972
Maine	10,212	31,476	11,484	40,123
Maryland	29,977	26,277	29,399	28,795
Massachusetts	64,006	43,266	58,101	52,712
Michigan	356,194	60,201	384,960	54,219
Minnesota	114,029	66,290	120,752	66,255
Mississippi	2,624	31,493	3,559	32,447
Missouri	76,748	51,991	79,429	65,553
Montana	17,537	6,494	20,608	6,692
Nebraska	30,112	46,171	45,832	51,129
Nevada	3,948	316	43,569	29,000
New Hampshire	8,544	34,330	9,260	41,273
New Jersey	83,200	161,044	84,366	153,887
New Mexico	7,974	17,548	9,746	14,146
New York	228,127	449,549	204,361	429,375
North Carolina	49,257	55,740	53,326	53,561

Distribution (shipments) of evaporated and rock salt in the United States, 1941-42, by States of destination, in short tons—Continued

Destination	1941		1942	
	Evaporated	Rock	Evaporated	Rock
North Dakota	13,225	4,116	11,594	5,110
Ohio	201,234	82,333	216,898	95,172
Oklahoma	35,080	33,671	33,312	36,422
Oregon	29,354	123	29,684	120
Pennsylvania	156,657	111,306	150,806	101,980
Rhode Island	11,760	10,789	10,071	10,472
South Carolina	8,584	17,673	8,513	22,519
South Dakota	16,209	11,483	19,688	12,480
Tennessee	22,558	47,547	26,631	49,086
Texas	244,055	166,452	315,777	189,759
Utah	14,902	3,218	22,135	3,316
Vermont	5,722	7,663	4,982	8,675
Virginia	57,585	50,120	52,544	63,790
Washington	116,187	538	125,528	941
West Virginia	171,727	60,980	167,864	75,171
Wisconsin	132,958	25,743	129,307	26,553
Wyoming	6,763	1,768	7,755	2,073
Other [1]	86,953	76,881	56,353	81,355
	3,330,106	2,619,087	3,517,832	2,802,287

[1] Includes production of Puerto Rico (evaporated salt); exports to Africa, Asia, Canada, Central America, Mexico, Newfoundland, South America, West Indies, and other countries; shipments to Alaska, Hawaii, Puerto Rico, and Virgin Islands; and some shipments to unspecified destinations.

Salt shipped to noncontiguous Territories of the United States, 1941–42

Territory	1941		1942	
	Short tons	Value	Short tons	Value
Alaska	5,929	$103,455	4,829	$94,646
Hawaii	2,909	78,996	2,668	109,222
Puerto Rico	1,629	50,046	1,004	34,100
Virgin Islands	32	1,775	53	3,562

Consumption trends have changed in the last few years, owing in part to the shift of consumers from one center to another and in part to the establishment of entirely new centers of consumption. The average annual shipments for 1931–36 show that New York received the largest total of dry salt of the two types; Illinois was next in receipts, followed by California, Michigan, Texas, and Kansas. In the evaporated-salt market, Illinois received the largest average annual total in 1931–36, followed by California, Michigan, New York, Texas, and Kansas. In rock-salt receipts, New York led, followed by Illinois, Kansas, Texas, Michigan, and California.

USES

Our first full year of war witnessed an increased use of salt for all the war purposes discussed in the chapter on Salt in Minerals Yearbook, 1941; and in addition there were a few new and modified uses, both military and civilian.

Less salt was used for industrial meat packing in 1942 than in 1941, chiefly because of greater demand for canned instead of salt-treated meat for camps at home and overseas. Also, more meat was packed and canned on the farms in 1942. Although canning requires less salt than packing, about 10,000 tons more salt were used in industrial

canning. Home canning of various products made greater demands also, as evidenced by the large increase in table salt and other household uses.

Chemicals were made not only from brine but from thousands of tons of "dry" salt as well. Chemicals from salt have long been used in many medicines, and recent uses include the groups of sulfa and vitamin drugs.

Both elements of salt are used in many of our war materials, as exemplified by the following: Both sodium and chlorine are needed in making tetra-ethyl lead for high-octane gasoline, production of which increased enormously in 1942. Sodium and chlorine are being used increasingly for synthetic-rubber manufacture. Many dyestuffs require both. Cotton linters for smokeless powder are treated with chlorine for bleaching and sodium for purifying. The cleaning and degreasing of metal tools, parts, and shells require both elements.

Fighting in the hot jungles has created a new application for salt and derivatives thereof. Chlorine is an effective spray for eliminating mosquitoes and other jungle insects. The men fighting in the tropics are supplied with salt tablets to combat heat cramps caused by loss of salt through perspiration. Also, Navy regulations provide for salt to be supplied to the men on ships, needed by men not only when in tropical waters but when working below decks in the hot engine rooms.

As a result of wartime requirements, chlorine output in 1942 was greater than it has ever been; even with the curtailment of civilian supplies, it exceeded the 1941 output by more than 30 percent. Because of lack of steel containers in which chlorine is "packaged" and tank cars to transport it, the chemical cannot be stocked ahead of the demand, and the suppliers must keep a watchful eye on requirements and prompt return of the containers.

Salt sold or used by producers in the United States, 1941–42, by classes and uses, in short tons

Use	1941			1942		
	Evaporated	Rock	Brine	Evaporated	Rock	Brine
Chlorine, bleaches, chlorates, etc	[1] 710,013	619,489	496,128	843,970	704,227	654,686
Soda ash	1,500		6,226,821	218	20	6,670,621
Dyes and organic chemicals	[1] 91,052	37,798		78,752	44,485	
Soap (precipitant)	35,196	17,086		28,118	13,360	
Other chemicals	61,924	218,570	[2]	60,849	254,198	[2]
Textile processing	63,523	75,744		41,535	77,189	
Hides and leather	[3] 79,063	[3] 139,041		118,976	182,650	
Meat packing	[3] 422,017	[3] 409,241		426,976	322,938	
Fish curing	34,939	6,363		28,908	32,007	
Butter, cheese, and other dairy products	105,179	4,664		94,050	6,642	
Canning and preserving	128,143	16,356		135,358	19,223	
Other food processing	172,068	14,827		194,714	17,857	
Refrigeration	30,489	94,790		32,536	153,010	
Livestock	519,027	254,031		556,885	246,340	
Highways, railroads, dust and ice control	26,382	167,126		13,414	197,751	[2]
Table and other household	420,532	75,289		460,020	224,764	
Water softening	165,610	187,445	[2]	171,433	203,757	[2]
Agriculture	50,523	21,261		81,700	16,968	
Metallurgy	25,690	41,288		31,990	33,347	
Other uses	187,236	218,678	48,487	117,430	51,554	47,858
	3,330,106	2,619,087	6,771,436	3,517,832	2,802,287	7,373,165

[1] Some salt used for dyes and organic chemicals included under "Chlorine."
[2] Included under "Other uses."
[3] Some salt used for hides and leather included under "Meat packing."

For many years most of the chlorine produced in the United States has originated in New York State. Little more than a decade ago New York still produced about half of the national output, and Michigan and Ohio were large producers also. The trend has changed, and in recent years the Midwest has become the largest chlorine-producing center, and new plants are to be found in the South and West. To the many uses for chlorine mentioned in the Salt chapter for 1941 may be added smoke screens and smoke bombs. Additional quantities of chlorine compounds were used in plastics, special water- and mildew-proofing waxes, fire extinguishers, and disinfectants.

With a view to utilizing some of the vast salt deposits in Kansas for chlorine and the petroleum from nearby oil fields for cheap power for steam generators, investigators (George W. Stratton and Delos E. Winkler) at the University of Kansas developed a method of making carbon black from natural gas and chlorine.[1] From 1,000 cubic feet of the mixture, it is said, 30 pounds of carbon black are produced. The process is not yet commercial.

Sodium compounds derived from salt have many important uses in the form of soda ash and caustic soda; the largest use for soda ash is in glassmaking, and for caustic soda in rayon-fabric manufacture. Sodium compounds will also assist in the removal of unwanted sulfur compounds from petroleum products and are essential raw materials for phenolic resins. They assist not only in making rayon cord for rubber tires but are used also to dissolve the cord fabric in the tires when the rubber is to be reclaimed.

Increases in output of magnesium metal made by methods that require large tonnages of salt led to corresponding increases in salt production in 1942.

The use of common salt for glazing ceramics has increased in the last year or two, because of the increased use of such ware for cooking utensils, structural building units, and other purposes, and because salt is said to be the simplest and cheapest of all glazes.

Statistics show that the use of salt on roads is continuing. It is applied mainly to secondary roads where the salt is bladed into the clay or gravel of the top layer. Emphasis has been placed upon the advantage of such roads in cold weather or during seasonal changes in temperature. In Cuba in 1942 salt was used on runways of air fields. It was added to the layer of clay and gravel under the top dressing of asphalt to make it more elastic and thus obviate cracking. Usually in the United States salt-treated roads have no top dressing, although a successful long-used road in Virginia was made by finishing with a thin layer of asphalt over the salt-treated layer.

Further interest in salt as a fertilizer for beets and mangolds was created by articles in the press [2] which advised all growers of beets on muck soil to make every acre produce its best in 1942 by applying 1,000 pounds of salt an acre in addition to the regular fertilizer used. It is claimed that 500 to 1,000 pounds of salt so applied may increase the yield from 13 tons to 21 tons an acre. Salt has also been utilized instead of potash on mangolds, sugar beets, and cabbage at the rate of 500 pounds an acre. Moreover, when employed in conjunction with a good dressing of sulfate of ammonia, salt is said to act as well

[1] Chemical and Engineering News (Am. Chem. Soc.), vol. 20, No. 20, October 25, 1942, p. 1317.
[2] Sugar Beet Journal, March 1942, p. 116; Chemical and Engineering News (Am. Chem. Soc.), vol. 20, No. 20, October 25, 1942, p. 1308.

as muriate of potash. Sandy soils (often deficient in potash) are said to be improved by its application; salt has also proved most effective on light and medium soils.

CHANGES IN THE INDUSTRY

The plant of Oklahoma Salt Industries, Inc., which began producing in 1941 at Sayre, Okla., suffered heavy loss by fire and was out of operation after September 26, 1942; it is being rebuilt. The Stauffer Chemical Co., which sold its solar salt works at Redwood, Calif., to the Leslie Salt Co. the latter part of 1940 but continued to operate in 1941, did not produce in 1942. The Leslie Salt Co., San Francisco, has enlarged its solar-salt fields on the Pacific coast and in 1942 also produced from a deposit of rock salt at Fallon, Nev. The Mullet Island Salt Co., Niland, Calif., began producing in 1942; and the Defense Plant Corporation, at Death Valley Junction, Calif., produced solar salt for 3 months of 1942. The Puerto Rico Salt Works, Inc., Mayaguez, P. R., reported in detail its three plants in Guaypao, Boqueron, and Llanos Costa Counties, instead of including them in a consolidated report as formerly. Works of Marcelino Ramos, Ensenada, P. R., made no sales in 1942. In March 1943, the Morton Salt Co., Chicago, bought the Worcester Salt Co., which operated an evaporated-salt plant at Silver Springs, N. Y.

IMPORTS AND EXPORTS [3]

From 1938 to 1942 imports averaged about 0.25 percent and exports a little more than 1 percent of production. Most of the imports are received on the Atlantic coast, where no salt plants operate.

In normal times pressed blocks have not been exported, but since lend-lease has been in effect some shipments of blocks have been made overseas. This is not apparent, however, in the accompanying table, as the exports are not shown by classes.

Salt imported for consumption in the United States, 1938–42, by classes

Year	In bags, sacks, barrels, or other packages (dutiable)		Bulk			
			Dutiable		Free (used in curing fish)	
	Short tons	Value	Short tons	Value	Short tons	Value
1938	654	$8,228	17,849	$45,897	[1] 21,010	[1] $47,800
1939	2,121	14,977	28,451	58,540	15,461	27,700
1940	1,024	6,601	16,413	59,029	[1] 12,965	[1] 25,174
1941	1,110	12,156	6,896	17,021	7,426	30,058
1942	[2] 367	[2] 4,138	953	7,496	[1] 6,434	[1] 17,667

[1] Includes salt in bags, sacks, barrels, or other packages as follows—1938: 93 tons valued at $673; 1940: 6 tons, $12; 1942: 122 tons, $1,200; 1939 and 1941: None reported.
[2] Includes 98 pounds valued at $3 imported into Alaska free for the U. S. Government.

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

Salt imported for consumption in the United States, 1941–42, by countries

Country	1941		1942	
	Short tons	Value	Short tons	Value
North America:				
Canada	695	$6,334	1,358	$12,430
Mexico			28	144
West Indies:				
British:				
Jamaica	1,248	7,276	4,142	14,767
Other British	7,276	29,287		
Netherlands: Curaçao	85	194	56	260
Europe:				
France	6,027	14,018		
United Kingdom [1]	101	2,126		
Africa: Egypt			2,170	1,700
	15,432	59,235	7,754	29,301

[1] United Kingdom of Great Britain and Northern Ireland.

Salt exported from the United States, 1941–42, by countries

Country	1941		1942	
	Short tons	Value	Short tons	Value
North America:				
Bermuda	21	$582	141	$6,295
Canada	68,288	287,411	72,617	321,907
Central America:				
British Honduras	5,548	5,435	673	7,715
Guatemala	19	382	25	629
Honduras	128	3,642	119	2,393
Nicaragua	362	5,654	190	3,617
Panama:				
Republic of	148	3,111	27	1,917
Canal Zone	887	27,225	933	23,794
Greenland	5	107	2,513	35,835
Iceland	8	483	34	2,008
Mexico	4,742	67,700	5,686	88,154
Newfoundland and Labrador	408	6,719	21,899	106,216
West Indies:				
British	114	1,695	168	3,302
Cuba	12,950	143,491	9,437	121,725
Dominican Republic	322	6,843	111	2,229
Haiti	12	476	15	945
Netherlands: Curaçao	116	5,349	132	7,092
Other North America	18	437	174	2,820
South America:				
Argentina	472	4,485	332	3,409
Brazil	157	3,124	26	668
Colombia	14	364	(1)	118
Other South America	455	7,796	819	27,547
Europe:				
U. S. S. R.			1,402	95,951
Other Europe	1	51		
Asia:				
China	7	969		
Hong Kong	61	1,442		
Japan	26,301	179,543		
Philippine Islands	353	11,169		
Other Asia	68	1,840	7	736
Africa:				
Liberia	774	18,623	548	12,790
Other Africa	118	6,285	92	3,701
Oceania:				
British:				
Australia	(1)	34		
New Zealand	158	2,570	42	3,182
Other			4	425
French	160	2,888	258	5,040
	123,195	807,925	118,424	892,160

[1] Less than 1 ton.

WORLD PRODUCTION

Salt production in the United States represents roughly about one-third of the global production. It does not figure largely in international trade until converted into products. In the last decade the United States has doubled its output. The war has had its effect on a number of other countries. Salt production in Canada increased 17 percent in 1942 compared with 1941, part of the increase being attributed to greater demand for chemicals, especially chlorine. Free China produced 800,000 metric tons of salt during the first 9 months of 1942 and 1,152,000 tons in the year 1941. Statistics for occupied China have not been available for the last 2 years, but the salt fields have been worked actively. In 1941 Germany established a compulsory national salt cartel comprised of one rock-salt and two evaporated-salt associations. The Italian Empire has suffered important salt losses through the war, first, by the loss of its East African colonies, later by the loss of Libya, and more recently through damage done by bombings of the salt works near Trapani, Sicily. In accordance with an agreement made in September 1942, Spain is to supply French Morocco with salt in exchange for phosphates from the latter country.[4] Additional details regarding the salt industry in these and other countries have been recorded in various issues of Bureau of Mines Mineral Trade Notes—Confidential Series, between July 1942 and May 1943.

World production of salt, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
North America:						
Canada	415,994	398,013	385,550	420,974	508,787	597,340
Costa Rica	4,287	4,740	6,822	(2)	6,000	(2)
Dominican Republic	(2)	9,286	9,536	7,500	14,700	(2)
Guatemala	12,610	10,465	(2)	(2)	(2)	(2)
Mexico	82,876	107,701	(2)	(2)	(2)	(2)
Panama	6,898	3,332	4,536	5,199	(2)	(2)
United States:						
Rock salt	1,841,967	1,725,330	1,846,254	2,055,260	2,375,983	2,542,179
Other salt	6,541,795	5,555,486	6,570,481	7,343,089	9,163,917	9,880,094
West Indies:						
British:						
Bahamas	2,000	17,900	11,600	27,000	25,400	(2)
Turks and Caicos Islands (exports)	50,833	35,578	47,389	67,028	48,179	(2)
Cuba	36,806	57,970	113,398	113,398	41,909	(2)
Netherlands (exports)	2,337	2,013	247	37	3,226	(2)
South America:						
Argentina (railway shipments)	290,084	264,150	303,321	292,307	372,689	(2)
Brazil	770,403	788,218	502,203	(2)	550,000	(2)
Chile	36,697	27,772	39,593	44,317	57,185	(2)
Colombia:						
Rock salt	4,211	4,010	3,950	4,703	4,530	(2)
Other salt	184,609	199,022	218,134	228,750	192,249	(2)
Ecuador:						
Rock salt	138			(2)		(2)
Other salt	13,800	13,800	16,145	29,900	20,207	(2)
Peru	39,010	38,451	39,669	41,326	46,707	(2)
Venezuela	26,298	22,658	20,473	52,540	(2)	(2)
Europe:						
Bulgaria:						
Rock salt	9,745	10,242	13,168	15,000	(2)	(2)
Other salt	43,602	66,258	(2)	65,000	(2)	(2)
Czechoslovakia	165,898	174,000	(2)	(2)	(2)	(2)

See footnotes at end of table.

[4] Department of Commerce, Foreign Commerce Weekly: November 14, 1942, p. 11.

World production of salt, 1937–42, by countries, in metric tons—Continued

Country	1937	1938	1939	1940	1941	1942
Europe—Continued.						
France:						
Rock salt and salt from springs	1,847,179	1,264,230	(2)	(2)	(2)	(2)
Other salt	490,906	346,046	(2)	(2)	(2)	(2)
Germany:						
Rock salt	2,757,242	2,694,984	(2)	(2)	(2)	(2)
Other salt	608,046	585,326	(2)	(2)	(2)	(2)
Austria:						
Rock salt	908	786	(2)	(2)	(2)	(2)
Other salt	169,883	93,576	(2)	(2)	(2)	(2)
Greece	102,285	102,057	(2)	(2)	(2)	(2)
Italy:						
Rock salt	603,798	613,870	(2)	(2)	(2)	(2)
Other salt	952,655	885,205	(2)	(2)	(2)	(2)
Malta	1,829	1,523	1,753	(2)	(2)	(2)
Netherlands: Rock salt	132,430	164,266	(2)	(2)	(2)	(2)
Poland	602,746	642,875	(2)	(2)	(2)	(2)
Portugal (exports)	4,633	6,096	9,289	11,955	(2)	(2)
Rumania:						
Rock salt	308,882	350,618	(2)	(2)	(2)	(2)
Other salt	2,077	1,140	(2)	(2)	(2)	(2)
Spain:						
Rock salt	29,673	150,878	157,784	206,650	(2)	(2)
Other salt	120,175	102,671	(2)	463,795	(2)	(2)
Switzerland	81,969	84,049	90,000	77,000	(2)	(2)
United Kingdom:						
Great Britain:						
Rock salt	18,666	19,974	(2)	(2)	(2)	(2)
Other salt	3,101,511	2,651,939	(2)	(2)	(2)	(2)
Ireland, Northern:						
Rock salt	4,254	2,362	(2)	(2)	(2)	(2)
Other salt	8,818	5,757	(2)	(2)	(2)	(2)
Yugoslavia	46,323	52,634	54,213	(2)	(2)	[3] 28,000
Asia:						
Aden	360,866	282,510	294,077	258,714	(2)	(2)
Burma	54,677	39,319	(2)	(2)	(2)	(2)
Ceylon	38,815	36,490	37,556	29,973	(2)	(2)
China (including Manchuria)	[4] 3,000,000	[4] 3,000,000	[4] 3,000,000	[4] 3,000,000	[5] 1,152,000	[5 6] 800,000
Chosen [4]	138,000	138,000	138,000	138,000	(2)	(2)
Cyprus [4]	3,000	3,000	3,000	3,000	(2)	(2)
India:						
British:						
Rock salt	190,103	191,395	196,503	(2)	(2)	(2)
Other salt	1,516,984	1,372,979	1,326,544	(2)	(2)	(2)
Portuguese	26,095	29,527	27,979	38,564	(2)	(2)
Indochina	193,558	193,050	213,526	166,000	(2)	(2)
Iraq	1,810	7,907	9,107	8,779	(2)	(2)
Japan:						
Japan proper [7]	535,775	(2)	(2)	(2)	(2)	(2)
Taiwan	210,471	(2)	(2)	(2)	(2)	(2)
Netherlands Indies	75,780	90,909	[8] 141,208	[8] 388,837	(2)	(2)
Palestine:						
Rock salt	727	444	645	599	(2)	(2)
Other salt	11,717	8,065	8,736	9,944	(2)	(2)
Philippine Islands	48,905	(2)	(2)	(2)	(2)	(2)
Syria [4]	10,000	10,000	10,000	10,000	(2)	(2)
Thailand (exports)	107,731	156,268	95,170	112,197	(2)	(2)
Turkey	262,226	247,293	(2)	(2)	(2)	(2)
Africa:						
Algeria	63,767	74,630	(2)	(2)	(2)	(2)
Belgian Congo	1,004	1,013	(2)	1,038	(2)	(2)
Canary Islands [4]	2,000	2,000	2,000	2,000	(2)	(2)
Egypt (exports)	276,735	284,949	442,532	[9] 168,591	(2)	(2)
Ethiopia: Rock salt [4]	10,000	10,000	10,000	10,000	(2)	(2)
French West Africa (exports)	643	51	(2)	(2)	(2)	(2)
Kenya Colony	----------	3,250	(2)	9,425	(2)	(2)
Libya (Italian Africa):						
Cyrenaica [4]	10,000	10,000	10,000	10,000	(2)	(2)
Tripolitania [4]	20,000	20,000	20,000	20,000	(2)	(2)
Mauritius [4]	1,500	1,500	1,500	1,500	(2)	(2)
Morocco, French	11,207	909	(2)	(2)	(2)	[4] 55,000
Nigeria [4]	400	400	400	400	(2)	(2)
Portuguese East Africa	2,605	6,448	6,628	251	(2)	(2)
Portuguese West Africa (Angola) [4]	25,000	25,000	25,000	25,000	(2)	(2)
Somaliland:						
British (exports)	950	353	(2)	(2)	(2)	(2)
French (exports)	85,273	(2)	(2)	(2)	(2)	(2)
South-West Africa:						
Rock salt	669	641	751	1,125	[10] 671	(2)
Other salt	3,443	4,431	4,704	5,364	[10] 3,445	(2)

See footnotes at end of table.

World production of salt, 1937–42, by countries, in metric tons—Continued

Country	1937	1938	1939	1940	1941	1942
Africa—Continued.						
Sudan, Anglo-Egyptian	34,553	37,532	40,633	40,471	(2)	(2)
Tanganyika Territory	8,723	9,678	9,472	9,505	(2)	(2)
Tunisia	129,708	129,287	(2)	(2)	(2)	(2)
Uganda	3,133	3,169	2,626	3,374	(2)	(2)
Union of South Africa	106,338	117,717	(2)	(2)	(2)	(2)
Oceania:						
Australia:						
South Australia	74,739	76,013	80,759	146,991	173,431	(2)
Western Australia	3,729	3,850	(2)	(2)	(2)	(2)

[1] In addition to the countries listed, salt is produced in Albania, Bolivia, Eritrea, Gold Coast, Leeward Islands, Madagascar, Southern Rhodesia, U. S. S. R., and Victoria (Australia), but figures of production are not available.
[2] Data not available.
[3] January to June, inclusive (Croatia only).
[4] Estimated annual production.
[5] Unoccupied China.
[6] January to September, inclusive.
[7] Year ended March 31 of year following that stated. Figures do not include output from salt beds which, although situated on government beach lands, have no fixed areas.
[8] Incomplete data.
[9] January to July, inclusive.
[10] January to June, inclusive.

MAGNESIUM COMPOUNDS AND MISCELLANEOUS SALINES

By Charles L. Harness and Nan C. Jensen [1]

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SUMMARY

War and essential civilian requirements absorbed nearly the entire output of the magnesia and natural-salines industries during 1942. Magnesia refractories were derived from magnesite, brucite, dolomite, sea water, and well brines principally to satisfy the increasing demands of open-hearth and electric steel furnaces. Caustic-calcined magnesite was used for flooring war plants and cargo ships. The total output of magnesium chloride from well brines, sea water, dolomite, and magnesite increased tremendously over production in previous years to meet magnesium-metal requirements. Consumption of calcium chloride grew in nearly all its customary uses, but particularly in freezeproofing coal and ores to facilitate unloading and release of cars. Bromine was valuable as a raw material in compounding antiknock fluids needed in mechanized warfare, and the production of iodine expanded. Sodium sulfates, carbonates, and borates were used increasingly to make glass containers, glass instruments, and structural glass—replacing metals needed for more vital war purposes.

Part I.—MAGNESIUM COMPOUNDS

MAGNESITE

The expansion in output of basic open-hearth and electric furnace steel was probably the chief single factor in the record production of raw magnesite in 1942. Magnesite and magnesia from other sources as a whole did not become critical during 1942, although shortages developed in certain of the purer grades. On their own initiative, producers undertook allocation of the scarcer grades of calcined magnesite and magnesia from sea water.

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

Salient statistics of the magnesite industry in the United States, 1938–42

	1938	1939	1940	1941	1942
Crude:					
Mined:					
Short tons	[1] 97,000	[1] 198,980	[1] 333,166	374,799	[1] 497,368
Value [1]	$725,000	$1,465,190	$2,487,969	$2,655,547	$3,874,334
Sold by producers:					
Short tons	919	1,123	2,133	4,536	6,835
Value	$12,332	$15,752	$32,810	$54,045	$57,350
Average per ton [2]	$13.42	$14.03	$15.38	$11.91	$8.39
Imports for consumption:					
Short tons	36	569	22	----------	----------
Value	$777	$5,456	$761	----------	----------
Apparent new supply, short tons	955	1,692	2,155	4,536	6,835
Percent domestic	96.2	66.4	99.0	100.0	100.0
Caustic calcined:					
Sold by producers: [3]					
Short tons	7,400	10,157	16,261	30,225	35,485
Value	$228,498	$310,102	$512,607	$1,052,077	$1,540,573
Average per ton [2]	$30.88	$30.53	$31.52	$34.81	$43.41
Imports for consumption:					
Short tons	1,452	2,218	928	865	577
Value	$39,551	$51,884	$21,301	$23,972	$19,105
Apparent new supply, short tons	8,852	12,375	17,189	31,090	36,062
Percent domestic	83.6	82.1	94.6	97.2	98.4
Refractory magnesia:					
Sold by producers: [4]					
Short tons	38,738	86,077	140,668	201,481	273,661
Value	$730,978	$1,699,723	$2,802,537	$5,052,879	$7,823,963
Average per ton [2]	$18.87	$19.75	$19.92	$25.08	$28.59
Imports for consumption:					
Short tons	24,990	44,420	30,951	36,792	7,728
Value	$371,669	$800,664	$551,536	$824,068	$280,342
Apparent new supply, short tons	63,728	130,497	171,619	238,273	281,389
Percent domestic	60.8	66.0	82.0	84.6	97.3

[1] Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.

[2] Average receipts f. o. b. mine shipping point.

[3] 1938–41: Includes caustic-calcined magnesite and caustic-calcined magnesia from sea-water bitterns; 1942: Includes caustic-calcined magnesite and caustic-calcined magnesia from sea-water bitterns, well brines, and raw sea water.

[4] 1938–40: Includes dead-burned magnesite and refractory magnesia from sea-water bitterns; 1941: Includes dead-burned magnesite and refractory magnesia from brucite, dolomite, and sea-water bitterns; 1942: Includes dead-burned magnesite and refractory magnesia from brucite, dolomite, sea-water bitterns, well brines, and raw sea water.

Magnesium compounds sold or used by producers in the United States in 1942, by kinds and sources

[Quantities and values reported apply to finished products, not raw materials]

Finished products	From magnesite		From brucite, dolomite, and sea-water bitterns		From well brines, dry-lake brines, and raw sea water	
	Short tons	Value	Short tons	Value	Short tons	Value
Magnesia:						
Caustic-calcined	19,551	$798,019	[1] 93,521	[1] $3,907,396	[2] 7,467	[2] $497,434
Refractory	189,218	4,397,766				
Total magnesia	208,769	5,195,785	[1] 93,521	[1] 3,907,396	[2] 7,467	[2] 497,434
Other magnesium compounds:						
Precipitated magnesium carbonate	(3)	(3)	59,666	5,096,231	(3)	(3)
Magnesium chloride	(3)	(3)	10,847	262,297	238,499	7,047,917
Calcium-magnesium chloride					(4)	(4)
Magnesium sulfate					40,265	1,029,662
Magnesium hydroxide					(3)	(3)
Undistributed [5]	9,796	337,504			3,819	464,753
Total other magnesium compounds	9,796	337,504	70,513	5,358,528	282,583	8,542,332
Total all magnesium compounds	218,565	5,533,289	164,034	9,265,924	290,050	9,039,766

[1] Includes caustic-calcined and refractory magnesia and magnesia from precipitated carbonate.
[2] Includes caustic-calcined and refractory magnesia and magnesia from precipitated carbonate and from magnesium hydroxide.
[3] Included under "Undistributed."
[4] Reported in Calcium Chloride section of this chapter.
[5] Includes items entered as "(3)" above.

Sales of dead-burned magnesite increased in 1942, exceeding the 1941 record. Most of the output was consumed in construction and repair of basic open-hearth steel furnaces, though some of the purer material was used in brickmaking. Imports of dead-burned magnesite, normally totaling about 35,000 tons a year, mainly from Austria, Greece, and Manchuria, declined heavily in 1942. The foreign supply pattern changed considerably, the principal source being the U. S. S. R. An impending shortage of magnesite brick was avoided by increasing the use of periclase with chromite to form the "kromag" type of brick, said to be interchangeable with or even preferable to all-magnesite brick in certain parts of open-hearth steel furnaces.

Caustic-calcined magnesite showed widely diverse adaptability to the war program. It was used chiefly in oxychloride cements for sparkproof flooring for industrial plants and interior decking of ships. Fortunately, the lower and more abundant grades of caustic-calcined magnesite (82 to 84 percent MgO before ignition) were suitable for this purpose. Oxychloride floors are particularly valuable in explosive plants and aluminum-powder plants, as their electrical conductivity prevents accumulation of electrical charges in objects being moved over the floor, thus reducing the danger of static sparking. The floors are also resistant to abrasive sparking.[2]

[2] Chemical and Metallurgical Engineering, vol. 50, No. 1, January 1943, p. 83.

Magnesium metal was the next-largest direct outlet for caustic-calcined magnesite. Permanente Metals Corporation, Permanente, Calif., reduces its sea-water magnesia by the Hansgirg carbothermic process, whereas Basic Magnesium, Inc., chlorinates the calcined ore to anhydrous magnesium chloride for electrolytic reduction at Royson near Las Vegas, Nev. Substantial quantities of caustic-calcined magnesia were used as fertilizer, particularly in Florida. The synthetic-rubber industry employed high-grade magnesia derived from sea water as a catalyst and lower grades, including those obtained from magnesite, as fillers. Sea-water magnesia was also consumed in making rayon-coagulating solution. Other important uses of caustic-calcined magnesia were in fused refractory cements, glass insulators, boiler-water treatment,[3] chemical reagents, and glue.

PRICES

The maximum price of $22 a short ton for maintenance grade of domestic grain magnesite in bulk (add $4 a ton for bags or sacks, carlots), f. o. b. Chewelah, Wash., established by Order 75 of the Office of Price Administration on January 28, 1942, continued in effect throughout the year. Owing to shortages of this grade of magnesite, however, the Westvaco Chlorine Products Corporation was permitted by the Office of Price Administration to sell dead-burned grain magnesite from its stocks at Patterson and Permanente, Calif., at $32 a ton, f. o. b. Chewelah, Wash., to steel producers on the West coast, an equivalent of $40.50 a ton f. o. b. Patterson and Permanente. The shortage was relieved early in the year, but the $32 ceiling remained in nominal effect. From its Patterson (Calif.) plant, Westvaco Chlorine Products Corporation was permitted to sell dead-burned grain to the Vanadium Corporation of America and to the Mathieson Alkali Works (Inc.) at $40.50 a ton. Early in 1943 the Westvaco Chlorine Products Corporation was permitted an increase of $2.24 a short ton in brickmaking grades of magnesia shipped from Livermore, Calif. The 85-percent magnesia grade ceiling price, f. o. b. Livermore, was raised to $38.24 a short ton and the 90-percent grade to $38.74.

The following prices per ton were quoted for magnesia by the Westvaco Chlorine Products Corporation, in carlots f. o. b. California, during 1942: Caustic-calcined magnesite, bulk, $52.75; powdered, $58.75; calcined (sea-water) magnesia, bulk, $54; powdered, $60; mined periclase, bulk, 85 percent, $38.24; 90 percent, $38.74; sea-water periclase, bulk, 85 percent, $36.00; 90 percent, $36.50.

REVIEW BY STATES

California.—Johns-Manville Products Corporation, Redwood City, prepared 85-percent magnesia insulation for steam pipes and boilers, using crude magnesite as a raw material. The Marine Magnesium Corporation continued to extract high-quality magnesia for medicinal and other purposes from raw sea water at San Francisco, using the

[3] Tiger, H. L., Silica Removal [from boiler feed water] by Improved Magnesia Process: Trans. Am. Soc. Mech. Eng., vol. 64, 1942, pp. 49–63; Brit. Chem. and Phys. Abs., B, I, 1, November 1942, p. 442.

Chesny process. The Permanente Metals Corporation began production of calcined magnesia from sea water at Moss Landing, Calif., for use in its carbothermic magnesium retorts; and its affiliate, the Permanente Cement Co., shipped magnesite from Luning, Nev., for calcining at its San Jose (Calif.) kiln. Plant Rubber & Asbestos Works, San Francisco, erected a new plant at Emeryville, Calif., to make 85-percent magnesia insulation from a sea-water-bittern derivative and continued production of magnesia insulation at its Redwood City (Calif.) plant, using sea-water bitterns. Westvaco Chlorine Products Corporation mined magnesite at its Bald Eagle mine near Gustine, Calif., and at its Western mine near Livermore, Calif. This magnesite, together with that purchased from the properties of the Sierra Magnesite Co., Luning, Nev., was calcined in seven rotary kilns at Gustine, Livermore, Patterson, and Newark, Calif. Two of the Newark kilns also calcined magnesia derived from sea-water bitterns.

Nevada.—Basic Magnesium, Inc., producing magnesium metal at Royson, Nev., near Las Vegas, mined, concentrated, and calcined magnesite in 1942 at Toiyabe, Nev., north of the Luning magnesite area. The calcined material was shipped to Royson by truck and rail for chlorination and conversion to metal. The truck haul is 350 miles, but the rail route, which is quite indirect, is over 1,000 miles. Seeking to eliminate this costly rail haul and to assure an almost inexhaustible supply of magnesia, the Bureau of Mines conducted research on the recovery of magnesia from a 400,000,000-ton dolomite deposit at Sloan, 19 miles southwest of Las Vegas. The Bureau developed a process of leaching partly hydrated dolomite with magnesium chloride solution, whereby the calcium hydroxide is dissolved, leaving a magnesium hydroxide precipitate, which is filtered and calcined to magnesium oxide. The magnesium chloride needed for leaching is regenerated in a carbonation step, which simultaneously produces calcium carbonate. The two end products of the process are magnesium oxide and calcium carbonate. Bureau engineers have carried the project further by developing a method whereby the magnesia can be fed directly into the electrolytic cell.

Basic Magnesium, Inc., which is scheduled to produce eventually 112,000,000 pounds of magnesium metal annually, will require about 300 tons of magnesia daily when it attains full capacity.

Basic Refractories, Inc., Cleveland, Ohio, continued shipping brucite from the Luning area. The mineral is calcined at Maple Grove, Ohio, and is combined with stabilized dolomite to produce a grain-magnesia refractory containing about 65 percent MgO.

The Sierra Magnesite Co., owned jointly by Westvaco Chlorine Products Corporation (Newark, Calif.) and Henry J. Kaiser and his associates (Oakland, Calif.), mined magnesite from the rich Segerstrom property and other claims near Luning, the crude mineral being shipped to Newark and San Jose, Calif., for calcining.

The Bureau of Mines has published data on occurrences of magnesite and dolomite near Boulder Dam, Nev.[4]

[4] Schlocker, J., Magnesium-Bearing Minerals in the Boulder Dam Area for the Production of Magnesium Metal: Bureau of Mines Inf. Circ. 7216, 1942, 16 pp.

Texas.—Meramec Minerals Co., Hanna Bldg., Cleveland, Ohio, and C. E. Heinz of Llano, Tex., continued to produce magnesite in the Llano County area.[5]

Washington.—The Northwest Magnesite Co., Farmers Bank Building, Pittsburgh, Pa., by far the largest producer of magnesite in 1942, operated the seven rotary kilns of its Chewelah (Wash.) plant at capacity during the year, producing mostly maintenance-grade magnesite for open-hearth furnaces but also shipping considerable brickmaking magnesite derived from the firm's new flotation plant. The Washington State Department of Geology reported that the Turk mine in southwestern Stevens County contains two bodies of magnesite about 500 feet apart and estimated that the two bodies contain 500,000 tons of metallic magnesium.[6]

FOREIGN COUNTRIES

Information on foreign developments in magnesite has been meager since the outbreak of the war. The latest Minerals Yearbook table showing world production by countries appeared in the volume reviewing 1939. During the 5-year period 1934–38, the U. S. S. R. produced about 534,000 short tons of crude magnesite annually, followed by Austria with 403,000 tons, Manchuria 233,000 tons, United States 157,000 tons, Greece 134,000 tons, and Czechoslovakia 83,000 tons.

Australia.—Magnesite obtained near Port Augusta, South Australia, is used in the new magnesium metal plant of the Broken Hill Proprietary Co. at Newcastle.[7]

Bahamas.—The sea-water magnesia plant under construction at Inagua by West India Chemicals, Ltd., was not completed in 1942 owing to difficulty in obtaining equipment.

Brazil.—A large deposit of magnesite in Ceara, already producing on a small scale, is said to be capable of supplying 150 metric tons of calcined magnesite monthly for export.[8]

Canada.—The Aluminum Co. of Canada, Ltd., erected a plant at Wakefield, Quebec, for the extraction of magnesia from brucitic limestone found in the area. Employing the process developed by Goudge,[9] the company calcines the rock and adds enough water to hydrate the lime, which is then removed from the magnesia granules by air separation, washing, and screening. The magnesia is delivered to Canadian Refractories, Ltd., at Kilmer, Quebec, where it is made into refractories and other products. In past years, Canadian Refractories, Ltd., and the International Magnesite Co., Ltd., have used as raw material for their basic refractories a magnesitic dolomite from Argenteuil

[5] Chelf, Carl, Magnesite Mining in Llano County, Tex.: Mineral Resource Survey Circ. 40, University of Texas, Austin, Tex., 1941, 6 pp. *See also* McCammon, J. H., Report on Tin and Magnesite Deposits in Mason County, Tex.: Mineral Resource Survey Circ. 32, University of Texas, Austin, Tex., 1941, pp. 4–6.
[6] Engineering and Mining Journal, vol. 144, No. 4, April 1943, p. 101.
[7] Engineering and Mining Journal, vol. 143, No. 5, May 1942, p. 99.
[8] Rock Products, vol. 45, No. 5, May 1942, p. 94.
Tyler, P. M., Industrial Minerals: Eng. and Min. Jour., vol. 144, No. 2, February 1943, p. 110.
Refractories Journal, vol. 19, No.1, January 1943, p. 18.
[9] Goudge, M. F., A Preliminary Report on Brucite Deposits in Ontario and Quebec and Their Commercial Possibilities: Canadian Bureau of Mines Memorandum Ser. 75, 1939, 57 pp. Magnesia from Canadian Brucite: Trans. Canadian Inst. Min. and Met., vol. 43, 1940, pp. 481–505. Sources of Magnesia and Magnesium in Canada: Trans. Canadian Inst. Min. and Met., vol. 45, 1942, pp. 191–207.

County, Quebec. It is reported that the former firm acquired the holdings of the latter in 1942 and will continue to produce refractory and reactive magnesias.

Cuba.—Magnesite was mined by numerous small farmers near Santa Clara, where it was caustic-calcined for export, principally to the United States.

Germany.—According to Mineral Trade Notes,[10] the Austrian and Bavarian magnesite companies have joined to form one large magnesite trust with headquarters in Berlin. The new company is styled Südost-Magnesit Ges. and has a capital of 1,000,000 marks.

Union of South Africa.—Deposits and production were reviewed in The South African Mining and Engineering Journal.[11] Reserves are estimated at not over 260,000 tons of minable material, found mostly at Burgersfort, Kaapmuiden, and in the Sutherland Range. Production is limited to a few thousand tons a year.

Venezuela.—The deposits on the Island of Margarita are said to contain over 6,000,000 tons of silica-free magnesite, and plans are under way to reopen the mines.[12]

REFRACTORY MAGNESIA FROM SOURCES OTHER THAN MAGNESITE

Particular shortages were felt in high-quality periclase for brick-making, but production of periclase by new plants in 1943 from sea water, well brines, and dolomite is expected to relieve the deficit.

Greater use of rammed dolomite-base furnace linings eliminated considerable basic brick corbeling along the front, back, and end walls of the furnaces. It is claimed that dolomite-base linings, if over 15 inches thick, can safely be rammed directly on fireclay brick and that such a bottom can be installed in less than half the time required to burn in an all-magnesite bottom, thus cutting fuel costs.

Recent developments in basic refractories were reviewed at the 25th conference of the Open-Hearth and Blast Furnace and Raw Materials Committees of the Iron and Steel Section of the American Institute of Mining and Metallurgical Engineers in April 1942 at Cincinnati. Rammed bottoms, in contradistinction to the older permanent hearth of bricks and working surface of magnesite, were shown to rebuild much faster. Bottoms of the stabilized dolomite-clinker or magnesia-chromite types are rammed a section at a time to predetermined dimensions. A layer of grain magnesite or grain dolomite may be burned in on top of the permanent hearth to serve as the working hearth, though this addition is said to be unnecessary.

The Bureau of Mines published a summary of methods for producing stabilized dolomite refractories.[13]

DOLOMITE

Shipments of dead-burned dolomite, stimulated by requirements of the steel industry, were 15 percent greater in quantity in 1942 than in 1941.

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[10] Bureau of Mines, Mineral Trade Notes: Confidential Series 3, September 1942, p. 26.
[11] South African Mining and Engineering Journal, vol. 53, pt. 2, No. 2595, October 24, 1942, pp. 167, 169, 171.
[12] Engineering and Mining Journal, vol. 143, No. 6, June 1942, p. 104; vol. 143, No. 8, August 1942, pp. 86-88.
[13] Schallis, Alvin, Dolomite-Base Refractories: Bureau of Mines Inf. Circ. 7227, 1942, 11 pp.

Dead-burned dolomite sold in and imported into the United States, 1938–42

Year	Sales		Imports [1]		Year	Sales		Imports [1]	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1938	366,626	$3,095,355	2,875	$67,340	1941	1,069,887	$9,111,172	-------	-------
1939	671,561	5,447,554	186	4,260	1942	1,229,357	10,817,634	449	$11,260
1940	867,909	6,925,328	-------	-------					

[1] Reported as "dead-burned basic refractory material."

Dolomite has long been used as a basic refractory for open-hearth maintenance and repair, averaging five to eight times the quantity of magnesite used for refractory purposes. Only recently, however, has dolomite invaded the metal field, competing with and supplementing magnesite and brines as a source of magnesium metal and compounds.

The following outline covers methods of recovering magnesium from dolomite which were either in commercial use during 1942 or to be used in plants under construction in that year.

1. Direct reduction with ferrosilicon to magnesium metal. This process is used by New England Lime Co., Canaan, Conn.; Ford Motor Co., Dearborn, Mich.; Electro-Metallurgical Co., Spokane, Wash.; Amco Magnesium Co., Wingdale, N. Y.; Magnesium Reduction Co., Luckey, Ohio; and Permanente Metals Corporation, Manteca, Calif.

2. Processes based upon the reaction $Ca(OH)_2+Mg(OH)_2+MgCl_2 \longrightarrow CaCl_2+2Mg(OH)_2$. The calcium and magnesium hydroxides are obtained by slaking calcined dolomite, and the magnesium chloride is a constituent of sea water and well brines. Calcium chloride may be added to well brines and sea-water bitterns before the milk of dolomite is added, in order to precipitate sulfate ions as synthetic gypsum (calcium sulfate), which is sold as a byproduct. If this preliminary step is not used, synthetic gypsum is precipitated to some extent with the magnesium hydroxide. The precaution is unnecessary with raw sea water, as the solution of salts is so dilute that any gypsum formed is redissolved. Permanente Metals Corporation (plant at Moss Landing, Calif.) and Northwest Magnesite Co. (plant at Cape May, N. J.) use the process to recover magnesia from raw sea water, the former for conversion to metal and the latter for refractory use; and The Dow Chemical Co. at Ludington, Mich. (plant not completed in 1942), and the Michigan Chemical Corporation, St. Louis, Mich., use (or will use) the method with well brines as the raw material, the former for metal use and the latter for refractory purposes.

3. Processes based upon the reaction, $Ca(OH)_2+Mg(OH)_2+CaCl_2+2CO_2 \rightarrow MgCl_2+2CaCO_3+2H_2O$. The calcium and magnesium hydroxides are obtained by hydrating calcined dolomite, and in present practice the calcium chloride used is a byproduct of the Solvay soda ash process. Carbon dioxide is available from the dolomite kiln gases. There are several possible variations in the process, depending on whether the end product desired is magnesium chloride or magnesium hydroxide and also on the purity and grain size of the dolomite. If the dolomite is too fine-grained it may be impracticable to recover the magnesium content as magnesium hydroxide, for the latter becomes more gelatinous and progressively harder to filter with decreasing dolomite grain size. The process is employed by the Diamond Alkali Co., Painesville, Ohio; Mathieson Alkali Works (Inc.), Lake Charles, La.; and in a pilot plant of the Bureau of Mines at Boulder City, Nev., all for conversion to metal.

4. Dolomite is calcined and washed with carbon dioxide-free water, which dissolves most of the lime, leaving magnesia undissolved. The Standard Lime & Stone Co. uses the process at its Millville, W. Va., plant, making "Sta-set" magnesia-grain refractories.

5. Milk of dolomite is carbonated, precipitating calcium carbonate, which is removed, leaving magnesium bicarbonate in solution.

(*a*) The solution is then heated, precipitating a basic magnesium carbonate. This is the Pattinson process used by Philip Carey at Plymouth Meeting, Pa.; Ehret Magnesia Manufacturing Co., Valley Forge, Pa.; Johns-Manville Products Corporation, Manville, N. J., and Waukegan, Ill.; Keasbey & Mattison Co., Ambler, Pa.; and Standard Lime & Stone Co., Millville, W. Va. Basic magnesium carbonate is used in making "85-percent magnesia" insulation for steam boilers and pipes.

(*b*) The solution is neutralized with hydrochloric acid, yielding magnesium chloride. This process is to be used by the International Minerals & Chemical Corporation, Austin, Tex., supplementing its supply of byproduct magnesium chloride from Carlsbad (N. Mex.) potash brines for conversion to metal.

6. Milk of dolomite is reacted with hydrogen sulfide, thereby dissolving the calcium as calcium bisulfide and leaving a precipitate of magnesium hydroxide, which may be filtered and calcined. The method is used by the Warner Co., Devault, Pa., for making refractory magnesia.

7. Milk of dolomite is used instead of lime in the ammonia kilns in the ammonia-soda process; ammonia is driven off, leaving magnesium hydroxide and magnesium oxide in a solution of calcium chloride. The insoluble magnesium compounds are filtered off and reacted with hydrochloric acid to yield magnesium chloride for conversion to metal. The hydrochloric acid is a byproduct of the magnesium metal cell. This so-called "acid process" is one used by the Diamond Alkali Co.

In 1942 the Bureau of Mines compiled a list of occurrences and analyses of domestic high-grade dolomite.[14]

Other aspects of the dolomite industry are reviewed in the Stone chapter of this volume.

OTHER MAGNESIUM COMPOUNDS

The production of precipitated magnesium carbonate, magnesium chloride, magnesium sulfate, and magnesium hydroxide from magnesite, dolomite, sea-water bitterns, raw sea water, well brines, and dry-lake brines in 1942 was reported to the Bureau of Mines as 362,892 short tons valued at $14,238,364, compared with 103,906 tons valued at $3,288,687 in 1941. Part of the increase in the 1942 figure is due to general expansion in output of virtually all magnesium compounds, especially magnesium chloride, and part to the inclusion in 1942 data of precipitated magnesium carbonate from dolomite, which was not included in the 1941 figures. In neither year do the figures include the magnesium sulfate derived from magnesite.

[14] Weitz, J. H., High-Grade Dolomite Deposits in the United States: Bureau of Mines Inf. Circ. 7226, 1942, 86 pp.

The production of all natural magnesium compounds, including those obtained from saline deposits or derived from natural brines, and including brucite but not including magnesite or dolomite or their derivatives, amounted to 369,257 short tons in 1942, valued at $10,727,560. The figures (137,357 tons valued at $3,587,784) given for 1941 in Minerals Yearbook, 1941, are not strictly comparable with those for 1942, as they do not include the production of magnesia from sea-water bitterns.

Expansion in magnesium chloride production for reduction to magnesium metal was the chief feature of the magnesium salines industry in 1942. The Dow Magnesium Corporation produced magnesium hydroxide from sea water at its new Velasco (Tex.) plant, finished in 1942. The magnesium hydroxide is converted to chloride and electrolyzed to magnesium metal. The same process is used in the nearby Freeport (Tex.) plant of The Dow Chemical Co. At Midland, Mich., The Dow Chemical Co. recovered magnesium chloride from well brines for use in making metal.

The Arizona Chemical Co. extracted magnesium sulfate (calcined) from well brines at O'Donnell, Tex. The C. A. Kearney Co. pumped magnesium sulfate-bearing brines from Epso Lake near Tonasket, Wash., and crystallized Epsom salt from the liquors. The Morton Salt Co. precipitated magnesium carbonate from well brines at its Manistee (Mich.) plant. The Ozark Chemical Co., of Tulsa, Okla., drilled wells into a magnesium chloride deposit near Gail, Borden County, Tex., and investigated methods of recovering commercial products from the brine.

Research into the extraction of magnesium salts from readily available magnesium silicate rocks continued in 1942. Olivine Products, Inc., Sylva, N. C., for several years a producer of Epsom salt from olivine and sulfuric acid, was inactive during the year, but the International Minerals & Chemical Corporation erected a plant at Augusta, Ga., to recover Epsom salt from serpentine. According to reports received by the Bureau of Mines, production was to begin early in 1943.

The Bureau of Mines, cooperating with the Geological Survey as agents for the Defense Plant Corporation, core-drilled into magnesium-bearing strata on the lease of the Utah Magnesium Corporation near Thompson, Grand County, Utah, in 1942.[15] A very rich section of carnallite ($KMgCl_3.6H_2O$) and sylvite (KCl), 220 feet thick, was cored at a depth of about 3,500 feet—the only magnesium-bearing section in the well. The lateral extent of the deposit is unknown, but it was estimated that the well cores prove 20 acres, with possibilities of a much larger area.

[15] Bureau of Mines, Thompson Magnesium Well, Utah: War Minerals Report 12, 1942, 39 pp.

Magnesium compounds imported for consumption in the United States, 1938–42

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
1938	41	$1,572	799	$12,328	3,193	$66,470	46	$15,947
1939	28	960	198	3,641	2,472	43,435	38	14,755
1940	(1)	21	6	898	----------	----------	18	5,672
1941	28	1,328	1	179	----------	----------	12	4,292
1942	186	115,025	----------	----------	----------	----------	16	5,487

Year	Magnesium carbonate, precipitated		Manufactures of carbonate of magnesia		Magnesium salts and compounds, n. s. p. f.[2]	
	Short tons	Value	Short tons	Value	Short tons	Value
1938	470	$53,151	3	$209	48	$17,146
1939	776	68,934	----------	----------	59	26,788
1940	754	82,764	----------	----------	92	44,492
1941	1,106	113,236	----------	----------	23	11,488
1942	640	70,756	----------	----------	13	6,701

[1] 109 pounds.
[2] Magnesium silicofluoride or fluosilicate included under "Magnesium salts and compounds, n. s. p. f."

Part II.—MISCELLANEOUS SALINES

CALCIUM CHLORIDE

Shipments of calcium chloride and calcium-magnesium chloride from natural sources were 35 percent greater in quantity in 1942 than in 1941. However, total consumption of natural and synthetic calcium chloride is not believed to have increased significantly in 1942. The increased shipments of the natural material are said to have resulted from the shut-down of a former producer of synthetic calcium chloride. There were 13 producers of natural calcium and calcium-magnesium chlorides in 1942, compared with 10 in 1941.

Calcium chloride and calcium-magnesium chloride from natural brines sold by producers in the United States, 1938–42

[In terms of 75 percent (Ca, Mg) Cl_2]

Year	Short tons	Value	Year	Short tons	Value
1938	96,470	$1,218,938	1941	165,932	$1,333,370
1939	108,441	1,307,717	1942	224,527	1,733,169
1940	99,536	998,241			

Calcium chloride imported for consumption in and exported from the United States, 1938-42

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1938	1,642	$21,174	24,118	$396,981
1939	996	12,314	19,382	318,199
1940			8,907	194,738
1941	7	795	20,777	511,366
1942	1,443	18,926	8,336	223,184

Calcium chloride and calcium-magnesium chloride recovered from natural brines are largely byproducts of the manufacture of bromine, sodium chloride, magnesium chloride, and certain other salts. Most of the calcium chloride produced in the United States is a byproduct of soda ash manufactured by the ammonia-soda process, and its cost is borne by the soda ash; in this synthetic calcium chloride, the calcium comes from limestone and the chlorine from salt. The output is not canvassed by the Bureau of Mines, but it is estimated that 4,000,000 tons of synthetic calcium chloride in solution were available as a byproduct of the ammonia-soda process in 1942, of which it is estimated 175,000 tons (185,000 tons in 1941) were recovered and sold, competing directly with calcium chloride from natural brines. Producers estimate that approximately 90 percent of the total natural and synthetic calcium chloride available from all sources is thrown away.

The following firms reported production of calcium chloride and calcium-magnesium chloride from natural brines in 1942: California Rock Salt Co., 2436 Hunter Street, Los Angeles, Calif., plant at Amboy, Calif.; J. Q. Dickinson & Co., Malden, W. Va.; The Dow Chemical Co., Midland, Mich.; Great Lakes Chemical Corporation, Filer City, Mich.; Hill Brothers Chemical Co., 2159 Bay Street, Los Angeles, Calif., plant at Amboy, Calif.; Liverpool Salt Co., Hartford, W. Va.; Michigan Chemical Corporation, St. Louis, Mich.; Mullet Island Salt Works, Niland, Calif.; Ohio River Salt Corporation, Mason W. Va.; Pomeroy Salt Corporation, Pomeroy, Ohio, plant at Minersville, Ohio; Rademaker Chemical Corporation, Eastlake, Mich.; and Westvaco Chlorine Products Corporation, 405 Lexington Avenue, New York, N. Y., plants at Chula Vista, Calif., and South Charleston, W. Va.

Calcium chloride is used chiefly in road stabilization, which accounts for nearly half the consumption. It is used also in the treatment of coal, air conditioning, preventing evaporation and freezing of water in fire buckets, and as a desiccator in oil pipe lines. A new commercial use is in the recovery of lithium chloride from spodumene concentrates. The process, which was developed by the Bureau of Mines,[16] involves heating spodumene with calcium chloride at high

[16] Fraas, F., and Ralston, O. C., Chloride Volatilization of Lithium from Spodumene: Bureau of Mines Rept. of Investigations 3344, 1937, 11 pp.

temperature, whereby the lithium is volatilized as the chloride and recovered. Other important outlets for solid calcium chloride or its solutions are in freezeproofing coal and various ores, in removing ice on streets and highways, in brines at refrigerating plants, in curing concrete, and in calcium-soap lubricants. A comparatively new household use is in dehumidification of basements and cellars; kits for this purpose are available in many department stores.

Prices of calcium chloride, flake, 77 to 80 percent, carlots, delivered, ranged from $18.50 to $35.00 a ton throughout 1942, according to Oil, Paint and Drug Reporter. Solid calcium chloride, 73 to 75 percent, was quoted at $18.00 to $34.50 a ton, carlots, delivered; and 40-percent solutions, $7.50 a ton, tanks, works.

BROMINE

Shortage of gasoline for civilian use in 1942 was largely responsible for a 4-percent decrease from 1941 in output of bromine and its compounds, as bromine is a constituent of ethylene dibromide used in antiknock fluids. Nevertheless, heavy requirements for antiknock fluids for mechanized warfare maintained the total output of bromine at a relatively high level.

Bromine and bromine in compounds sold or used by producers in the United States, 1938–42

Year	Pounds	Value	Year	Pounds	Value
1938	33, 324, 116	$6, 610, 056	1941	68, 317, 019	$11, 506, 213
1939	37, 882, 005	7, 611, 400	1942	65, 880, 935	13, 729, 383
1940	59, 266, 275	11, 772, 515			

Fourteen plants produced bromine and its compounds in 1942, as follows: American Potash & Chemical Corporation, Trona, Calif.; J. Q. Dickinson & Co., Malden, W. Va.; The Dow Chemical Co., Midland, Mich.; Ethyl-Dow Chemical Co., Wilmington, N. C., and Freeport, Tex.; Great Lakes Chemical Corporation, Filer City, Mich.; Liverpool Salt Co., Hartford, W. Va.; Michigan Chemical Corporation, St. Louis, Mich.; Morton Salt Co., Manistee, Mich.; Pomeroy Salt Corporation, Minersville, Ohio; Rademaker Chemical Corporation, Eastlake, Mich.; and Westvaco Chlorine Products Corporation, South Charleston, W. Va., and Chula Vista and Newark, Calif. Most of it was produced by the Ethyl-Dow Chemical Co. at Wilmington, N. C., and Freeport, Tex., from raw sea water, and by The Dow Chemical Co. from well brines at Midland, Mich. Other raw materials used were sea-water bitterns and dry-lake brines.

An increasingly important use of bromine is in the preparation of methyl bromide, a fumigant for growing plants and stored grains. Bromine and bromides are also used in making tear gases, dyes, medicinals, photographic reagents, and certain kinds of synthetic rubber.

Most bromine enters the market as ethylene dibromide, which was quoted over a range of 65 to 70 cents a pound in 60-pound drums during 1942, f. o. b. plant. Sodium and potassium bromides, U. S. P., granular, were quoted at 27 to 31 cents in 500-pound barrels, works; ammonium bromide at 31 to 35 cents; and bottled elemental bromine in cases at 25 to 30 cents a pound.

IODINE

There was no problem in iodine procurement in 1942, due to ample domestic production and to large stocks of Chilean iodine—estimated at a year's supply—held in the United States by the Chilean Nitrate Sales Corporation, New York City. Although some iodine was recovered on the West coast from kelp during the first World War, the American iodine industry really was born in 1928, when The Dow Chemical Co. undertook to recover iodine from oil-well waste waters near Shreveport, La. Dow later transferred its operations to Venice and Seal Beach, Calif., again using oil-well brines, and the Louisiana plant was shut down. The Deepwater Chemical Co., Ltd., Compton, Calif., also produces iodine from oil-well wastes. As there have been only two producers since 1937, the Bureau of Mines is not at liberty to reveal domestic output. In 1937, domestic producers shipped 299,286 pounds valued at $242,422. Production has been considerably higher in recent years.

Iodine is used in medicinals, photography, stock feed and human food, in organic syntheses, analytical reagents, leather manufacture, and special soaps.

American output is very effective in keeping the price of Chilean iodine low. As late as 1931, Chilean crude iodine sold in the United States at $4 a pound; in 1936 the price dropped to $0.90 but has gradually risen since then to $1.35 a pound less 5 percent, in 150-pound kegs, which price was constant throughout 1942. Resublimed iodine in 5-pound bottles, 50-pound lots, sold at $2 a pound during the year.

Imports of crude iodine, all from Chile, were 951,243 pounds valued at $1,051,432 in 1942, compared with 1,010,039 pounds valued at $1,121,513 in 1941. War Production Board General Import Order of December 17, 1942, prohibited import and export of iodine except by authorized persons.

Crude iodine imported for consumption in the United States, 1938–42

Year	Pounds	Value	Year	Pounds	Value
1938	570,532	$464,303	1941	1,010,039	$1,121,513
1939	200,000	168,238	1942	951,243	1,051,432
1940	1,244,146	1,296,181			

SODIUM SULFATES AND CARBONATES

Sales of natural sodium sulfates and carbonates increased 11 and 3 percent, respectively, in quantity in 1942 compared with 1941. Nine producers reported sales of natural sodium sulfate in 1942; eight reported for 1941. Natural sodium sulfate production rivals the output of salt cake and chemical sodium sulfates in the United States. Production of natural sodium carbonates, however, is small as compared with the quantity manufactured by the Solvay process, which yielded 3,944,000 short tons in 1942, according to Chemical and Metallurgical Engineering (vol. 50, No. 2, February 1943, p. 105). As in past years, nearly all the output of natural sodium carbonate was produced by four firms from Searles and Owens Lakes in California. In addition, a small quantity of soda ash was recovered from well brines in the vicinity of Green River, Wyo., which area is underlain by extensive strata of trona.[17]

It has been proposed for several years to recover potassium carbonate by reacting Green River trona with potassium-bearing wyomingite, also found near Green River, and in 1942 the Bureau of Mines erected a pilot plant to study the reaction.[18] Potassium carbonate is used in the glass, ceramics, and chemical industries.

Natural sodium sulfates and sodium carbonates sold or used by producers in the United States, 1935–42

Year	Sodium sulfates [1]		Sodium carbonates [2]	
	Short tons	Value	Short tons	Value
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
1941	157,524	1,443,137	146,677	1,822,986
1942	175,033	1,669,983	150,619	2,145,289

[1] 1935–38: Salt cake and Glauber's salt; 1939–42: Salt cake, Glauber's salt, and burkeite.
[2] 1935–41: Soda ash, bicarbonate, and trona; 1942: Soda ash and trona.

The American Potash & Chemical Corporation (plant at Trona, Calif., on Searles Lake) rushed the expansion of its Soda Products Plant during 1942; the new units were expected to be in operation early in 1943. As a raw material for some of its soda ash and salt cake, the expanded plant will use burkeite, a sodium carbonate-sulfate hitherto sold to the kraft-paper industry as a substitute for salt cake. The American Sulphates Co., Mecca, Calif., a new producer, extracted sodium sulfate from magnesium-sodium salts mined near Bertram, Imperial County, Calif. The deposit has been described by Sampson

[17] For a description of the deposit, see Smith, H. I., Trona in Wyoming: Am. Inst. Min. and Met. Eng. Tech. Pub. 1489, July 1942, 3 pp.
[18] Ralston, O. C., and Stern, A. George, Annual Report of the Nonmetals Division, Fiscal Year 1942: Bureau of Mines Rept. of Investigations 3675, November 1942, p. 11.

and Tucker.[19] The Arizona Chemical Co., 30 Rockefeller Plaza, New York City, increased its output of sodium sulfate from well brines near O'Donnell and Brownfield, Tex. The Desert Chemical Co., 4031 Goodwin Avenue, Los Angeles, Calif., extracted sodium sulfate and sodium chloride from well brines at its Dale Lake plant near Twentynine Palms, Calif. The company enlarged its facilities and drilled additional wells in 1942 with the intent of increasing its capacity to 50,000 tons of sodium sulfate and 80,000 tons of sodium chloride annually. The Iowa Soda Products Co., Council Bluffs, Iowa, mined sodium sulfate from an open pit near Rawlins, Wyo., and operated the Rawlins refinery at capacity during the year, producing Glauber's salt for mineral feed and veterinarian requirements. The Natural Soda Products Co., 405 Montgomery Street, San Francisco, recovered sodium carbonate at Keeler, Calif., from Owens Lake, Inyo County, for use mainly in glass, sodium chemicals, paper, and nonferrous metallurgy. The Ozark Chemical Co., Mid-Continent Building, Tulsa, Okla., operated its Monahans (Tex.) plant at full capacity during 1942, recovering sodium sulfate from well brines. The major portion of the output was of "salt-cake" grade and was shipped to kraft pulp mills; the remainder was consumed by the glass and chemical industries. The Pacific Alkali Co., 523 West Sixth Street, Los Angeles (plant at Bartlett, Calif.), extracted soda ash and trona from Owens Lake brines for use in mining and metallurgy, cleansers, and glass. W. E. Pratt, Casper, Wyo., mined sodium sulfate near Casper and converted it to Glauber's salt. The Washington Chemical & Salt Corporation, Brewster, Wash., in a test run extracted about 20 tons of sodium sulfate from a dry lake near Monse, Wash. The West End Chemical Co., 608 Latham Square Building, Oakland, Calif., increased its production of sodium carbonate from Searles Lake and began the construction of additions to its plant, including carbonating towers, tanks, and other facilities, the cost of which is estimated at $300,000.

The uses of natural and synthetic sodium sulfate are approximately the same; both are used in the manufacture of kraft pulp; flat, pressed, fiber, and optical glass; antimony recovery; stock feeds; dye standardization; and control of caustic embrittlement of boilers. The use of sodium sulfate in glassmaking was reviewed by Weyl.[20]

The chief use of natural sodium carbonates is in glass (mostly container), which takes nearly half the output. Large quantities of trona, $Na_2CO_3.NaHCO_3.2H_2O$, and hydrated sodium carbonate are consumed in cleansers. Increasing quantities of natural sodium carbonate are being used in the metallurgy of tungsten, molybdenum, vanadium, and antimony.

In 1942 the Bureau of Mines published a brief analysis of the production and uses of sodium carbonate.[21] The second edition of Manufacture of Soda, by T. P. Hou, was published by the Reinhold Publishing Corporation, New York City, in 1942.

[19] Sampson, R. J., and Tucker, W. B., Mineral Resources of Imperial County: California Jour. Mines and Geol., vol. 38, No. 2, April 1942, pp. 140-143.
[20] Weyl, W. A., The Role of Sodium Sulfate in Glass Manufacture: Glass Ind., vol. 24, No. 1, January 1943, pp. 17-20, 39.
[21] Harness, C. L., and Coons, A. T., Sodium Carbonate: Bureau of Mines Inf. Circ. 7212, 1942, 35 pp.

Domestic salt cake was quoted at $15 a short ton, bulk, works; anhydrous sodium sulfate at $1.70 to $1.90 per hundredweight, works; and Glauber's salt at $1.05 to $1.28 per hundredweight throughout 1942, according to Oil, Paint and Drug Reporter. Soda ash, calcined sodium carbonate, was sold in 1942 at $0.90 to $3.25 a hundredweight, depending on grade and other factors.

BORATES

Boron-mineral production in 1942 slumped from lack of shipping space for exports and from shifts in the domestic consumption pattern. Shipments of boron minerals and boron derivatives made by the producers of boron minerals were 25 percent below those of 1941 in quantity. Five producers—all in California and same five that produced in 1941—reported shipments.

Salient statistics of the boron-mineral industry in the United States, 1938–42

	1938	1939	1940	1941	1942
Sold or used by producers: [1]					
Short tons	215,662	245,284	243,355	301,282	226,723
Value	$4,739,291	$5,689,797	$5,643,390	[2] $6,785,662	$5,733,648
Imports for consumption (refined): [3]					
Pounds	631	[3] 774	752	2,025	----------
Value	$131	[3] $170	$185	$92	----------
Exports:					
Short tons	77,519	91,139	64,313	41,793	36,542
Value	$2,642,446	$3,230,304	$2,456,523	$1,893,500	$1,562,794
Apparent consumption: [4]					
Short tons	138,143	154,145	179,042	259,490	190,181

[1] 1938: Borax, kernite, and boric acid; 1939: Borax, colemanite, kernite, ulexite, and boric acid; 1940–41: Borax, kernite, boric acid, and colemanite; 1942: Borax, anhydrous sodium tetraborate, kernite, boric acid, and colemanite.
[2] Revised figures.
[3] Also 348 pounds of crude valued at $7 in 1939.
[4] Quantity sold or used by producers plus imports minus exports.

The American Potash & Chemical Corporation, 122 East Forty-second Street, New York City, extracted borax from the brines of Searles Lake at its Trona, Calif., plant and sold borax, dehydrated borax, and boric acid for domestic and foreign consumption in a wide variety of uses, but particularly in special glassware. The Pacific Alkali Co., 523 West Sixth Street, Los Angeles, recovered borax from Owens Lake, at Bartlett, Calif., chiefly for export. The Pacific Coast Borax Co., 510 West Sixth Street, Los Angeles, oldest and one of the largest producers, operated its kernite mines at Boron, Calif., and its Wilmington (Calif.) refinery (making kernite concentrates, borax, boric acid, and other boron derivatives) at near-capacity levels in 1942 for domestic and export trade. The United States Borax Co., 510 West Sixth Street, Los Angeles, mined colemanite (crude calcium borate) near Shoshone, Inyo County, Calif., for conversion into borax at a nearby refinery. The West End Chemical Co., 608 Latham Square Building, Oakland, Calif., recovered borax from Searles Lake at its Westend (Calif.) plant and sold both borax and dehydrated borax.

Before the war, borax was used chiefly in porcelain enameling. Owing to the lack of steel for making stoves, refrigerators, and similar articles, the amount of borax consumed in the enameling industry was small in 1942. The major wartime use is in glass, principally container and bottle glass, and kitchen utensils (replacing aluminum, stainless steel, and enamelware). Borax in the glass batch enables glass to withstand, with minimum breakage, such treatments as washing and pasteurizing; borax improves the tensile strength, elasticity, and hardness of glass, thus facilitating handling and shipping. The salt is used in many types of optical glass, in heat-resistant laboratory ware, in reflectors and beacons for airports, in water-gage glasses, in the bulbs of electron tubes, and in "foamglas" insulation.

Boron minerals and their derivatives are also used in the manufacture of pharmaceuticals, in water treatment (*p*H control), in making detergents, in textile treatment, in alloy steels,[22] as a preservative in adhesives, in rust inhibitors, and in abrasives. A molding sand for magnesium castings, containing boric acid to prevent reaction of magnesium with the moisture in the sand, has been described.[23] The use of borax in fire-retardant paints is discussed in Technical Notes 249 of the Forest Products Laboratory, Madison, Wis. Borax contents of 32 to 50 percent of the total paint are typical. A steel producer reported that kernite (crude $Na_2B_4O_7 \cdot 4H_2O$) could be substituted for aluminum as a scavenger in the ladle, on open-pour steels containing 0.10 percent carbon and under, accomplishing a saving of about 2.5 ounces of aluminum per ton of ingots without sacrificing quality.[24] The use of borax as a plant food is growing. Application of 10 to 20 pounds of borax per acre to boron-deficient soils is said to stimulate the growth of alfalfa, vetch, turnips, beets, and other plants. Many of the more important articles dealing with this use are reprinted in "Boron-O-Gram," a bimonthly published by the Pacific Coast Borax Co., 510 West Sixth Street, Los Angeles, Calif.

The price of technical borax, granular, bulk, works, remained at $41.50 a short ton throughout 1942, according to Engineering and Mining Journal Metal and Mineral Markets.

[22] Tisdale, N. F., The Use of Boron in Steel and Iron: The Frontier, vol. 5, No. 4, December 1942, pp. 6–7, published by Armour Research Foundation, Chicago, Ill.
[23] Metal Progress, vol. 4, No. 4, April 1942, p. 493.
[24] Iron Age, vol. 149, No. 17, April 3, 1942, p. 53.

GEM STONES

By Sydney H. Ball

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JEWELRY INDUSTRY IN 1942

Retail sales by jewelry stores in the United States totaled $699,000,000 in 1942—an all-time record and a 32.9 percent increase over 1941. Gains were particularly large in Washington and Oregon and in other areas where there are big war plants. As in the past 2 years, the increase was due to a large turn-over of relatively inexpensive items, although a few high-priced items were sold. Even the New York Fifth Avenue shops are showing more reasonably priced articles. The Christmas trade reached an all-time record, many believing it to be the last Christmas until the war is over when one could buy what one liked.

Increased sales were due to the marked rise in income of a large number of Americans (national income: 1939, 70 billion dollars; 1942, 119.8 billion dollars—thanks, unfortunately, to the war), to some investment buying, and to an all-time high in number of weddings (about 1,800,000 marriages, an 11-percent increase over 1941). Women war workers form a new class of jewelry-store customers, and some new fortunes are being made which will mean new purchasers of gems.

National income in 1943 will be even greater than that in 1942; and, notwithstanding the markedly higher taxes, the public will be ready to buy jewelry, particularly that moderately priced. Retailers will have difficulty in keeping their showcases filled, even though their business, as is likely, may average less than that of 1942. However, they can get diamond-set palladium jewelry and other gem stones, probably set in gold, and will find dealing in old jewelry profitable. As retailers face a shortage in help and higher operating costs and taxes, as well as ceiling prices on their wares, their 1943 profits are not likely to be as large as those of 1942.

Sales by wholesalers showed smaller gains (9 percent), and yet their stocks decreased (10 percent). Retailers' stocks decreased during the

year, and certain lines (watches, alarm clocks, etc.) were sold out during the Christmas season; they are begging wholesalers for goods, and of course, owing to Government regulations, the situation will become more acute. Late in 1942 the War Production Board limited the size of inventories that might be carried by the large and financially more stable companies in the hope that stocks might be distributed more evenly among retailers. Inventories in 1942 shrank only slightly.

As far as selective service is concerned, the jewelry trade is to receive few favors; jewelry artisans, lapidaries, and salesmen (both retail and wholesale) are nondeferrable.

Canadian retail sales were excellent before the new 25-percent excise tax was effective, June 23, 1942.

FASHIONS IN JEWELS

The rather severe modern gown requires the gaiety of jewels. Utilitarian, though smart, jewelry characterized the mode in 1942, and hence multiple-use clips and other double-duty jewelry were popular. The vogue for gold continued to grow at the expense of platinum, which cannot be used hereafter for jewelry. Regimental jewelry, "V for Victory," and floral designs were popular, although geometric, Hindu, and Latin American motifs also were used. Ensembles set with similar stones were much worn. Clips and brooches were especially popular; bracelets (identification and charm bracelets largely), earrings, and rings were also in demand.

Owing to the shortage of melee, pavé mountings are becoming rare. Topaz, amber, and aquamarine barbaric in size were used in bracelets and rings. Diamond (including some yellow stones), ruby, and sapphire (largely blue, but also yellow and pink) were the most popular gems, followed by topaz, aquamarine, amethyst, and amber. The insistent demand for diamonds and the patriotic motif in jewelry caused colorless stones to be dominant, followed by blue and red stones, then yellow and brown, and then green, purple, and black. The wide knowledge of gem stones, because of lectures by jewelers and courses in some colleges, is causing the American public to use a wider range of gem stones than ever before. Fine examples of certain of these stones are not too expensive, and some of them may be as beautiful as some of the noble gems.

DOMESTIC PRODUCTION

The production of gem stones in the United States in 1942 did not escape the blight of war, because producers sought minerals of greater strategic importance. Further, gas rationing in 1942 reduced not only collecting by amateurs but cut down the number of tourist customers who passed the lapidary's door. On the other hand, the shortage of foreign-cut stones improved the market for stones of American origin and cut. Intensified mining of pegmatitic ore bodies for block mica, beryl, and tantalite should have increased the production of aquamarine and other pegmatitic gem stones; but, if so, the miners appear to have high-graded the gem byproduct. Government-aided crystal mining (for radio plates) in Arkansas and California also probably increased the production of crystal suitable only for objets d'art. Makers of meerschaum pipes were short of the Turkish raw material, and satin spar was not available to the cutters of beads at Niagara

Falls. Restrictions on the use of silver in jewelry are said to have reduced the manufacture of turquoise-set jewelry by the Navajos.

It is believed that the net result of these various factors was a markedly smaller production of gem stones in 1942. A rough estimate of the value of uncut stones used in jewelry and related industries is $150,000 with a total value after cutting of $400,000; corresponding estimates in 1941 were, respectively, $240,000 and $770,000. Of the total value in 1942, sapphires (largely used industrially) represented 31 percent, turquoise 21 percent, and the quartz minerals 20 percent. The chief producing States in approximate order of output were Montana, Nevada, Oregon, and Wyoming.

Two corporations in Montana in 1942 produced sapphires weighing about 50,000 ounces (1.71 short tons) worth $47,000; most of these stones were stock-piled for possible use as instrument jewels, although a few were cut for gems. American Gem Mines (Charles H. Carpp, manager) at Philipsburg was the principal producer; this company sold its product to the Government. The Perry-Schroeder Mining Co., a gold-dredging company operating near Helena, was permitted, after the orders closing gold mines were issued, to continue dredging because of its sapphire byproduct. The New Mine Sapphire Co. at Utica and the Simon property near Butte did not operate.

The Smith mine near Beowawe, Nev. (product sold in California), was the principal turquoise producer; it yielded 13,033 pounds valued at $32,000. B. F. Couch reports that other Nevada turquoise miners produced about 350 pounds worth $4,000. The King property, at Manassa, Colo., also produced considerable turquoise, and a small quantity is said to have been mined near Kingman, Ariz. The Los Cerrillos mine, near Santa Fe, N. Mex., was not operated.

Dr. H. C. Dake reports that in 1942 gem mining in the Pacific Northwest (Washington, Oregon, Idaho, Montana, and Wyoming) was only about half as active as in 1941, although cutting of agate cabochons increased. Part of the lapidary industry was converted to the cutting of radio quartz plates. Fine moss agate was discovered about 8 miles southeast of Willowdale, central Oregon; the agate is reported to occur as a thick vein in rhyolite, and about 4,000 pounds worth $4,000 is said to have been mined.

Fine moss agates continue to be recovered from the gravels of Yellowstone River in southeastern Montana, but in diminishing quantities. R. L. Harris, of Miles City, Mont., a jeweler and moss-agate enthusiast, found on the banks of the Yellowstone a moss agate with a natural "V" for Victory on it. He had it cut and mounted in a ring of Montana silver and requested a national news weekly to present it to Winston Churchill; this was done, and the last leg of the journey was made in a ferry bomber. The Prime Minister was pleased to accept it. A little agatized wood, "rainbow" agate, and other forms of quartz are produced in Wyoming.

New occurrences of both green and black jade (nephrite) have been discovered in the general vicinity of Lander, Wyo. (personal communications of Fred Abernathy, Lloyd B. Curtis, H. C. Dake, and O. W. Plaga). Some of the green is of fine quality and worth $5 a pound. Boulders of jade, one of which is said to weigh almost 2,000 pounds, occur in an area 20 miles long and 3 miles wide paralleling Sweetwater River. Black nephrite is reported to occur in place in granite, but

the lighter green is known only as boulders. It is by no means impossible that after the war American jade will be exported to China.

A. M. Buranek reports that several hundred pounds of variscite were mined from the Clay Canyon deposit near Fairfield, Utah, and collectors obtained some variscite from Grantsville (Tooele County) and Lucin (Box Elder County). Fine agates and jaspers were obtained in eastern Utah. Considerable jet was collected from the Henry Mountains in southeastern Utah. Black obsidian with white christobalite inclusions, attractive when polished, has been found in Millard County, and some has been sold. Good topaz crystals were collected on Topaz Mountain, and pyrope garnet was obtained near Mexican Hat, San Juan County.

P. C. Leggett reports that several hundred carats of fine amethyst were produced in 1942 from two New Hampshire localities—Stark and Milan. The Stark locality, on Lone Mountain, is almost exhausted, but smoky quartz crystals occur rather abundantly in other "pockets" on the mountain. After heat treatment, the gem turns pale yellow. The Milan amethyst from Greens Ledge is not as fine as that from Stark, but the crystals are larger and less flawed. Gems of almost 30 carats have been obtained. Yellow, wine, blue, and colorless topazes also are found on Greens Ledge. Several good aquamarine crystals were found during the year in two mines in North Groton. Deeply colored, asteriated rose quartz was produced near the French mine in Gilsum.

Hugh D. Miser (see Bibliography) considers the veins from which the Hot Springs (Ark.) quartz crystals are obtained to be hydrothermal deposits of probable magmatic origin of mid-Pennsylvanian age. Although some of the finer crystals are sold for jewelry under the trade name "Hot Springs diamonds," most are sold to collectors or to constructors of water fountains and religious and memorial shrines. He estimates the value of crystals sold in 1941 at $12,000. Some are cut into radio oscillators. Crystals weigh from a small fraction of an ounce to 330 pounds. Certain localities furnish beautiful crystals of smoky quartz.

Other gems produced in the United States in 1942 included alabaster (South Dakota); albite (Maine); amazonstone (near Bar Harbor, Maine); amethyst (Maine); aquamarine (Amelia, Va.; Avon, Idaho); asteriated quartz (Wyoming); caesium beryl (Maine); lepidolite (Maine); moss agate (Siskiyou and San Bernardino Counties, Calif.); pipestone (Minnesota); rock crystal (Arkansas); rose quartz (Maine and South Dakota); greenish spodumene (Maine); topaz (Maine); tourmaline (Maine); and californite, a variety of vesuvianite, (Siskiyou County, Calif.).

CANADA GEM STONES

Dr. A. L. Parsons reports that a little rock crystal was discovered in 1942 in Leeds County, Ontario; otherwise, the industry, never important, was dead.

The Royal Ontario Museum at Toronto has a fine collection of Canadian gem and decorative stones, notably agate (Bay of Fundy and Thunder Bay district, Ontario); amethyst (Nova Scotia and Thunder Bay district, Ontario); and rose quartz (Lyndock Township, Ontario, and Manitoba). The rose quartz is deep in color and has

been used commercially to some extent. Included, also, are peristerite, an iridescent feldspar (Monteagle Township, Ontario); sodalite (Bancroft, Ontario, and Ice River, British Columbia); aquamarine (rare, Lyndock Township, Ontario, and southeastern Manitoba); golden beryl (rare, Manitoba); yellow scapolite (Grenville Township, Quebec); and amber (Cedar Lake, Manitoba).

IMPORTS[1]

Imports of precious and semiprecious (real and imitation) stones (exclusive of industrial diamonds) totaled $28,449,422 in 1942, a 16-percent decrease from 1941. Details are as follows:

Precious and semiprecious stones (exclusive of industrial diamonds) imported for consumption in the United States, 1941–42

Commodity	1941		1942	
	Carats	Value	Carats	Value
Diamonds:				
Rough or uncut (suitable for cutting into gem stones), duty-free	215,026	$10,301,371	277,826	$11,518,085
Cut but unset, suitable for jewelry, dutiable	229,582	18,346,415	125,806	14,599,770
Emeralds:				
Rough or uncut, free	10,295	25,739	6,506	676
Cut but not set, dutiable	22,160	313,185	21,209	205,717
Pearls and parts, not strung or set, dutiable:				
Natural		387,053		179,169
Cultured or cultivated		469,676		
Other precious and semiprecious stones:				
Rough or uncut, free		107,610		72,387
Cut but not set, dutiable		2,968,129		1,580,705
Imitation, except opaque, dutiable:				
Not cut or faceted		10,962		195
Cut or faceted:				
Synthetic		244,264		86,829
Other		534,070		97,573
Imitation, opaque, including imitation pearls, dutiable		33,377		2,622
Marcasites, dutiable:				
Real		28,228		104,150
Imitation		7,136		1,544
		33,777,215		28,449,422

METAL SHORTAGES IN AMERICAN JEWELRY TRADE

Most of the common metals normally utilized in costume jewelry were diverted to national defense in 1941; and in 1942 use of most of the other metals in jewelry was prohibited. Limited amounts of domestic silver are still available, as, of course, is gold. Small amounts of the copper necessary to harden these metals can be used until June 30, 1943. The use of platinum, iridium, and rhodium in jewelry is forbidden. However, palladium alloyed with ruthenium is an acceptable substitute for platinum. Incidentally, should the need for it arise, the diamond-set platinum jewelry of United States citizens constitutes a considerable reserve of two critical materials for war purposes—platinum and diamonds. The Canadian manufacturer of jewelry is restricted even further, because the use of palladium is forbidden.

PRICE CEILINGS

Jewelry prices were frozen in June 1942 to the level effective during March 1942, although this did not affect "precious stones" as defined

[1] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Departments, Commerce.

by the Office of Price Administration. A precious stone, according to the OPA, is "any ruby, sapphire, emerald, natural pearl or any diamond weighing more than 1 carat or any semiprecious stone, after sale by the cutter, when the cutter has received more than $100 for sale of the stone." In addition, when "two or more diamonds with an aggregate weight of 1.5 carats are set in one mounting," the diamonds shall be deemed precious. According to this definition a faded ruby, a watery sapphire, or a badly flawed emerald weighing a carat is precious, but a half-carat, flawless, well-cut diamond is not.

CONVERSION OF THE JEWELRY INDUSTRY

The jewelry industry—as it produces in part articles of no value to the war effort and as it has been shorn of many of its raw materials—has been converted to war work to the greatest possible extent. Some of the larger units are wholly converted, the smaller less completely so, although some of the smaller shops, by pooling, have obtained valuable subcontracts. Silverware plants are making munitions; a firm formerly manufacturing expensive jewelry is now cutting quartz plates for radio work; and watch factories are turning out instrument jewels.

GOVERNMENT REGULATIONS

Every government, from the smallest to the largest, since the war began has had to formulate a host of regulations for the jewelry trade. The principal objects were to divert funds normally spent on jewelry to government securities, to discourage exportation of easily converted wealth, and to prevent critical material and needed skilled labor from being used to produce unessential merchandise.

EFFECT OF WAR ON THE GEM-STONE TRADE

In 1942, the United Nations lost Burma and thereby an important source of ruby, sapphire, spinel, jade, and tourmaline. On the other hand, when Dakar sided with the Fighting French, the Axis Powers lost the most important source of industrial diamonds remaining to them.

There is no shortage of gem diamond, ruby, emerald, and sapphire in America, nor of most of the less expensive precious stones, with the possible exception of zircon. The "good-neighbor policy" is making Americans more familiar with the lovely tourmaline, aquamarine, and topaz of South America. The lapidaries of the Northwestern States are cutting many agate and jasper cabochons for mountings of inexpensive jewelry. Supplies of synthetic stones and imitations are inadequate.

Owing to the war, Indian and Ceylonese stones (especially sapphire and star sapphire) arrive in New York direct instead of via Paris and London, as formerly. By air mail, elapsed time is 3 or 4 weeks.

Nazi puppets in the Netherlands, Croatia, and other dependencies continue to rob Jews of their jewelry, in instances having the effrontery to pretend that the funds which the jewels represent will be administered in favor of the victims.

Americans in India are buying jewels for souvenirs on an extensive scale. Jaipur, the principal Indian cutting center, has never been busier. As the business ethics of the average Hindu jeweler are low,

some American soldiers will find themselves possessing fine bits of glass; others will acquire jewels that will serve as heirlooms for generations to come. Algerian goldsmiths look upon the arrival of Americans as a reasonable excuse to quadruple prices.

DIAMOND

The diamond industry had its most prosperous year in over a decade, owing to unprecedented sales of industrial diamonds. Rough, suitable for gem cutting, also was sold in considerable quantity.

Production continued in 1942 at about the 1941 rate, although it was only 69 percent of that in 1940. A large part of the product of the mines of central and northwest central Africa—only African mines now operating—is of industrial grades, but the gem stones recovered are sufficiently valuable to keep industrial prices reasonable. Prices of rough and fine large cut continued to advance; those of small cut declined somewhat. In fear of inflation, "investment" buying increased in the black markets of Europe and the free market here.

Share dealings.—The shares of diamond-mining companies, virtually all of which are listed on the London Stock Exchange, gained over one-third in value in 1942. Their record was much better than that of the British industrials or American stocks in general. Frequently they were market leaders.

Stocks were hesitant for the first quarter, then advanced sharply; fell, owing to the British set-back in Libya, but from mid-July to the year end gained markedly. At the close of the year stocks stood at 560 percent of the all-time low (1932) and at 52 percent of the all-time high (1927). Nearly all the companies paid dividends in 1942, several at increased rates.

Market.—In 1942, the Diamond Trading Co., which in normal times controls the sale of about 95 percent of the world output, sold rough to the value of well over £10,500,000. "American qualities" (large fine rough) and fine small goods enjoyed a satisfactory market, but probably over 40 percent of the sales were of industrials. In mid 1942 the British Government appointed C. H. Rodwell diamond controller. The Trading Co. branch office at Hamilton, Bermuda, is said to have been closed recently, all stocks on hand having been sold.

In 1942 America bought large quantities of medium-size cut, particularly in the second half of the year. The other warring nations bought what they could, usually in "black" markets at fantastic prices. In time of war diamonds are natural "investments" to the enslaved people of a conquered country and to citizens of a belligerent country whose war future is dismal.

Prices of rough diamonds early in the year advanced 5 to 20 percent, according to qualities. Fine cut advanced 10 to 15 percent; melee slumped 30 percent in the first half of the year but rallied and was off but 10 percent at the year end.

Stocks of rough decreased markedly in 1942, as consumption exceeded production. Stocks in the hands of American cutters are probably adequate, as are those of fine large cut; the supply of small cut is abnormally low.

Imports.—As the following table shows, 1942 imports of gem diamonds were 91 percent of those of 1941, a small gain in rough imported being offset by a larger loss in cut. The quality of cut imported was excellent; that of rough was mediocre.

Diamonds imported into the United States, 1941–42, by countries

[Exclusive of industrial diamonds]

Country	Rough or uncut			Cut but unset		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
1941						
Argentina				146	$8,607	$58.95
Belgium				145,504	8,298,551	57.03
Brazil	63,710	$2,280,628	$35.80	7,434	678,099	91.22
British Malaya				236	19,878	69.50
Cuba				205	17,808	86.87
France				4,950	726,665	146.80
Germany				539	42,337	78.55
Hong Kong				9	596	66.22
Mexico				443	35,930	81.11
Netherlands				1,521	76,565	50.34
Netherlands Indies				104	5,339	51.34
Palestine				5,523	703,293	127.34
Switzerland				630	108,796	172.69
Union of South Africa	150,324	7,986,039	53.13	42,326	5,450,923	128.78
U. S. S. R.				30	2,250	75.00
United Kingdom				19,932	2,170,778	108.91
Venezuela	992	34,704	34.98			
	215,026	10,301,371	47.91	229,582	18,346,415	79.91
1942						
Argentina				36	32,013	889.25
Belgian Congo	205	4,573	22.31			
Belgium and Luxembourg				26,755	2,042,757	76.35
Brazil	6,320	477,812	75.60	23,842	2,686,071	112.66
British Guiana	591	19,775	33.46	55	5,810	105.64
British Malaya				278	19,628	70.60
Canada				1	395	395.00
Colombia				18	2,666	148.11
Cuba				2,746	321,863	117.21
France				1,327	184,250	138.85
Germany				162	7,520	46.42
India and Dependencies (British India)				1	50	50.00
Mexico				365	41,211	112.91
Netherlands				960	83,341	86.81
Netherlands Indies				117	13,579	116.06
Palestine and Trans-Jordan (Palestine)				20,502	2,989,910	145.84
Switzerland				175	19,346	110.55
Union of South Africa	252,580	10,524,425	41.67	35,153	4,738,062	134.78
United Kingdom [1]	1,683	102,154	60.70	13,307	1,410,598	106.00
Venezuela	16,447	389,346	23.67	6	700	116.67
	277,826	11,518,085	41.46	125,806	14,599,770	116.05

[1] United Kingdom of Great Britain and Northern Ireland.

Cutting.—In 1942 diamond cutting ceased its recent rapid growth, due partly to a slightly smaller demand for large cut but mostly to the diversion of artisans from gem to industrial cutting.

Now that the Low Countries are no longer factors in the cutting industry, the United States (750 cutters and 750 apprentices) and Palestine (reported as 2,500 cutters) are the largest cutting centers, followed by South Africa (400 cutters), Great Britain (300), Puerto Rico (75), and Cuba (66). Java, Borneo, and Brazil cut some diamonds for their local trade, but the cutting is not done well enough to satisfy the American trade.

Several of the belligerents propose to train their wounded as cutters, notwithstanding the unfortunate outcome of similar experiments after the First World War.

World production.—For the third year, due to the war, accurate diamond-production statistics are not available, but the estimates in

the following table are believed to be fairly accurate. World production (gems and industrials) in 1942 is estimated to have been 9,254,200 carats (1.851 metric tons) valued at $28,000,000. Compared with 1941, the weight increased somewhat more than 1 percent, and the value did not change. The quality was similar to that of 1941, bort representing about 79 percent of the total and gem stones 21 percent. Belgian Congo was the leading producing country, both in weight (65 percent of the total) and in value (29 percent). The British Empire produced 22 percent of the total by weight and 33 percent by value. As the South African pipe mines were not operated, all production was from alluvial mines.

The following table shows, as accurately as available statistics permit, world production for the past 5 years.

World production of diamonds, 1938–42, by countries, in metric carats

[Including industrial diamonds]

Country	1938	1939	1940	1941	1942
Africa:					
Angola	651,265	690,353	784,270	787,000	[1] 791,850
Belgian Congo	7,205,620	8,360,000	9,603,000	5,866,000	6,018,000
French Equatorial Africa	16,013	[1] 16,000	[1] 16,000	20,000	20,000
French West Africa	61,928	56,314	[1] 75,000	35,000	36,000
Gold Coast [2]	1,296,763	1,087,652	[1] 825,000	1,000,000	[1] 1,000,000
Sierra Leone	689,621	[1] 600,000	750,000	850,000	[1] 850,000
South-West Africa	154,856	35,470	30,017	46,578	60,000
Tanganyika (exports)	3,576	3,445	2,250	[1] 1,750	1,000
Union of South Africa:					
Mines	979,460	1,089,144	[1] 371,447		
Alluvial	259,147	160,684	[1] 172,027	112,300	[3] 106,000
Total Union of South Africa	1,238,607	1,249,828	[1] 543,474	112,300	[3] 106,000
Brazil	235,000	[1] 350,000	[1] 325,000	325,000	300,000
British Guiana	32,522	32,491	[1] 26,764	27,000	27,000
Other countries [4]	34,200	19,000	31,750	34,350	44,350
Grand total	11,619,971	12,500,553	13,012,525	9,104,978	9,254,200

[1] Estimated.
[2] 1938–40: Exports; 1941–42: Production.
[3] South African production without Namaqualand was about 76,505 carats.
[4] 1938: U. S. S. R., India, Borneo, New South Wales, and Venezuela; 1939: Venezuela, India, Borneo, New South Wales, and U. S. S. R.; 1940 and 1941: Borneo, India, New South Wales, U. S. S. R., and Venezuela (Venezuela produced 29,399 carats); 1942: Borneo, India, New South Wales, Rhodesia, U. S. S. R., and Venezuela (Venezuela produced 34,084 carats).

Both Angola and Belgian Congo showed slightly greater production; but the decrease in South Africa was rather marked, indicating near exhaustion of its alluvial diggings.

In 1942 some of the companies attempted to increase production of the industrial stones so necessary today and succeeded in a small way. If the war continues, however, the long-term outlook is for a drying up of production, as certain essential supplies will be lacking owing to the isolation of the mines now producing.

Industrial diamonds.—In these days industrial diamonds steal the limelight from the gem variety, not only as to sales but as to romance. Concerning the latter, we may cite the recovery of several shipments snatched by the Allies from under the eyes of the Axis Powers.

The use of industrial diamonds, particularly of crushing bort, continues to increase beyond the expectations of anyone in the industry. Part of this expansion, of course, is due to the war program; but after the war is over, industrial diamonds will retain much of their gain in use. Consumption greatly exceeds production. The

finer grades continue to be scarce, but users are schooling themselves to utilize advantageously the grades that are available.

Germany and Italy are already feeling a shortage of industrial diamonds. Germany's shortage is dramatically indicated by the fantastic prices charged in the Swiss "black" market. Japan is in an even less enviable position, as it has not a store of gem stones to which it can resort.

Wholesale prices of industrials in 1942 remained firm; retail prices strengthened. During the year the War Production Board tightened its regulations as to transactions in industrial diamonds.

In pre-war days the percentages, by value, of the chief uses for industrial diamonds were as follows:

	Percent
Diamond drilling	45–40
Diamond-set tools	30–35
Diamond dies	10– 7
Crushing bort (bonded wheels and tools)	10– 7
Miscellaneous	5–11

Today the use of crushing bort is much greater, and the use of diamond-set tools and of dies is relatively greater, largely at the expense of diamond consumption in drilling.

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, 1938–42

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1938	1,396,247	$4,213,412	$3.02	1941	6,882,248	$14,908,809	$2.17
1939	3,568,730	9,725,683	2.73	1942	11,203,704	22,154,076	1.98
1940	3,809,071	11,026,563	2.89				

RUBY, SAPPHIRE, EMERALD

In Indian Precious Stones, by L. A. N. Iyer (Bull. 6, Records of the Geological Survey of India, Calcutta, New Delhi, 1942, pp. 17–23), the Indian sapphire localities of Afghanistan, Burma, and Ceylon are described. In its 40-year life (1885–1925), the average annual gross of the Burma Ruby Mines Co. was only about $300,000, sufficient reason why the company expired some years ago. The local natives carry on mining in a crude way, either by shallow shafts from which the "byon" is removed and robbed laterally as far as safety permits; by terracing the sides of a hill, somewhat after the Colombian mining practice; or by collecting gravels from limestone caves. The gravels are treated in an open, slightly sloping pond, in which the valuable gems sink and the valueless sands are washed away.

Edward Gübelin (see Bibliography) described the rather distinctly differing microscopic and other characteristics of sapphires from the major fields (Kashmir, Burma, Thailand, and Ceylon).

LESSER GEMS

Jade (nephrite) occurs in Burma in place in a dike, in a Tertiary conglomerate derived from it, and in modern stream gravels (Indian Precious Stones, by L. A. N. Iyer, pp. 38–41). Mining is confined to the dry months, March to May. Although the finer cutting is done in China (75 percent of the product is exported to that country), some stones are cut in Mandalay. The market depends on the prosperity of China; hence, at present it is depressed.

In 1940, Madagascar produced 4,400 pounds of agate, 1,004 pounds of rock crystal, and 28,508 troy ounces of precious stones of various classes. Its beryl, amethyst, and particularly its amber are fine.

Brazil is rich in precious stones. Its diamond and quartz crystal are mentioned elsewhere; one report states that in the first 9 months of 1941 Brazil exported the following additional gem stones to the United States:

Kind		*Quantity*	*Value, milreis*
Aquamarine	grams	26, 080	1, 912, 092
Amethyst	do	45, 286	666, 336
Tourmaline	do	3, 412	238, 027
Topaz	do	16, 561	175, 821
Agate	kilos	5, 410	83, 076
Other gem stones	grams	371, 129	1, 431, 107

About 63 percent of these exports reached the United States. Total exports of aquamarine in 1940 were reported to have been 1,169,034 grams, worth about $667,000, and in 1941, 524,651 grams, worth about $550,000. Brazil's cutting industry employs about 2,500 artisans.

An aquamarine weighing 109 kilos was found early in the summer of 1942 at Ariranho in the State of Minas Gerais. The owners were at once offered 800 contos for the stone, or about $40,000. A short time before, a fine block of rock crystal weighing 480 kilos had been found in the same region.

South-West Africa formerly sold its precious stones to the Germans; in consequence, since the war began very little if any mining has been done. In 1939, however, 4,075,031 grams of precious stones were produced, and 9,226,269 grams, worth £1,132, were exported to Germany. The principal stones were aquamarine, heliodor (golden yellow beryl), tourmaline (blue, through green, to a pale yellow-green), rose quartz, and chalcedony. A few colorless or light-blue topazes are also produced around Leideritz Bay in the diamondiferous gravels, and some agate. Apparently, so far as aquamarine, tourmaline, and topaz are concerned, the pegmatite druses at the surface are more or less exhausted. The unweathered rock is hard, requiring the use of dynamite in mining, and any gem stones recovered from such rock are likely to be flawed.

INSTRUMENT AND CHRONOMETER JEWELS

Before the war, the United States imported virtually all its instrument and watch jewels from Europe, particularly from Switzerland. Without such jewel bearings, high-grade instruments and chronometers to guide our aviators and to assist our bombardiers and Navy officers cannot be made. When war came, plants were created in this country to produce synthetic sapphire, and stocks of Montana sapphire were set aside as a reserve. Simultaneously, mechanical means of

fabrication were introduced. The program is apparently approaching successful completion. In addition, certain hard-glass bearings are being made, which will alleviate the situation. Imports for consumption of jewels for any movement, mechanism, device, or instrument or for any meter or compass numbered 92,547,236, valued at $2,007,012, in 1941 and 36,649,359, valued at $1,015,788, in 1942. In November 1942 the use of instrument jewels was confined to essential war work (WPB. M–50, amended Nov. 2, effective Nov. 2, 1942).

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NITROGEN COMPOUNDS[1]

By BERTRAND L. JOHNSON

SUMMARY OUTLINE

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GENERAL CONDITIONS

Nitrogen, in various compounds, is an essential element in the domestic economy of the United States. About 500,000 short tons were consumed in this country yearly in normal pre-war times—nearly 400,000 tons in agriculture and the remainder in industry. The current war increased the domestic need for nitrogen for both agricultural and industrial purposes far beyond productive capacity or importation possibilities available at its start. The result was a shortage in nitrogen. In the recent past the demand for this element was met largely from domestic sources, but an important part of the supply has necessarily come from foreign countries, as the United States in the past was never self-sufficient in nitrogen supply.[2]

The war cut off some imports, hindered the importation of other commodities, and seriously disturbed the domestic nitrogen economy. Munitions factories had first call on the lessened nitrogen supply, and the military demands for nitrogen were so great that there was not enough for agricultural needs. Restrictions were placed on the use of nitrogen in fertilizers, and one after another of the nitrogen compounds was placed under allocation. Consumption in 1942 was exceedingly heavy, and the supply did not equal the demand either for munitions or agricultural use. Agriculture attempted to turn to organic nitrogenous materials for fertilizer use, and new synthetic nitrogen plants were started to satisfy the demand for explosives. On January 1, 1943, there had been built or were in process of construction in the United States synthetic and byproduct nitrogen plants with the huge capacity of at least 1,725,000 tons of nitrogen, a quantity nearly three times as great as the maximum pre-war consumption of nitrogen for all purposes. Development of this great productive capacity will release the United States from dependence upon foreign countries for supplies of this vital material, but it will introduce a hazard in the post-war economy because it exceeds any peacetime requirements that can now be foreseen.

[1] Latest previous chapter on this subject: Mansfield, G. R., Nitrates: Geol. Survey Mineral Resources, 1922, part II, 1923, pp. 39–40.

[2] Johnson, Bertrand L., Nonmetallic Minerals Needed for National Defense. 1. Fertilizer Materials: Bureau of Mines Inf. Circ. 7159, 1941, 6 pp.

INORGANIC NITROGEN COMPOUNDS

NATURAL NITRATES

Domestic nitrate deposits.—Deposits of soluble nitrate minerals are widely distributed in small quantities in the United States. Nitrate deposits have been found in 23 States, including the humid States Pennsylvania, Tennessee, and Alabama, but occurrences are much more numerous in the arid and semiarid parts of the West. Three types of nitrate deposits are known—cave, caliche, and playa. The cave nitrates are most widely distributed; the caliche and playa types occur only in the arid regions. The cave deposits contain the widest variety of nitrate salts, including potassium, sodium, calcium, and (more rarely) magnesium and ammonium nitrate. The caliche and playa deposits are chiefly sodium nitrate. The deposits are discussed in detail in various Geological Survey reports.[3]

The known natural nitrate deposits in the United States are too small and too low-grade to serve as a basis for a domestic nitrate industry. Furthermore, the general conditions under which nitrates occur in nature are quite well known, and this knowledge affords little hope that deposits of commercial size or quality will ever be found.

The United States has no domestic production of natural nitrates, so far as known. Cave nitrates were used occasionally in the past. The domestic caliche and playa nitrate deposits have never been worked.

Chilean nitrates.—Natural sodium nitrate and smaller quantities of potassium-sodium nitrate are imported from Chile. All Chilean nitrate of soda imported from July 1, 1942, to the end of the year was for the account of the Defense Supplies Corporation, a subsidiary of the Reconstruction Finance Corporation.

Sodium nitrate imported into the United States, 1938–42

Year	Chile		Total		Year	Chile		Total	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1938	644,942	$10,689,289	646,386	$10,731,678	1941	610,561	$10,868,222	610,569	$10,868,568
1939	676,409	11,199,895	676,917	11,213,445	1942	899,785	17,213,549	899,845	17,216,194
1940	744,145	12,451,179	744,145	12,451,179					

Potassium-sodium nitrate (all from Chile) imported into United States, 1938–42

Year	Short tons	Value	Year	Short tons	Value
1938	44,493	$971,646	1941	34,541	$725,846
1939	55,164	1,235,078	1942	14,272	377,703
1940	55,016	1,366,131			

Imported and synthetically produced domestic sodium nitrates are under allocation—approximately 80 percent for agricultural and the

[3] Mansfield, G. R., and Boardman, Leona, Nitrate Deposits of the United States: Geol. Survey Bull. 838, 1932, 107 pp.
Noble, L. F., Mansfield, G. R., and others, Nitrate Deposits in the Amargosa Region, Southeastern California: Geol. Survey Bull. 724, 1922, 99 pp.
Noble, L. F., Nitrate Deposits in Southeastern California, with Notes on Deposits in Southeastern Arizona and Southwestern New Mexico: Geol. Survey Bull. 820, 1931, 108 pp.
Gale, H. S., Nitrate Deposits: Geol. Survey Bull. 523, 1912, 36 pp.

remaining 20 percent for industrial uses. Control of allocation is under General Preference Order M–62 of January 15, 1942, effective February 1, 1942.

A stock pile of Chilean nitrate was started in Chile in 1941 by the United States Government.

SYNTHETIC NITROGEN COMPOUNDS

General.—The general situation with respect to chemical nitrogen up to the entrance of the United States into World War II is well-covered by recent publications.[4]

The following summary presents the major developments in the leading chemical nitrogen products in 1942.

Ammonia and its compounds.—In the United States ammonia (NH_3) is made principally by the high-temperature reaction of pure nitrogen and hydrogen under pressure in the presence of a catalyst. A relatively smaller quantity is recovered as a byproduct of the coking of coal. Ammonia is now used principally in military explosives, and, to a slightly smaller extent, in the manufacture of nitrogenous fertilizers. Smaller quantities are used in industrial explosives, chemicals, and in various minor ways. Agricultural consumption in 1941 has been estimated at about 65,200 short tons of nitrogen in the form of anhydrous ammonia and ammonia liquors; consumption in 1942 is believed to have decreased because during part of the year the use of these commodities for the direct ammoniation of superphosphate was prohibited.

Although the production of synthetic ammonia at privately owned and Government plants made an all-time record in 1942, the supply was still short because of the greatly increased demand for its use in making munitions and in other war industries.

The United States capacity for the production of synthetic ammonia is being vastly increased. Several new plants have been erected, and others are in process of erection. It is reported that eventually there will be synthetic-ammonia plants in 10 or more States.

General Preference Orders M–163 and M–164, effective June 1, 1942, placed both byproduct ammonia and synthetic ammonia under complete allocation by the War Production Board. There was no Government stock piling in 1942.

Ammonium sulfate is one of the most important agricultural fertilizers and one of the principal sources of nitrogen in mixed fertilizers. Production increased in 1942 over 1941, but sales declined from 756,569 short tons in 1941 to 751,914 tons in 1942. In 1941, agricultural consumption of this commodity in the United States totaled 138,248 short tons of contained nitrogen, or 30.6 percent of the total nitrogen consumed in agriculture.[5]

Byproduct ammonium sulfate was placed under allocation by the War Production Board in General Preference Order M–163 of May 30, 1942, effective June 1, 1942. Allocation did not change the use pattern, and most of the ammonium sulfate is stated by the War

[4] U. S. Tariff Commission, Chemical Nitrogen: Rept. 114, 2d ser., 1937, 300 pp.
Johnson, Bertrand L., Work cited in footnote 2.
Schallis, A. H., Nonmetallic Minerals Needed for National Defense. 3. Nitrates: Bureau of Mines Inf. Circ. 7170, 1941, 6 pp.

[5] Mehring, A. L., Consumption of Commercial Nitrogen as Fertilizer in 1941: Fertilizer Review, vol. 17, No. 3, 1942, pp. 2–3, 11–13.

Production Board to have gone to the fertilizer industry, but smaller quantities were allocated than before.

Ammonium nitrate, hitherto used chiefly in the manufacture of explosives, is being utilized to a considerable extent as a nitrogenous fertilizer. Tennessee Valley Authority Nitrate Plant No. 2 at Muscle Shoals, Ala., was modernized and rehabilitated in 1942 and began to produce and ship ammonia nitrate for explosives and later for fertilizers. Imports of a mixture of ammonium nitrate and limestone, produced in Ontario, Canada, were released by the War Production Board early in 1943 for direct application to the soil.

Sodium nitrate.—When the United States entered World War II, only one domestic establishment was producing synthetic sodium nitrate—the Hopewell (Va.) plant of the Allied Chemical & Dye Corporation. Several new domestic plants were erected and began operations in 1942. The production capacity of synthetic sodium nitrate plants in the United States at the end of 1942 has been estimated at about a million tons annually, but this capacity could be attained only at the expense of reducing supplies of ammonia available for other purposes. Most of the domestic synthetic nitrate of soda produced in 1942 is reported to have gone to munitions plants, and the remainder to fertilizer consumers. The allocation of synthetic nitrate of soda is covered by the same order (General Preference Order M-62) as is Chilean nitrate.

Cyanamid.—Imported Canadian calcium cyanamid, a synthetic fertilizer, has contributed materially to meeting United States needs. It has been produced since about 1910 at the plant of the American Cyanamid Co., of New York, at Niagara Falls, Canada. Domestic production has been limited to a single venture of the United States Government. Nitrate Plant No. 2 at Muscle Shoals, Ala., was originally erected as a cyanamid plant, but except for a 2-week trial run in 1919 it was never operated. Calcium cyanamid is, like other chemical nitrogen fertilizers, under allocation (Conservation Order M-231).

ORGANIC NITROGEN COMPOUNDS

Organic nitrogenous materials of vegetable or animal origin, such as tankage, fish scrap, cottonseed meal, castor pomace, dried blood, guano, bones, sewage sludge, and tobacco stems, are utilized entirely in the fertilizer and feed industries and compete with chemical nitrogen products. The best grades, however, contain an average of only 5 to 12 percent nitrogen. The demand for some of these materials for animal feed is increasing.

Restriction in the use of chemical nitrogen in fertilizers after September 1942 resulted in an increased demand for organic nitrogen compounds, and competitive bidding by feed makers and fertilizer interests led to shortages and unequal distribution.

MINOR NONMETALS

By G. Richards Gwinn [1]

SUMMARY OUTLINE

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CARBON DIOXIDE

Carbon dioxide, widely known as a means of supplying sparkle and palatability to carbonated beverages and in its solid form as a highly efficient refrigerant, has constantly increasing utility in war equipment. In this field it is used as a fire extinguisher in tanks, trucks, and airplanes and as an inflating agent for life preservers and rafts.

Production of commercial carbon dioxide in the last 6 months of 1942, as compiled by the Chemical Branch of the War Production Board, was 146,173 short tons of dry ice valued at $7,308,650 and 76,981 short tons of liquid and gas. The value of carbon dioxide in liquid or gaseous form ranges from 1 cent to 8 cents per pound, depending on the purity of the product; as the total for liquid and gas is given as one, no attempt has been made by the Bureau of Mines to compute an average or total value.

GRAPHITE

Demand for all qualities of graphite, except natural amorphous, was greater in 1942 than in 1941; demand for crucible-grade material was greatest. Aided by conservation orders and restrictions, stocks of both Madagascar flake and Ceylon lump were at higher levels than in 1941.

Graphite has been placed on the critical materials list, but only about 10 percent of the graphite employed in the United States has critical importance. This is principally flake graphite from Madagascar, used in crucibles. Although the advent of electric furnaces for manufacturing high-grade steel reduced the demand for graphite crucibles, fairly large numbers are still used in melting nonferrous metals and some steels. Flake graphite is used also in retorts for smelting and refining zinc and brass.

On December 28, 1941, graphite was included under General Imports Order M–63, which placed imports of critical materials under Govern-

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

ment control. On February 17, 1942, the War Production Board issued Order M–61, restricting the use of plus-35-mesh Madagascar flake graphite to the manufacture of crucibles, and named the Metals Reserve Co. as sole importer of graphite of this quality. On December 4, 1942, the order was amended to include all crystalline graphite (in flake, lump, or chip form) that will stand on a No. 50 mesh screen, U. S. Sieve Series. The United States depends principally on Madagascar and Ceylon for its supplies of strategic-grade graphite; therefore, imports in the following table are of primary importance.

Graphite (natural and artificial) imported into the United States for consumption, 1938–42

Year	Crystalline				Amorphous				Total (natural and artificial)	
	Flake		Lump, chip, or dust		Natural		Artificial			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1938	1,620	$90,663	209	$13,717	14,676	$247,789	500	$19,870	17,005	$372,039
1939	2,260	110,476	602	30,421	18,675	269,046	413	15,383	21,950	425,326
1940	6,551	340,396	752	54,027	23,766	487,675	260	9,187	31,329	891,285
1941:										
Australia			(1)	16					(1)	16
Canada					839	53,762	38	1,384	877	55,146
Ceylon			2,705	363,705	10,343	1,072,940			13,048	1,436,645
Japan					1,853	16,439			1,853	16,439
Madagascar	4,877	289,322	194	6,492					5,071	295,814
Mexico					20,347	220,293			20,347	220,293
United Kingdom			1	200					1	200
	4,877	289,322	2,900	370,413	33,382	1,363,434	38	1,384	41,197	2,024,553
1942:										
Canada	7	2,376			629	36,133	169	4,739	805	43,248
Ceylon	280	19,098	3,922	582,928	8,951	1,157,969			13,153	1,759,995
China			68	9,680					68	9,680
India [2]			56	3,820					56	3,820
Madagascar	5,744	391,445	106	4,722					5,850	396,167
Mexico					23,933	274,476			23,933	274,476
Union of South Africa					(1)	1			(1)	1
United Kingdom [3]					56	11,500			56	11,500
	6,031	412,919	4,152	601,150	33,569	1,480,079	169	4,739	43,921	2,498,887

[1] Less than 1 ton.
[2] India and Dependencies (British India).
[3] United Kingdom of Great Britain and Northern Ireland.

The Madagascar total of 5,850 short tons represents shipments received in March and April 1942, the only months of that year during which graphite arrived from the island. As a result of the allocation order of the War Production Board and its subsequent revision, the existing industrial and Government stocks of crucible flake on hand at the end of the year were adequate for current needs plus a 9-month reserve (3,600 short tons). The supply of Ceylon lump material was in an even more favorable condition. Based on the quantity consumed during 1942 (800 short tons) and requirements estimated by the War Production Board for 1943 (900 short tons), the stock of 1,300 short tons at the end of 1942 represents a reserve of approximately 15 months' supply. Stocks of graphite fines represent a 2 years' supply.

Exports of natural graphite, 1938–42, were—1938: 983 short tons, valued at $112,443; 1939: 976 tons, $109,715; 1940: 1,632 tons, $148,639; 1941: 1,723 tons, $166,612; and 1942: 4,420 tons, $448,141. Exports of natural graphite represent, for the most part, reexports of Madagascar flake; the export market includes U. S. S. R., England, Canada, Mexico, and several South American countries.

As foreign shipments are uncertain, efforts were continued to promote a larger domestic output. The Bureau of Mines continued its investigation of possible domestic sources. Graphite samples from Alabama, Georgia, Pennsylvania, New York, Texas, and California were collected and analyzed. Various flow sheets were used in an attempt to determine the best method of recovery with minimum degradation of the coarse flake. The data from these tests were used as a guide in designing plants to produce crucible-grade flake graphite approved by the War Production Board.

Five plants have been built with the assistance of loans from the Reconstruction Finance Corporation—three in Alabama and one each in Texas and Pennsylvania. They have a combined capacity of 4,300 short tons of crucible-grade graphite a year. Only one of the new plants was in operation during 1942, but all of them were producing by the end of the first quarter of 1943. The combined total of crystalline and amorphous graphite produced by domestic mines in 1942 was 7,070 short tons; except for part of the Ceylon Graphite Co. output, which sold as crucible flake, domestic graphite was used chiefly in foundry facings and paint. Artificial graphite was manufactured and sold by the Acheson Graphite Co., 30 East Forty-second Street, New York, N. Y., from a plant operated at Niagara Falls, N. Y.

The Canadian graphite industry is again becoming active as the result of a diamond-drill program by Ventures, Ltd., on the old Black Donald graphite property in eastern Ontario. Drilling has disclosed reserves of 40,000 tons of commercial-grade ore to a depth of 300 feet. The mill has been rehabilitated to treat 50 to 75 tons of ore daily.

Some impetus will be given to Mexican trade because of a trade treaty, signed December 23, 1942, which reduces the ad valorem duty on graphite from 10 percent to 5 percent. The treaty is effective for 3 years and thereafter until 6 months after either Government serves notice of termination.

Prices for Madagascar and Ceylon graphite in carlots, f. o. b. New York City, duty paid, in 1942 were as follows, in cents per pound: Madagascar, No. 1 Flake, 9 to 16; No. 2 Flake, 7; Fines (ground), 55 to 70 percent carbon, 3; Ceylon Lump, 10 to 12; Carbon Lump, 9 to 10; Chip, 7; and Dust, 4 to 5.

Figures for total world production of graphite are not available. A table covering the period 1915–39 appeared in Minerals Yearbook, Review of 1940 (p. 1414), and the following table includes all production figures from 1937 through 1942 that can be obtained.

World production of natural graphite, 1937–42, by countries, in metric tons [1]

[Compiled by B. B. Waldbauer]

Country [1]	1937	1938	1939	1940	1941	1942
Argentina	25	28		100	135	(2)
Australia:						
New South Wales					64	[3] 91
Queensland	12	10		63	320	(2)
South Australia	2				50	[4] 28
Tasmania				5	5	(2)
Brazil (exports)	9		(2)	(2)	60	(2)
Bulgaria			23	50	(2)	(2)
Canada (exports)	2,675	1,044	1,199	1,381	(2)	(2)
Ceylon	[5] 17,660	[5] 11,972	[5] 22,756	[5] 24,414	(2)	[6] 10,800
Chosen (exports)	43,569	50,348	78,501	[7] 2,591	(2)	(2)
Czechoslovakia	5,144	(2)	(2)	(2)	(2)	(2)
Germany:						
Austria	18,158	16,852		(2)	(2)	(2)
Bavaria	23,544	28,106	(2)	(2)	(2)	(2)
Greenland	60	(2)	(2)	(2)	(2)	(2)
India, British	567	465	951	(2)	(2)	(2)
Indochina (exports)		1	2	(2)	(2)	(2)
Italy	5,411	5,485	(2)	(2)	(2)	(2)
Madagascar	[5] 12,387	[5] 13,4[illegible]	2,[illegible]0	15,311	13,018	(2)
Mexico	11,210	9,611	9,8[illegible]5	12,327	16,928	20,816
Morocco:						
French (exports)	152	369	[4] 2[illegible]	(2)	(2)	(2)
Spanish		73	(2)	[5] 353	[5] 408	(2)
Norway	3,638	3,802	4,333	(2)	(2)	(2)
South-West Africa				71	188	(2)
Sweden	25	48	[illegible]65	(2)	(2)	(2)
Union of South Africa	63	54	[illegible]9	78	[8] 62	[8] 656
United States:						
Amorphous	(9)	(9)	(9)	(9)	(9)	6,414
Crystalline	(9)	(9)	(9)		(9)	

[1] In addition to countries listed graphite is produced in France, Japan, Nyasaland, Portuguese East Africa, Spain, and U. S. S. R., but production data are not available.
[2] Data not available.
[3] January to July, inclusive.
[4] January to June, inclusive.
[5] Exports.
[6] Estimated production.
[7] April to December, inclusive.
[8] January to October, inclusive.
[9] Bureau of Mines not at liberty to publish figures.

KYANITE, ANDALUSITE, AND DUMORTIERITE

Production of the sillimanite-group minerals increased in 1942 but not enough to keep pace with demand. The supply situation was aggravated by curtailment of shipments from India, occasioned partly by the threat of Japanese invasion of that country during the early months of 1942 and partly by lack of shipping facilities.

Domestic production, imports, and stocks of kyanite in the United States, 1940–42

Year	Domestic production		Imports from British India		Total new supply		Stocks [1]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940	4,241	$93,716	7,658	$92,159	11,899	$185,875	(2)	(2)
1941	8,335	175,581	14,285	175,218	22,620	350,799	(2)	(2)
1942	8,708	190,750	6,524	93,743	15,232	284,493	[3] 18,970	[3] $449,317

[1] Industry stocks of Indian kyanite as of Dec. 31.
[2] Figures not available.
[3] War Production Board Miscellaneous Minerals Division.

Imports of Indian kyanite were received every month of 1942 but July and August. Although the proposed 1,500-ton Government stock pile had not materialized, industry stocks were still a year ahead of the current requirement rate.

Domestic production of kyanite failed to attain expected proportions, chiefly because of dffiiculties in two eastern locations. Celo Mines, Inc., at Burnsville, N. C., pioneer producer in the east (which in 1941 became Mas-CeloMinnes, Inc., subsidiary of Munn & Steel of Newark, N. J.), ceased operation in June 1942; it was later reorganized as the Yancey Cyanite Co. and financed by the Reconstruction Finance Corporation. Mining and milling were resumed in February 1943 on a schedule of 12 tons of kyanite concentrate a day, or 300 tons a month. Half of this production will be low-iron glass-grade kyanite (Fe_2O_3 content, not over 0.20 percent) and the remainder refractory grade. This company will do no calcining.

The Kyanite Products Corporation near Farmville, Va.—largest individual domestic producer—hampered by bad weather during the last quarter of the year and by loss of employees to the armed forces produced several thousand tons less in 1942 than capacity output. With an enlarged plant and stabilization of manpower, increased production is expected during 1943.

Experimental work is still in progress to improve the grade of domestic kyanite, so that it may be used as a substitute for Indian kyanite. It makes an excellent mortar and may also be used in plastics, but at present it is not regarded as a satisfactory substitute in superrefractories for the Indian material.

The cost of Indian kyanite delivered at Atlantic seaports rose from a little over $30 per short ton in 1941 to $54 in 1942. Prices for domestic kyanite have been set by the Office of Price Administration under Order MPR 327 released February 17, 1943. On and after that date domestic kyanite cannot be sold, delivered, or bought at a price above the highest net charged by the operator for the same product on a delivery made during March 1942.

Under this order specific prices were set for the Yancey Cyanite Co. (Asheville, N. C.) at $22 per short ton f. o. b. plant for refractory-grade and $40 for glass-grade material. Prices set for the Kyanite Products Corporation (11 Broadway, New York, N. Y.) were $19 per short ton for raw kyanite, 35-mesh in carlots, to $37.50 for 325-mesh material, less than carlots in 100-pound bags; for calcined kyanite in 100-pound bags, the range was $26.50 per short ton, 35-mesh in carlots, to $42.50 for 325-mesh material, less than carlots, f. o. b. Cullen or Pamplin, Va.

Production of andalusite on White Mountain, Mono County, Calif., and dumortierite at Oreana, Pershing County, Nev., by Champion Sillimanite, Inc., Merced, Calif.—only domestic producer of either mineral in 1942—increased sharply over the 1941 total. This material was shipped to the parent firm—Champion Spark Plug Co., Detroit, Mich.—for use in spark-plug cores and other electrical porcelains.

Experimental work on sillimanite from a deposit near Troy, Latah County, Idaho, indicates that the crude material must be beneficiated by flotation or a similar process of concentration to be marketable.[2]

A large deposit of sillimanite in the Broken Hill district, New South

[2] Forrester, J. D., A Sillimanite Deposit Near Troy, Latah Co., Idaho: Idaho Bureau of Mines Pamph. 59, November 1942, 10 pp.

Wales, Australia, has been investigated by the Board of Economic Warfare through the War Supplies Procurement Mission of the Commonwealth of Australia. In January 1943 a 200-ton sample of this material was received in the United States by Charles F. Taylor & Sons Co., Cincinnati, Ohio, for use in experimental work in the manufacture of high-temperature refractories. If the tests are successful and shipping space is available a definite market can be developed for this material.

LITHIUM MINERALS

Shipments of lithium minerals and compounds reached 5,405 short tons valued at $243,516 in 1942 compared with 3,832 tons valued at $115,718 in 1941; they originated in four States—South Dakota, North Carolina, California, and Maine. Lithium used as a scavenger in metal refining and as an alloy, the stearate in greases, the chloride in air-conditioning industrial plants and in dehydrating air in blast furnaces, and the hydride as a transporter of hydrogen have increased in importance during the war. Available production facilities were inadequate to meet these increasing demands. On December 5, 1942, the War Production Board promulgated Order M–253, placing all lithium ores under control of the Director General for Operations. This order includes not only ore produced on that date and thereafter but also stocks held within the continental limits of the United States as of that date, whether in private or Government hands. A much more favorable supply situation will be created in 1943 by the completion of the new plant of the Solvay Process Co. at Kings Mountain, N. C., and the rebuilding of the Black Hills Tin Co. mill at Tinton, S. Dak. (destroyed by fire January 5, 1943), and the entrance of several new producers into this field.

Under supervision of the War Production Board all new plants set up to produce and concentrate lithium ores were constructed to mill spodumene because of its relative abundance and ease of separation. Production is also confined to extraction of the chloride, to the exclusion of other compounds which are used in ceramics.

The United States is the leading producer and consumer of lithium ores and compounds and apparently has the largest known ore reserves. South-West Africa, Australia, and Sweden produce the remainder of the world total, except for a small output from Canada, Portugal, Southern Rhodesia, Spain, and Germany.

Information on world production of lithium ores has been meager since 1937, when the United States produced 52 percent of the world total, South-West Africa 42.5 percent, Portugal 4 percent, and other countries 1.5 percent. In pre-war times Germany produced about the same amount of lithium compounds as the United States; however, these were derived largely from ores imported, chiefly from the United States and South-West Africa. The present German position is therefore unfavorable, as the only sources of imports available to Germany are Sweden, Spain, and Portugal, which are minor producers. Stocks are not known but are probably small or nonexistent, as this mineral is usually mined as needed.

Prices for lithium ores produced in the United States for sale on the open market, as quoted by Engineering and Mining Journal Metal and Mineral Markets, were constant during 1942 as follows: $5 per 20 pounds of contained lithia (Li_2O), 6 percent minimum, relatively free of iron, quartz, and tourmaline, $30 per short ton in carlots; amblyg-

onite, 8 to 9 percent Li_2O, $40 per short ton f. o. b. mine; and lepidolite, 3 percent (Li_2O), $24 to $25 per short ton f. o. b. mine.

MINERAL EARTH PIGMENTS AND MANUFACTURED IRON OXIDE PIGMENTS

[Prepared by Charles L. Harness]

World War II hastened domination of American markets by domestic pigments and encouraged local manufacture of many foreign-type pigments, thus accelerating trends in the earth-pigments industry that had been discernible for several years before 1939. Improvements in processing domestic pigments have offset without great difficulty the curtailment in imports of French yellow ochers, Spanish and Persian Gulf red iron oxides, Italian siennas, Turkish umbers, and German Vandyke and sap browns. Although the Bureau of Mines has no complete sales figures for mineral pigments in 1941 comparable with those for 1942, it estimates that total production was 30 percent greater in 1942 than in 1941.

Many producers geared their operations more closely to war needs in 1942. The Clinton Metallic Paint Co., Clinton, N. Y., formerly specializing in natural red iron oxide (Clinton hematite and blended colors based on it) for use in brick and mortar colors, installed equipment to prepare the pigments for paint use. To meet increased demands for earth pigments, the Geo. S. Mepham Corporation erected a new plant at East St. Louis, Ill. The Mineral Pigments Corporation, Muirkirk, Md., announced completion of new improved methods for synthesizing red iron oxides, Vandyke brown, and siennas; the siennas, which are made from scrap iron, are said to be considerably superior to Italian siennas. Reichard-Coulston, Inc., Bethlehem, Pa., built a plant for manufacturing synthetic yellow iron oxide for olive drab and camouflage paints. The Tamms Silica Co., Chicago, Ill., improved red iron oxides for use in rust-inhibiting primers and expanded its plant capacity for this and other products. C. K. Williams & Co., Easton, Pa., was active in camouflage-pigment research and was particularly successful in developing infrared-reflecting pigments.

Natural mineral pigments and manufactured iron oxide pigments sold by processors in the United States in 1942, by kinds

Pigment	Short tons	Value
Mineral blacks	2,229	$83,558
Precipitated magnetic blacks	2,244	378,395
Natural brown oxides (metallic browns)	7,839	334,445
Vandyke brown (finished pigment) and sap brown	208	27,915
Pure browns (96 percent or better iron oxides)	1,085	191,248
Natural red oxides	17,452	863,424
Pure red oxides (98 percent or better Fe_2O_3)	9,160	1,551,209
Venetian reds	8,507	557,576
Other red iron oxides	5,996	518,084
Natural yellow oxides (high Fe_2O_3)	8,223	228,197
Pure yellows (85 percent or better Fe_2O_3)	14,426	1,963,519
Ochers (low Fe_2O_3)	12,537	398,820
Siennas:		
Burnt	887	101,608
Raw	2,358	309,699
Umbers:		
Burnt	2,335	140,934
Raw	1,146	71,189
Other	695	44,412
	97,327	7,764,232

Natural mineral pigments and manufactured iron oxide pigments sold by processors in the United States in 1942, by States where processed

State where processed	Short tons	Value
Georgia	7,067	$133,111
Maryland	2,220	147,600
Pennsylvania	31,815	3,142,177
Other States [1]	56,225	4,341,344
	97,327	7,764,232

[1] Arkansas, California, Illinois, New Jersey, New York, North Dakota, Ohio, Tennessee, Virginia, and Wisconsin.

Dry ocher, sienna, umber, and other forms of iron oxide for paint exported from the United States, 1939–42, by countries of destination

Country of destination	1939		1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	316	$36,377	462	$57,348	325	$44,906	50	$8,993
Brazil	26	3,693	142	23,397	243	35,319	108	22,188
Canada	2,029	104,519	2,691	133,693	3,006	200,427	2,364	151,109
Colombia	14	2,537	22	4,275	124	24,751	97	26,857
Cuba	37	4,721	45	6,340	172	21,872	359	33,681
France	101	6,163	24	3,258				
Mexico	69	9,937	122	24,319	210	39,411	153	32,902
Netherlands	101	5,554						
Netherlands Indies	84	3,974	82	10,182	137	25,099	27	4,830
United Kingdom	2,328	77,596	1,166	33,427	20	8,696	1	224
Venezuela	30	3,624	89	11,563	161	19,264	100	16,112
Others	320	40,594	352	39,308	542	72,061	372	65,761
	5,455	299,289	5,197	347,110	4,940	491,806	3,631	362,657

Selected mineral pigments imported into the United States for consumption, 1939–42, by kinds

Pigment	1939		1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Natural iron oxide	5,439	$171,649	7,451	$248,290	6,196	$232,924	1,936	$60,697
Synthetic iron oxide	3,018	305,485	2,213	246,898	2,321	290,162	1,978	250,650
Ocher, crude and refined	3,465	83,560	2,099	52,257	380	11,717	477	12,036
Sienna, crude and refined	1,386	74,100	815	39,740				
Umber, crude and refined	4,727	57,555	2,826	43,580	31	1,579	5	159
Vandyke brown	453	30,555	7	722	3	185	(1)	43
	18,488	722,904	15,411	631,487	8,931	536,567	4,396	323,585

[1] Less than ½ ton.

Prices of finished earth pigments, which are quoted in cents per pound, were generally unchanged during the year, according to Oil, Paint and Drug Reporter. Precipitated magnetic blacks, in barrels, less carlots, works, were quoted at 8.5; metallic browns declined from 2.6 to 2.35; and Vandyke brown sold at 9, sap brown crystals at 12, synthetic browns at 12, natural red iron oxides at 2, synthetic red iron oxides at 9, Venetian reds at 2.2 to 4 (depending on iron oxide content), and natural yellow oxides, high iron, at 5. Synthetic iron oxide yellows declined from 7.25 to 7.1 during the year as production increased; domestic French-type ochers declined from 3.65 to

3.45; burnt siennas were quoted over a range of 3.5 to 6 (depending on quality), the prices declining slightly toward the end of the year; raw siennas ranged from 3.25 to 10, depending on quality, the quotations rising later in the year; and umbers were quoted at 3.375. Raw, untreated earth pigments are purchased by processors over a wide range of prices, from less than $1 to as high as $10 a ton at the mine.

MINERAL WOOL

The necessity of saving fuel for military uses, increasing the efficiency of industrial plants, and maintaining temperatures at normal levels in homes with less fuel during the war has hastened realization of the true economy of insulation.

It is estimated that production of mineral wool in 1942 reached 500,000 short tons valued at $22,500,000,[3] representing production from 58 companies operating 70 plants. To meet the unusual demands, the industry operated virtually at capacity, and this capacity was enlarged substantially by improvement in melting technique, which increased the output of mineral wool per ton of fuel from 2 to 1 to about 4 to 1 as an average, with a maximum of 6 to 1 in several plants. Efforts are being made to stabilize employment in the industry by encouraging dealers to purchase on a monthly basis rather than seasonally and thus keep production and employment in constant balance.

Through the efforts of the National Bureau of Standards and the Industrial Mineral Wool Institute, commercial specifications for the use of mineral wool in loose, granulated, or felted form in low-temperature installations were established in December 1942, to be effective on and after March 1, 1943. Tests at the National Bureau of Standards in Washington, D. C., the Engineering Experiment Station of the University of Illinois, and the National Research Council of Canada, as described in a recent Bureau of Mines information circular,[4] show that complete insulation of homes results in a 30-percent saving in fuel consumption.

This fuel saving is particularly important to the eastern region, which contains 65 percent of the total oil burners installed in the United States. The Office of Price Administration estimates that 51 percent of the houses having oil burners are insulated.

Mineral-wool insulation has been specified for use in military equipment by the War and Navy Departments for tanks, airplanes, and bulkhead insulation in ships. The loss of life by fire and suffocation from fumes of burning-cork insulation in sinking ships during the Pearl Harbor attack was responsible in large measure for the change in specifications for ship insulation. Prices in 1942, per short ton in carlots, f. o. b. plant, were $30 for loose mineral wool and $45 for granulated wool.

MONAZITE

Monazite sand is the only commercial source of cerium, other rare-earth oxides, and thorium which, although used in rather small quantities, are essential to many industries. The United States

[3] Estimate by Bureau of Mines, based on figures obtained from War Production Board covering first half of 1942.

[4] Bowles, Oliver, Home Insulation with Mineral Products—Conservation of Fuel for War: Bureau of Mines Inf. Circ. 7220, 1942, 15 pp.

depends entirely upon British India and Brazil for its supplies. Imports of monazite sands in 1942 increased 950 short tons over 1941, and the tonnage received from Brazil represented 31 percent of the total in 1942 as against 21 percent in 1941. If need be, Brazilian production can be expanded to supply all our essential requirements. The stock pile of these sands—entirely in the hands of industry—is in excellent condition, containing 2½ years' supply at the current rate of consumption as of March 1943.

Monazite sand and other thorium ore imported into the United States for consumption, 1938–42, by countries of origin [1]

Country of origin	1938		1939		1940		1941		1942	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Brazil	110	$3,421	54	$1,516	201	$7,440	734	$25,240	1,346	$62,555
India and Dependencies [2]	339	14,402	1,336	46,753	2,766	92,387	2,714	82,068	3,052	112,928
Netherlands Indies			170	3,747						
United Kingdom [3]	7	387								
	456	18,210	1,560	52,016	2,967	99,827	3,448	107,308	4,398	175,483

[1] Quantities are gross weight; monazite content not reported.
[2] British India.
[3] Great Britain and Northern Ireland.

Commercial utilization of the various elements in monazite sand has expanded considerably in the past few years. The original basis of value of 6 to 8 percent thoria content has been superseded by the ceria and other rare-earth oxides content, and requirements are now based on a 57- to 60-percent minimum of rare-earth oxides. Considerable technical skill is required to extract the rare-earth metals from these sands, and for many purposes the rare earths are used as a group. Cerium and the cerium group—the most important rare-earth elements—are used principally as arc stabilizers in carbon arc lamps, as mildew-proofing agents, and in the manufacture of pyrophoric alloys. Thorium is used principally in electron-emissive elements, praseodymium and neodymium are used in the manufacture of special optical glasses, and lanthanum and erbium in beauty preparations.

The market for these sands is variable and sporadic; therefore, buyers' specifications are elastic. Indian sands are finer-grained and have a higher thoria content than those of Brazil. The following quoted prices are nominal: $42.50 per long ton f. o. b. India plus $24 ocean freight to Baltimore; and $64 per metric ton f. o. b. Brazil plus $17 ocean freight to Baltimore.

OLIVINE

Shipments of olivine reached 5,739 short tons valued at $45,201 in 1942 and were consumed entirely in refractories. This tonnage is the largest ever produced and shipped in the United States. Olivine occurs in commercial quantities only in the rock dunite and in its alteration products, serpentine and steatite. These rocks, in lump or ground form, make up the material produced and sold as olivine.

Olivine deposits are found chiefly in Washington, California, North Carolina, and Georgia. A review of these deposits, which includes an estimate of their reserves and a description of their development in the

past few years, has recently been published.[5] Of particular interest is the experimental work now in progress to determine the potentialities of olivine as an ore of magnesium.

Prices for crude olivine, f. o. b. North Carolina, were quoted at $7 to $9 per short ton, and for ground olivine, 8- to 200-mesh, at $12 to $20 per short ton.

QUARTZ CRYSTAL

Piezoelectric-grade quartz crystals, which are required for radio oscillators and filters, telephone resonators, and other sound equipment, head the list of strategic and critical minerals published by the War Production Board. Although several domestic sources of supply bear some promise, we still depend upon Brazil for quartz of this grade, and the question as to whether our supply from Brazil will be adequate to meet the present requirement rate depends upon the extent to which small crystals can be used.

Imports of quartz pebbles reached 1,305 short tons valued at $8,941,965 in 1942. Except for imports of 1,024 pounds from Guatemala and 61 pounds from Colombia, which were sample shipments, the entire quantity was received from Brazil. This tonnage supplied 5,202,808 small [6] oscillators, 1,576,782 large [6] oscillators, 91,173 telephone resonators, and 17,050 units for detection equipment.

However, much of the quartz received did not meet specifications, and more thorough, systematic check of the material in Brazil was begun. American engineers were sent to visit the various producing areas, and inspection laboratories were set up in Rio de Janeiro. Toward the close of 1942 production increased, and quality improved.

On May 18, 1942, the War Production Board under Order M–146 assumed control over the products for which quartz crystals may be used; and on August 4, 1942, under General Imports Order M–63, importers were required to obtain War Production Board authorization for disposal of quartz crystals in this country. Beginning in January 1943 most of the crystals imported into the United States were air-borne, arriving at New York City, Washington, D. C., and Miami, Fla.; the largest portion entered at the Florida port. Only the low-grade material (of which about 10 percent will be usable) will be brought in by ships, and it will be purchased entirely by the Metals Reserve Co.

Arkansas, California, and certain other areas in the United States offer possibilities for developing domestic quartz-crystal production. The Hot Springs area in Arkansas offers two good possibilities, each of which (it is believed) will yield about 50 tons a year of 30-percent-usable material. Samples of Arkansas quartz when tested show a higher piezoelectric activity than Brazilian material.

Complete specifications and prices for piezoelectric-grade quartz have not been formulated, chiefly because of the lack of a systematic and consistent method of mining and grading the material at the source. The original specifications called for quartz, each piece weighing not less than 200 grams, 30 percent or more of which must

[5] Gwinn, G. Richards, Olivine: Bureau of Mines Inf. Circ. 7239, 1943, 11 pp.

[6] "Small" defined as one-half inch or smaller in January–April and October–December 1942; as five-eighths inch or smaller in May–September.
"Large" defined as sizes above these in same periods.

be free from inclusions, cracks, needles, bubbles, or twinning. Because of improved technique developed under the urge of necessity, smaller crystals were subsequently accepted. The minimum size has been reduced in several stages until in March 1943 it stood at 50 grams.

STRONTIUM MINERALS

[Prepared by Charles L. Harness]

Sales of celestite (crude strontium sulfate) by domestic producers declined somewhat, amounting to 4,041 short tons valued at $55,529 in 1942, compared with 4,724 tons valued at $69,054 in 1941. Despite an active market for use in tracer bullets and flares, no new deposits of chemical-grade celestite were worked commercially in 1942. Production of the abundant subchemical-grade celestite in Texas, formerly used entirely for oil-well drilling muds, declined with curtailment in drilling activity, although some of the higher-grade rock was sold for purifying caustic soda and for conversion to strontium chemicals, both with and without beneficiation. Research by the Bureau of Mines and by the Foote Mineral Co. on methods of beneficiating crude celestite found in Brown and Nolan Counties, Tex., indicated that the impure celestite can be beneficiated to a plus-92-percent content of strontium sulfate.

Imports of celestite into the United States amounted to 10,387 short tons valued at $144,848 in 1942, mostly from Mexico, compared with 4,294 tons valued at $66,271 in 1941, mostly from the United Kingdom.

Prices for chemical-grade celestite, lump, ranged from $30 to $35 a short ton laid down in the Philadelphia area.

TOPAZ

The United Feldspar & Minerals Corporation, of Spruce Pine, N. C., shipped 583 short tons of topaz valued at $8,807 from the Brewer mine near Kershaw, S. C., in 1942; it was used entirely in refractories. Experiments are still being made by the Bureau of Mines regarding the substitution of properly calcined topaz or a product composed of domestic kyanite and topaz for Indian kyanite in refractories.

VERMICULITE

Sales of crude and exfoliated vermiculite, which originated in seven States, totaled 57,848 short tons valued at $319,931 in 1942. Production was more than twice that in 1941, when 23,438 tons valued at $125,444 were sold. Although the Universal Zonolite Insulation Co. (2601 West One Hundred and Seventh Street, Chicago, Ill.), operating properties at Libby, Mont., remained the predominant producer and processor, the number of smaller producers increased during 1942.

The increased production of this material is directly associated with wartime industries. Under normal trade conditions the principal use for expanded vermiculite has been in home insulation, a minor portion being employed in acoustical installation, lightweight plaster, cements, and coatings. However, during the war major uses of expanded vermiculite have been as an aggregate in lightweight and insulating concretes—principally in poured concrete for structural roof deck—

and in insulating roof and floor fills in temporary and permanent buildings. Vermiculite is also employed in deck coverings and firewalls of tankers that may be exposed to bombing attacks and by the petroleum industry for lining cracking units in refineries where vermiculite blocks or bricks serve both as refractories and insulators.

Virtually all vermiculite that enters the domestic market is cleaned and screened at the mine; some is exfoliated by the producers, or it may be sold to a processor for exfoliation. Screened vermiculite was sold to processors at $8 to $12 a short ton f. o. b. mine. The exfoliated material was quoted at 70 cents to $1.25 a bag—each bag containing 4 cubic feet weighing 25 pounds—or $56 to $100 a short ton f. o. b. works.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. Adams

SUMMARY OUTLINE

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INTRODUCTION

The war year 1942 witnessed the operation of the mining industry of the United States with somewhat fewer men employed but with a large increase in number of man-hours of work performed. Copper, iron, lead, zinc, and other metals were in great demand by the Army and Navy; they were needed also for the manufacture of tools and other working equipment by civilian industrial plants engaged in producing airplanes, guns, tanks, and ships for the armed forces. Thus, the metal-mining industry was the original source of supply of raw materials of war. Back of the industries whose raw materials were of metal stood the coal-mining industry, without whose product the metal-using industries could not operate and the transportation systems of the Nation could not function. Faced with such conditions in 1942, the metal-mining industry and the coal-mining industry measured up to their wartime responsibilities. The difficult situation was met, so far as the mining and allied industries are concerned, by extension of the period of operation over a larger number of days during the year rather than by an attempt to increase the number of employees in the face of ever-increasing calls for men by the armed forces.

Reports thus far received (many companies not having yet reported) indicate that the mines, quarries, coke ovens, ore-dressing plants, and smelters in the United States employed approximately 812,600 men in 1942, or about 23,000 less than in 1941. However, operations during 1942, expressed in man-days of labor performed, reached nearly 211 million, a gain of 15 million man-days over the previous year. Expressed in another way, the volume of work performed was about 1.6 billion man-hours, compared with approximately 1.4 billion during 1941.

Accidents to the employees caused 1,878 deaths and 97,232 nonfatal lost-time injuries, such an injury meaning one that disables an employee longer than the remainder of the day on which he is hurt.

Based upon reports received by the Bureau, the mineral industries may be grouped into 22 classes, as shown in the accompanying table. Of these classes, 14 were operated with fewer employees than in 1941 and 8 with more. As the number of employees, however, does not necessarily indicate the extent of operations, the number of man-hours of work by the employees must be considered; on this basis, 15 classes showed gains and 7 showed losses. Of special note among the branches of the mineral industry that increased the number of man-hours of work during 1942 were mines and quarries or other plants that produced coal, iron, copper, lead and zinc, cement, limestone, coke, and such metals as mercury, manganese, and tungsten (included under "Miscellaneous" metals in the table). Gold mining experienced a loss in both number of employees and of man-hours worked, owing to the order of the War Production Board, which stopped or greatly reduced operations at mines whose principal output was gold-bearing ores.

Number of men employed [1] in the mineral industries of the United States, 1940–42

	1940	1941	1942 [2]
Coal mines:			
Bituminous	440,847	457,737	449,000
Pennsylvania anthracite	92,420	88,948	83,500
	533,267	546,685	532,500
Metal mines:			
Iron	23,250	25,870	28,100
Lead-zinc (Mississippi Valley)	7,644	8,634	8,800
Copper	19,498	21,576	22,600
Gold and silver lode mines (including lead, zinc, and copper, except as listed above)	39,128	38,235	29,900
Gold placer mines	15,701	13,368	12,700
Miscellaneous (tungsten, manganese, etc.)	5,119	6,614	7,000
	110,340	114,297	109,100
Nonmetallic-mineral mines	9,780	11,088	10,900
Quarries:			
Cement	26,695	28,859	30,200
Marble	3,240	2,693	2,400
Slate	2,800	2,845	2,400
Traprock	2,951	3,029	2,900
Granite	7,162	7,830	6,500
Sandstone	3,078	3,180	3,100
Limestone	23,251	26,395	25,900
Lime	10,332	11,292	10,500
	79,509	86,123	83,900
Coke ovens:			
Byproduct	17,469	18,633	19,500
Beehive	2,493	4,008	4,300
	19,962	22,641	23,800
Metallurgical plants:			
Mills	13,990	14,807	14,900
Smelters	20,120	22,003	20,700
Auxiliary works	14,958	17,539	16,800
	49,068	54,349	52,400
Grand total	801,926	835,183	812,600

[1] Figures represent summation of reports for individual mines showing daily average number of employees at each mine on days when mine was in operation

[2] Subject to revision.

An 11-year (1932 to 1942) review of accidents and employment in the 22 classes of the mineral industries of the United States is presented in the following table. Trend lines based upon the figures in the table are given in figure 1. As is evident from the table, the volume of employment, as measured by number of man-hours worked,

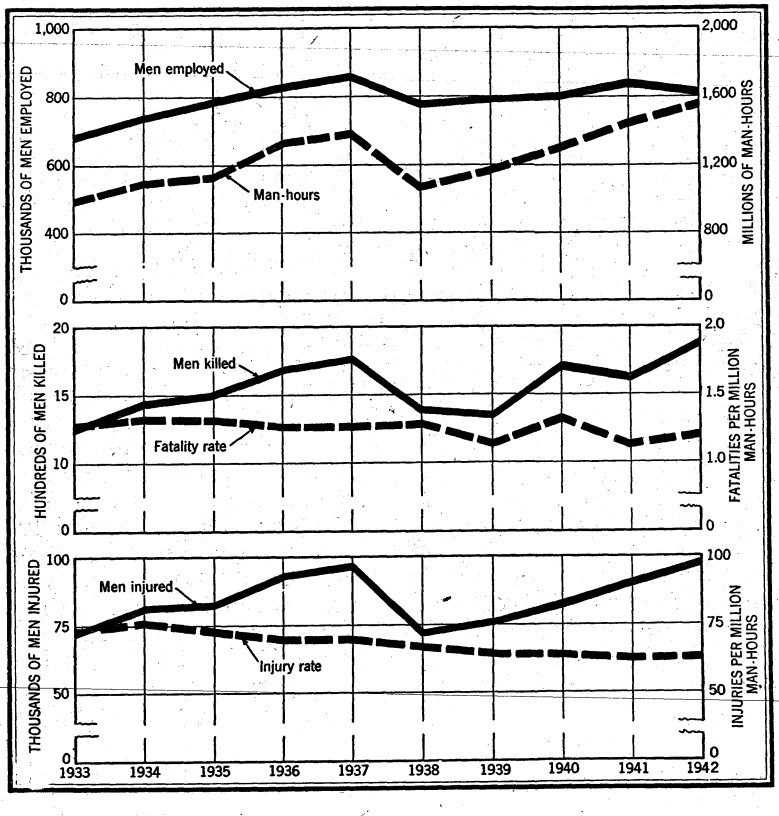

FIGURE 1.—Trend of employment and fatal and nonfatal accidents in the mineral industries of the United States, 1933–42.

reached its maximum in 1942. Maximum employment, as measured by the number of men working without regard to the number of days or hours available, was reached in 1937. The frequency of accidents in relation to the volume of employment in 1942, though not at the lowest point during the 11-year period, compared favorably with all other years except 1941.

Employment and accident record of mineral industries of the United States, 1932–42

Year	Men employed	Man-days of employment	Man-hours of employment	Number		Rate per million man-hours	
				Killed	Injured	Killed	Injured
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	801,926	175,663,792	1,293,131,693	1,716	82,861	1.33	64.08
1941	835,183	195,425,228	1,440,988,174	1,622	90,334	1.13	62.69
1942 [1]	812,600	210,778,000	1,550,206,000	1,878	97,232	1.20	62.72

[1] Subject to revision.

EMPLOYMENT AND ACCIDENTS

BITUMINOUS-COAL MINES

Employment.—More than 775 million man-hours of labor and a working force of about 449,000 men were required to operate the bituminous-coal mines of the United States during 1942. Production of coal reached 579 million short tons, or 12 percent more than in 1941; it exceeded the production of each year in the history of coal mining in the United States with the possible exception of 1918, the previous record year. About 2 percent fewer men worked in 1942 than in 1941, but the number of man-hours worked increased 12 percent. The large increase in production was the direct result of the heavy demand for coal for the industries of a nation at war, as bituminous coal is predominantly an industrial fuel and is the chief source of power on which other industries depend. The greater demand for coal was met with a smaller working force than in 1941 owing to the transfer of many coal-mine workers to the armed forces and, perhaps to a less extent, to the attraction of some employees to nonmining industries.

Accidents.—Accidents at the mines during 1942, according to present reports, killed 1,254 employees. This number, if confirmed by final reports, will indicate an increase of 182 over the number of miners killed in 1941. Nonfatal injuries increased by more than 7,400 and reached a total estimated at 54,125. The accident rate per million man-hours of employment during 1942 now stands at 1.62 for fatalities (slightly above 1941) and at 69.84 for nonfatal injuries, the latter rate being comparable with the previous year's rate of 67.49.

The year was marked by 6 major disasters in which 127 men were killed, as compared with 8 such disasters in 1941 when 73 men lost their lives. The six major disasters of 1942 were chargeable to four States—one each to Arkansas, Colorado, and Kentucky and three to West Virginia—and all were explosions.

Detailed information as to the causes of the more than 55,000 injuries and deaths in 1942 are not yet available and will not be known for several months, when reports from all mines in the United States shall have been received. However, a review of accident records over a period of years affords a typical picture of the cause-distribution of fatal and nonfatal injuries at bituminous-coal mines. For example,

during the 5-year period 1936 to 1940 accidents caused 5,247 deaths and 222,693 nonfatal lost-time injuries among the employees, a total of 227,940 personal injuries. Following are the percentages of the total number of accidents due to each main cause.

	Percent
Underground accidents:	
Falls of roof or face	27.8
Mine cars and locomotives	22.1
Handling materials	13.5
Hand tools	7.6
Machinery (cutters, loaders, etc.)	7.3
Falls of persons	3.6
Explosions of gas or coal dust	.6
Explosives	.7
Electricity	1.5
Miscellaneous	6.3
Shaft accidents	.2
Open-pit-mine accidents	2.6
Surface accidents	6.2
	100.0

A similar distribution of fatal accidents alone, which comprise only 2 or 3 percent of the large number of accidents, would show a different percentage distribution. The main causes of fatal accidents, in order of their numerical importance, are falls of roof or face, haulage accidents, gas and dust explosions, electricity, and machinery, these five classes covering about 88 percent of the total number of fatal accidents during any representative period in recent years.

ANTHRACITE MINES

Employment.—The output from mines of eastern Pennsylvania constitutes the product known as "anthracite" or "hard coal." Although a few other localities of the United States also produce hard coal, anthracite is usually identified with the coal-mining industry of eastern Pennsylvania. During 1942 the mines of this region produced and prepared for market approximately 58 million short tons of coal. This does not include several million tons from illegitimate or so-called bootleg mines, as reports of accidents or employment from such mines are not available. The regular or legitimate anthracite industry employed 83,500 men in 1942, according to reports available at present. These men worked approximately 144 million hours in and about the mines, breakers, preparation plants, washeries, and strip pits. Seven hours was the standard shift. Preliminary returns indicate that the collieries were operated about 246 days during the year, or 39 days more than in 1941.

Accidents.—Fatal accidents occurred to 228 men, an increase of 34 over the number reported for 1941. The number of nonfatal injuries increased also, the estimate for 1942 being 17,500, compared with 16,828 reported for the previous year. In relation to the increased man-hours of work, the record for 1942 was favorable, as the injury rate was 121.53, a decrease from 129.34 for 1941. The fatality rate for 1942 stands at 1.58, compared with 1.49 for 1941.

No major disasters have occurred in the anthracite mines of Pennsylvania since June 2, 1938, when an explosion of gas in a mine in Luzerne County caused the loss of 10 lives. This disaster-free record represents a period of 1,673 days to December 31, 1942.

IRON-ORE MINES

Employment.—Men employed and man-hours worked increased sharply in 1942. Incomplete returns indicate a total of 28,100 employees, a gain of nearly 9 percent over the year 1941. The total man-hours worked during the year was nearly 65 million, an increase of approximately 18 percent over 1941 when 54.9 million man-hours of work was performed.

Accidents.—Notwithstanding an increase in men employed and man-hours worked, continued progress was made in accident prevention. The accident-frequency rate was 22.69 per million man-hours in 1942, which compares favorably with the rate of 23.07 for 1941. The estimated number of injuries during 1942 is 1,466, including 51 fatalities.

COPPER MINES

Employment.—The demand for copper, due to the war, caused an increase in employment beyond that recorded in 1941, which was already substantially above the volume of employment in 1940. The number of mine workers reached approximately 22,600, an increase of 5 percent over 1941 and of 16 percent over 1940. Similarly, the number of man-hours of labor worked at the mines rose to about 58.8 million in 1942, from 55.1 million in 1941 and 48.7 million in 1940.

Accidents.—With increased employment and, hence, greater exposure to mining hazards, accidents in 1942 might also be expected to increase in number. However, present reports indicate no increase in the number for that year and an actual reduction in the accident rate per million man-hours worked. Both the fatality rate and the injury rate appear to have declined in 1942. Present information indicates a fatality rate of 0.83 and an injury rate of 49.99, compared with 1.14 and 53.71, respectively, in 1941.

LEAD AND ZINC MINES (MISSISSIPPI VALLEY STATES)

Classification.—This group covers mines producing lead and zinc in the Mississippi Valley States, chiefly Oklahoma, Missouri, and Kansas, and those producing fluorspar in Kentucky and Illinois, where somewhat comparable conditions prevail.

Employment.—The number of men working increased slightly in 1942, and the number of man-hours showed a decided gain. The number of employees was approximately 8,800, a gain of 2 percent. The aggregate man-hours worked increased about 13 percent, as preliminary reports for the year indicated 19.2 million man-hours worked compared with 16.9 million in 1941.

Accidents.—Tentative figures now available reveal that accidents increased in 1942 and resulted in a higher accident-frequency rate than in 1941. The accident rate increased from 59.35 per million man-hours in 1941 to approximately 65.81 in 1942. The safety record, therefore, was less favorable than in 1941. Accidents during 1942 caused 17 deaths and 1,247 injuries.

GOLD AND SILVER MINES (LODE AND PLACER)

Classification.—This group includes mines operated chiefly for the gold or silver content of their ores; it also includes mines outside the Mississippi Valley region whose ores were valuable mainly for the lead or zinc they contained, as well as mines that produced some copper

but whose ores were chiefly valuable for metals other than copper. Both placer mines and lode mines are included in the group.

Employment.—Employment diminished in volume in 1942, particularly during the latter part of the year, following the order of the War Production Board requiring the closing of many mines engaged chiefly in the production of gold. From a total of 51,603 employees in 1941, reports thus far received (for 1942) indicate about 42,600 men employed. Man-hours of work dropped from 90 million in 1941 to approximately 69 million in 1942.

Accidents.—According to present reports, accidents caused 85 deaths and 6,464 nonfatal injuries during 1942, representing a fatality rate of 1.24 and an injury rate of 94.33 per million man-hours worked, as compared with a fatality rate of 0.81 and an injury rate of 92.00 in 1941. Eight deaths were caused by a single disaster at a mine in Colorado.

MISCELLANEOUS METAL MINES

Classification.—This group includes all mines engaged in production of metallic ores exclusive of gold, silver, copper, lead, zinc, and iron. It therefore includes mines that produced such critical and strategic metallic ores (ores declared essential to the national defense) as bauxite, chromite, manganese, mercury, molybdenum, and tungsten, as well as various other minerals.

Employment.—Preliminary figures now available reveal that the production demands of a war economy have been partly responsible for raising employment in 1942 to approximately 7,000 men, or 6 percent over 1941. Man-hours of employment rose to over 15.1 million in 1942, compared with 13.8 million in 1941, or approximately 10 percent.

Accidents.—As estimated for 1942, the safety record was more favorable than that of 1941. The accident-frequency rate per million man-hours of employment was 81.30, compared with 85.03 for 1941. Present reports indicate that 17 men were killed and 1,213 injured by accidents in 1942.

NONMETALLIC-MINERAL MINES

Classification.—Included in this group are mines that yield any kind of nonmetallic mineral except coal, stone, sand, gravel, and clay. Hence, it includes all those that produce barite, feldspar, gypsum, sulfur, rock salt, mica, phosphate rock, and many other minerals.

Employment.—Employment in 1941 numbered 11,088 men, and in 1942, according to preliminary figures, the group as a whole employed approximately 10,900 men. The man-hours of employment, however, rose to 24.1 million, compared with 23.2 in 1941, or about 4 percent.

Accidents.—From reports now available for 1942, the accident-frequency rate was about 50.55 per million man-hours, which represents progress when compared with the 1941 rate of 51.62. Accidents during 1942 resulted in 19 deaths and 1,196 injuries among the workers.

CEMENT MILLS AND QUARRIES

Employment.—Approximately 30,200 men were employed in the cement industry (quarrying and manufacturing) during 1942, an increase of 5 percent over 1941. These men worked about 72 million man-hours, which was 11 percent more than in 1941.

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Accidents.—Increased employment in 1942 was accompanied by an increase in the number of fatal and nonfatal accidents. It is estimated that 46 men lost their lives during the year, including 28 who were killed in a single disaster caused by an explosion of dynamite; nonfatal injuries are estimated at 797. The fatality rate was 0.64 and the nonfatal-injury rate 11.10, compared with final rates of 0.22 and 10.93, respectively, in 1941.

MARBLE QUARRIES

Employment.—Employment at marble quarries and related plants in the United States continued to decrease in 1942. Employment is estimated at 2,400 men and 4.9 million man-hours, a decline from 2,693 men and 5.2 million man-hours for 1941. The proportionate decrease in number of man-hours of employment during 1942 was not as great as that in number of employees, hence an increase in number of days of employment per man.

Accidents.—Two men were killed by accidents, whereas no deaths were reported in 1941. The fatality rate for 1942 is estimated at 0.41 per million man-hours of exposure. Nonfatal injuries, estimated at 212, give a rate of 42.95, compared with a final rate of 46.33 for 1941.

SLATE QUARRIES

Employment.—Preliminary estimates indicate a decrease of approximately 16 percent in number of men employed in 1942. Employment expressed in man-hours was 4.8 million for the 2,400 men employed.

Accidents.—Two men were killed and 439 injured by accidents. The number of injuries was much larger than for 1941, when only 323 occurred. Based on these estimates, the fatality rate for 1942 was 0.42 and the nonfatal-injury rate was 91.14 per million man-hours, compared with 0.18 and 57.21, respectively, based on final figures for 1941.

TRAPROCK QUARRIES

Employment.—Preliminary reports indicate about 2,900 employees and 5.3 million man-hours worked in 1942. Employment in 1941 covered 3,029 men and slightly less than 5.3 million man-hours.

Accidents.—Accidents resulted in 5 fatalities and 256 nonfatal injuries, according to incomplete reports. These figures represent a fatality rate of 0.94 and an injury rate of 48.07 per million man-hours of employment and indicate a relatively large reduction in accident frequency.

GRANITE QUARRIES

Employment.—The estimated number of employees was 6,500, a decrease of 17 percent from the 1941 total. These men worked 1.5 million man-shifts or 12.7 million man-hours during the year. The decline in employment was due chiefly to the shut-down or curtailment of operations at dimension-stone plants and quarries.

Accidents.—Estimates indicate that 15 men were killed by accidents. This record compares unfavorably with that of 1941, which showed only 8 fatalities. Nonfatal injuries declined along with the decrease in employment, the number of such injuries having been 610, according to available data. Accidents in 1942 gave a fatality rate of 1.18 and a nonfatal-injury rate of 47.84 per million man-hours of employment; the rates for 1941 were 0.55 and 49.40, respectively.

SANDSTONE QUARRIES

Employment.—Employment changed very little in 1942 from 1941; estimates place the number of workers at 3,100, with a total of 5.7 million man-hours worked. As the number of man-hours decreased 3 percent, compared with the 1941 total, and the number of men employed was virtually unchanged, the working time per man declined in 1942.

Accidents.—Accidents in and about quarries and related plants resulted in death to 2 men and in lost-time injuries to an additional 336 men. Neither the fatality nor injury rate changed materially from 1941, when the record showed 0.34 and 59.76, respectively.

LIMESTONE QUARRIES

Employment.—Incomplete reports indicate that the number of men employed was about 25,900, a decline of 2 percent from 1941. However, the number of man-hours of employment increased 4 percent. Final returns for 1942 are expected to show a total of 48.7 million man-hours of work performed during the year.

Accidents.—Thirty men were killed and 2,540 men injured in accidents during the year. This is a decrease in nonfatal accidents from 1941, when 2,622 men were injured; however, the number of fatalities remained the same as in 1941. Thus, the fatality rate for 1942 was 0.62 compared with 0.64 for 1941, and the nonfatal-injury rate was 52.16 compared with 55.96.

LIMEKILNS AND ASSOCIATED QUARRIES

Employment.—The number of men employed, estimated at 10,500, was 7 percent less than the number employed in 1941. Despite this decrease, the number of man-hours of employment was 25.2 million, virtually the same as in 1941. Thus, the average employee had a longer work year—304 days or 2,400 hours; comparable figures for 1941 are 296 and 2,241, respectively.

Accidents.—Fortunately, the number of both fatal and nonfatal accidents declined substantially in 1942. Estimates indicate that 10 men were killed and 1,460 injured, compared with 17 and 1,551, respectively, in 1941. The 1942 fatality rate was 0.40 and the nonfatal-injury rate was 57.94, compared with a fatality rate of 0.67 and a nonfatal-injury rate of 61.30 in 1941.

BYPRODUCT COKE OVENS

Employment.—Final figures on employment during 1942 show 19,551 men employed, or 5 percent more than in 1941. They worked 56,771,172 man-hours, or 2,904 hours per man, during the year; man-hours of employment also increased 5 percent over 1941.

Accidents.—Accidents occurring among the employees killed 9 men and injured 545 during 1942. These accidents represent a fatality rate of 0.16 and a nonfatal-injury rate of 9.60 per million man-hours of employment, compared with 0.22 and 8.07, respectively, in 1941.

BEEHIVE COKE OVENS

Employment.—Present estimates indicate that employment in 1942 reached a new high level for recent years. Final returns are expected

to show that 4,300 men were employed for a total of 8.5 million man-hours.

Accidents.—Three men were killed and 375 men met with lost-time injuries from accidents during the year. These accidents indicate a fatality rate of 0.35 and a nonfatal-injury rate of 44.04 per million man-hours of employment. If these rates are unchanged by final returns they will be lower than the fatality rate of 0.43 and nonfatal-injury rate of 52.71 for the beehive-coke industry in 1941.

ORE-DRESSING PLANTS

Employment.—Gains in the number of workers and the man-hours worked in 1942, compared with 1941, were reported by ore-dressing and beneficiating plants. Men employed numbered about 14,900 and approximately 36 million man-hours of work was performed.

Accidents.—Incomplete data indicate an accident-frequency rate of 27.09 per million man-hours in 1942. As this rate is lower than the rate of 28.42 in 1941, the safety record for 1942 appears slightly more favorable than that of the previous year.

SMELTERS

Employment.—Included in the term "smelters," as used herein, are operations employed in the smelting and refining of all metallic ores other than iron ore. The smelting of iron ore and manufacture of steel are not included in the accident and employment statistics collected by the Bureau of Mines, as such statistics are collected and tabulated by the Department of Labor. Reports for the smelting industry indicate that 20,700 men were employed in 1942. This represents a loss of 6 percent in number of employees from 1941 but a gain of 3 percent over 1940. The man-hours of employment increased 3 percent, however, being 56 million in 1942.

Accidents.—The intense production effort occasioned by war demands resulted in a setback to accident prevention for the third successive year. The accident-frequency rate rose in 1942 to 30.49, from 27.05 in 1941, 19.70 in 1940, and 16.35 in 1939.

AUXILIARY WORKS AT ORE-DRESSING PLANTS AND SMELTERS

Employment.—All operations at mills and smelters not directly connected with milling and smelting processes are included in the term "auxiliary works." About 16,800 men were employed in such works in 1942, a decrease of 4 percent from 1941. Despite this loss in number of employees, man-hours worked increased about 4 percent, reaching 44.8 million.

Accidents.—The accident-frequency rate for 1942 increased slightly, being 20.65 per million man-hours compared with 20.06 in 1941.

SUMMARY, 1932–42

Absenteeism has become widely recognized as a factor in the slowing down of production of war materials. Also widely recognized are certain contributions to absenteeism. Among these are insufficiency of supplies when needed, inadequacy of transportation facilities, strikes, lock-outs, sickness, and accidents. Perhaps accidents are least widely recognized as contributors; and perhaps even less appreciated, not only by the public but by many production experts, is

that saboteur of war energy, the preventable accident. Although all will agree that some risk of personal injury is inherent, or seemingly inherent, in industry, there can be no justification or excuse, even in wartime, for most of the accidents that occur.

On several recent occasions the attention of the public and of industry has been called by the President of the United States to the importance of conserving manpower through the prevention of accidents in factories, on farms, in mines, and on the highways and railways of the country. It has become conventional to recite some of the leading causes of these accidents. The public has to some extent become familiar with such recitals. To safety engineers they are an old story. But perhaps it may justly be said that the chief cause of all accidents in the mineral and other industries is the small amount or complete absence of thought given to the importance of accident prevention by those who do not have safety thrust upon their attention every day. To such persons, in many instances, the safety engineer must look for the approval and support of his safety programs. Until the safety engineer occupies a position in his organization equal to and not under that of the production engineer, industrial workers will continue to be killed and injured by preventable accidents, and the rehabilitation of needlessly injured persons will remain a major and serious problem demanding the attention of governmental and other agencies.

In 1942, a year in which the Nation could ill afford a loss of manpower from any cause, between 3 and 4 million man-days were lost because of accidents in the mineral industries alone. This loss was from injuries classed as "temporary", so called because in each instance the injured employee was ultimately able to return to work without having lost a leg, foot, arm, or other part of his body. A loss of manpower nearly as great arose from injuries classed as "permanent injuries", as the accident caused the loss of some part of the body or of its use. Such cases are considered equivalent to the loss of 6,000 work days when they permanently and totally incapacitate an employee.

Applying this thought to the coal-mining industry alone it may be observed that as the over-all average of production of coal in the United States is about 4.9 tons per man per day, the loss of time from "temporary" injuries alone represented a production loss of 15 or 20 million tons of coal during 1942. An additional and even larger loss, not confined to 1942, must be charged for deaths and permanent-total and permanent-partial disabilities caused by accidents. Such losses are continuing, owing to the permanent impairment of the miner's ability to work and, in the case of deaths or permanent-total disability, owing to the absolute cessation of the miner's ability to produce coal.

In the face of such losses, which are but a repetition of a record that has continued for many years, there can be little doubt that one of the most important problems facing the Nation is the prevention of industrial accidents. It is to be hoped that when the war is won, the safeguarding of the lives and limbs of industrial workers will be advanced to the front ranks among subjects universally recognized as meriting first consideration of production engineers and executives of industry.

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