DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

MINERAL RESOURCES

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UNITED STATES

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1902

DAVID T. DAY
CHIEF OF DIVISION OF MINING AND MINERAL RESOURCES

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Department of the Interior,
United States Geological Survey,
Division of Mining and Mineral Resources,
Washington, D. C., February 18, 1904.

Sir: I have the honor to transmit herewith the report Mineral Resources of the United States, Calendar Year 1902, being the nineteenth annual report of the series published by this office. Besides the statistics for the calendar year 1902, considerable descriptive and technical matter, obtained while the statistical canvass was in progress, is presented. All of this material has been given such prompt publication as was possible as advance extras from the report, in accordance with the law providing for the printing of any chapter as soon as completed.

In accordance with your instructions, the report for the calendar year 1903 is in preparation.

Very respectfully, your obedient servant,

David T. Day,
Geologist in Charge.

Hon. Charles D. Walcott,
Director of United States Geological Survey.

MINERAL RESOURCES OF THE UNITED STATES, 1902.

DAVID T. DAY, *Chief of Division.*

INTRODUCTION.

The arrangement and scope of this volume are practically the same as in the eighteen preceding reports of the series Mineral Resources of the United States. Each report records the development of the mineral industries of the United States since the time covered by the preceding number of the series; the reports should therefore be consulted together. Every chapter in this report is a census of the productive features of the industry under discussion. The statistics of the production of gold and silver have been prepared in conjunction with the Director of the Mint, Treasury Department. The statistics of the imports and exports of minerals, which form an essential part of the volume, are obtained through the courtesy of the Chief of the Bureau of Statistics, Department of Commerce and Labor. At the request of the Director of the Census, the schedules of inquiry of the Twelfth Census in regard to mining were inclosed with the statistical cards annually sent out by this office. The returns were transmitted through the Geological Survey to the Census Office, thus affording both offices the benefit of cooperation.

ACKNOWLEDGMENTS.

Except as noted above, and in a few isolated instances where some other well-established agency already exists by which the statistics are collected accurately, the figures are obtained directly from the producers, and it is impossible to acknowledge here, otherwise than by brief mention, the invaluable assistance which has been freely rendered by them and the voluntary contributions of many local experts. The names of the statistical experts who, acting under the authority of the United States, have collected statistics from the producers are given at the heads of the special chapters. The technical press, besides affording much information concerning new mining enterprises, has been largely drawn upon for prices, market reports, and new technical processes.

As heretofore, the publication of this volume has been anticipated to a great extent by the issue in advance, in pamphlet form, of the several chapters which compose it. Before the publication of this volume all of the chapters, except the one treating of gold and silver, will have been so given to the public.

The summary gives the principal statistical information recorded in this report.

In presenting these statistics all unnecessary duplication has been avoided. The coke product, discussed in the following pages and amounting to 25,401,730 short tons, valued at $63,339,167, is excluded from the tabular statement, as the quantity and value of the coal used in its manufacture is included in the statistics of coal production. Similarly, white lead, red lead, and litharge, whose average aggregate value for the last ten years has exceeded $10,000,000, are not given in the table, the base from which they are made being included in the output of pig lead. Zinc oxide, or zinc white, made directly from the ores and consequently not included in spelter production, is tabulated. The production of pig iron and its value are given in the table as the best means of presenting the statistics of the production of iron in the first marketable condition. The value of brick and pottery clays, rather than the value of the manufactured products, is embraced in the tabular statement, although the statistics of brick, tile, and pottery production are presented in detail in the report. Inflation of valuation and all unnecessary duplication are thus avoided.

SUMMARY OF THE MINERAL PRODUCTION OF THE UNITED STATES IN 1902.

GENERAL REMARKS.

The varied character of the units of measurement employed in the mineral industry makes it impossible to compare the outputs of the several minerals except in the value of the products. The figures given in the following summary show a continuation of the remarkable activity in the mineral industries of the United States noted in 1900 and 1901.

In 1902, for the third time, the total value of the commercial mineral production of the United States exceeded the enormous sum of $1,000,000,000. The exact figures for 1902 were $1,260,639,415 as compared with $1,086,584,851 in 1901, with $1,063,678,053 in 1900, and with $972,208,008 in 1899, a gain of 1902 over 1901 of $174,064,414, or 16.02 per cent; a gain of 1902 over 1900 of $196,961,362, or 18.52 per cent; and a gain of 1902 over 1899 of $288,431,407, or 29.67 per cent. Although this gain is not so great either actually or proportionally as was the gain in 1899, when the gain over 1898 was $273,601,810, or 39.17 per cent, it is sufficient to be worthy of note.

The notable gains and losses of the last two decades are as follows: The largest actual gain was that of 1899 over 1898, $273,601,810, or 39.17 per cent; next, that of 1902 over 1901, $174,053,760, or 16.02 per cent; then the gain of 1895 over 1894, which was $94,215,822, or 17.88 per cent; then that of 1900 over 1899, $91,468,340, or 9.41 per cent; and the gain of 1887 over 1886, $74,927,880, or 16.81 per cent. In other years than those mentioned between 1880 and 1898 the gains were not noteworthy, and in some of the years, notably in 1884, the production decreased $40,451,968, or nearly 9 per cent. During the industrial depression of 1892–1895 the production would have been expected to decline, as it did, going from $648,895,031 in 1892 to $574,464,724 in 1893, and to $527,079,225 in 1894, and then rising to $621,295,047 in 1895, and not reaching the output of 1892 until 1898.

As heretofore, iron and coal are the most important of our mineral products. The value of the iron in 1902 was $372,775,000; the value of coal, $367,032,069. Nearly all the important metals increased in both output and value; and among the less important metals platinum, as compared with 1901, lost in both quantity and value even more than it gained in 1901 as compared with 1900, the production in 1902 being 94 ounces, valued at $1,814, as compared with 1,408 ounces, valued at $27,526, in 1901, with 400 ounces in 1900, and with 300 ounces in 1899. The fuels increased from $442,410,904 in 1901 to $469,078,647 in 1902, a gain of $26,667,743, or 6 per cent. Every variety of fuel increased in value except anthracite coal, which showed a decrease in quantity of 23,301,850 long tons and in value of $36,330,434. The average price of anthracite coal per long ton at the mine was $2.35, as against $2.05 in 1901—the highest figure then obtained since 1888—as compared with $1.85 in 1900, and with $1.80 in 1899; and the average price per ton for bituminous coal at the mine was $1.125, as compared with $1.047 in 1901. The increase in value of the bituminous coal output over 1901 was $54,436,434.

The gain of $174,064,414 in the total value of our mineral production is due to the increase in both metallic and nonmetallic products, the metallic products showing an increase from $518,266,259 in 1901 to $642,258,584 in 1902, a gain of $123,992,325, and the nonmetallic products showing an increase from $567,318,592 in 1901 to $617,380,831 in 1902, a gain of $50,072,089. To these products should be added estimated unspecified products, including building, molding, and other sands reported to this office, the rare mineral molybdenum, and other mineral products, valued at $1,000,000, making the total mineral production for 1902 $1,260,639,415.

The manufacture of arsenious oxide, noted for the first time in the United States in the report for 1901, was continued in increased proportions in 1902.

METALS.

Iron and steel.—Twenty-two States made pig iron in 1902, as against 21 in 1899 and 1900, and 20 in 1901. The total production of pig iron in 1902 was 17,821,307 long tons, against 15,878,354 tons in 1901, 13,789,242 tons in 1900, 13,620,703 tons in 1899, 11,773,934 tons in 1898, and 9,652,680 tons in 1897. The production of 1902 shows an increase of 1,942,953 long tons, or 12.2 per cent, in quantity over the production of 1901, and in increase in value from $242,174,000 to $372,775,000, amounting to $130,601,000, or about 54 per cent. The average price per long ton of pig iron increased from $15.25 in 1901 to $20.90 in 1902. The average prices per long ton in recent years have been as follows: 1900, $18.85; 1899, $18; 1897, $9.85; 1896, $10.47; 1895, $11.14; 1894, $9.76.

Iron ores.—The production of iron ores in 1902 amounted to 35,554,135 long tons, as compared with 28,887,479 long tons in 1901, a gain of 6,666,656 long tons, or 23 per cent. The value at the mines of the ore mined in 1902 was $65,412,950. As in the four preceding years, the production of iron ores in 1902 in the United States has never been equaled by any other country. There were mined also in 1902, 13,275 long tons of manganiferous iron ore, valued at $52,371, which were used in the production of spiegeleisen.

Gold.—The production of gold in 1902, as reported by the Bureau of the Mint, was 3,870,000 fine ounces, valued at $80,000,000.

Silver.—The production of silver in 1902, as reported by the Bureau of the Mint, was 55,500,000 fine ounces; coining value, $71,757,575; commercial value, $29,415,000.

Manganese ores.—The production of manganese ores increased from 11,995 long tons, valued at $116,722, in 1901, to 16,477 long tons, valued at $177,911, in 1902, an increase in quantity of 4,472 tons and in value of $61,189. The average price per ton was $10.74 in 1902, as compared with $9.73 in 1901 and with $8.52 in 1900.

Copper.—The copper-mining industry suffered during 1902 from the reaction which followed the unsuccessful attempt in 1901 to maintain the metal at an artificial level. The production, however, increased from 602,072,519 pounds in 1901 to 659,508,644 pounds in 1902, an increase of 57,436,125 pounds, or about 9 per cent, in quantity, but decreased in value from $87,300,575 in 1901 to $76,568,954 in 1902, a decrease of $10,731,561, or about 12 per cent. Unless unforeseen events cause widespread or long stoppage at the mines, the production of copper in the United States will be considerably larger in 1903 than it has ever been.

Lead.—The production of lead has been almost exactly the same for the last three years, viz, 270,000 short tons in 1902, 270,700 short tons in 1901, and 270,824 short tons in 1900. The value of the production in 1902 was $22,140,000, as compared with $23,280,200 in 1901, and with $23,564,688 in 1900.

Zinc.—The production of zinc in 1902 showed a continued increase in quantity as compared with 1901 and 1900, the production being 156,927 short tons in 1902, as compared with 140,822 short tons in 1901 and with 123,886 short tons in 1900. The value of the zinc production in 1902 was $14,625,596, as compared with $11,265,760 in 1901, and with $10,654,196 in 1900.

Aluminum.—The production of aluminum during 1902 was 7,300,000 pounds, valued at $2,284,590, as compared with 7,150,000 pounds, valued at $2,238,000 in 1901, and with 7,150,000 pounds, valued at $1,920,000 in 1900.

Platinum.—The production of platinum from domestic ores in the United States during 1902 was 94 ounces, valued at $1,814, as compared with 1,408 ounces, valued at $27,526 in 1901.

Quicksilver.—The production of quicksilver during 1902 amounted to 34,291 flasks of 76½ pounds net, as compared with 29,727 flasks in 1901 and with 28,317 flasks in 1900. The value of the quicksilver produced in 1902 was $1,467,848, as compared with $1,382,305 in 1901 and with $1,302,586 in 1900. California reported 28,972 flasks in 1902, as compared with 26,720 flasks in 1901; and Texas reported 5,319 flasks in 1902, as against 2,932 flasks in 1901. In addition, the census reports 10,427 tons of cinnabar or crude, valued at $67,242, mined in California, and 1,300 tons of cinnabar, valued at $1,500, mined in Texas in 1902, but not roasted or treated, a total of 11,727 short tons of cinnabar, valued at $82,242. The total production of both quicksilver and cinnabar in 1902 was therefore valued at $1,550,090.

Lithium.—The production of lithium minerals in 1902 was 1,245 short tons, valued at $25,750 at the railroad, a decrease of 505 tons in amount and of $17,450 in value as compared with the production of 1901, which was 1,750 tons, valued at $43,200. As far as can be ascertained the greater part of the lithium minerals mined during 1902 was not shipped. Although the price of these minerals was lower in 1902 than in 1901 for the same grade of mineral, there was apparently no increase in the home demand. There is, however, an increase in the demand for these minerals from foreign chemical manufacturers.

Nickel.—The production of metallic nickel in 1902 was 5,748 pounds, valued at $2,701, as compared with 6,700 pounds, valued at $3,551 in 1901.

Antimony.—No antimony was obtained from domestic ores during 1902. The antimony obtained from the smelting of foreign imported ores amounted to 657 short tons, valued at $129,126, and the antimony obtained from hard lead produced from foreign and domestic lead ores was 2,904 short tons, valued at $505,240, a total production for 1902 of 3,561 short tons, valued at $634,506, as compared with 2,639 short tons, valued at $539,902, in 1901. The estimated total amount of antimony available for consumption in 1902 was 6,255 short tons, including 2,694 short tons of imported antimony regulus, as compared with 4,475 short tons, including 1,837 short tons of imported antimony regulus in 1901, and with 6,053 short tons, including 1,827 short tons of imported antimony regulus in 1900.

Bismuth.—No bismuth ores were produced in the United States during 1902. The marketed output in 1901 was 318.6 short tons. The ore contained gold and silver, for which the producers were paid. As nearly as can be ascertained, the value of the output in 1901 was $80 per ton, not including charges for transportation or treatment.

Molybdenum.—The production of molybdenum in 1902 was approximately the same as that of 1901, but none of the product was shipped in 1902. The value of these molybdenum ores is very erratic, the highest price hitherto quoted being $1,500 per ton, and the lowest, $100.

Tungsten.—The production of tungsten during 1902 was 184 short tons of crude ore, of which not more than a few tons were sold. This does not represent the amount of tungsten ore sold in 1902, for 76 tons of concentrated ore, mined in 1901, were sold in 1902. In 1901 the production amounted to 179 tons of concentrated ore, valued at $27,720. The larger part of the production of 1902 was from Colorado.

Uranium and vanadium.—There was a marked increase in the production of uranium and vanadium minerals in 1902, which, as reported to the Survey, amounted to 3,810 short tons, valued at $48,125, or $12.62 per ton. This, of course, represents the crude ore. In 1901 the production was 375 tons of crude ore.

FUELS.

Coal.—For the first time in the history of the United States the production of coal reached a total of over 300,000,000 short tons, showing an actual output of 301,590,439 tons of 2,000 pounds, valued at $367,032,069. Of this total the output of anthracite coal amounted to 36,940,710 long tons (equivalent to 41,373,595 short tons), which, as compared with the production of 60,242,560 long tons in 1901, was a decrease of 23,301,850 long tons, or about 39 per cent. This decrease, as is well known, was due entirely to the suspension of operations by the strike in the anthracite region from May 10 to October 23, a little over five months. But for the strike the output for the year would probably have been over 65,000,000 long tons. The value at the mines of the anthracite coal in 1902 was $76,173,586 as against $112,504,020 in 1901, a loss of about 32.3 per cent. The average value of the marketed coal sold during the year at the mines was $2.35 per long ton, the value in 1901 having been $2.05.

The output of bituminous coal (which includes semianthracite and all semibituminous and lignite coals) amounted in 1902 to 260,216,844 short tons, valued at $290,858,483, as against 225,828,149 short tons, valued at $236,422,049 in 1901. The increase in the production of bituminous coal was, therefore, 34,388,695 tons in quantity and $54,436,434 in value.

Out of 30 States and Territories producing coal in 1902, seven—California, Michigan, New Mexico, Oregon, Pennsylvania, Texas, and Washington—had smaller outputs than in 1901.

The production of bituminous coal in Pennsylvania in 1902 exceeded that of 1901 by 15,755,874 short tons, but was not sufficient to overcome the great loss in anthracite production. The States in which the more important increases occurred with the corresponding gains are as follows: Illinois, 5,547,751 short tons; Colorado, 2,314,412 short tons; Ohio, 2,444,577 short tons; Indiana, 2,268,371 short tons; Alabama, 1,490,865 short tons; Kentucky, 1,193,176 short tons.

Coke.—The coke production of the United States in 1902 exceeded that of any year in our history. The production, which includes the output from 1,663 retort or by-product ovens, amounted to 25,401,730 short tons, as compared with 21,795,883 short tons in 1901, and with

20,533,348 short tons in 1900. The increase in 1902 over 1901 amounted to 3,605,847 short tons, or 16.5 per cent. Large as this increase was, it was considerably less than it would have been had the transportation facilities been commensurate with the demand for coke and with the productive capacity of the ovens. The increase in the value of coke was even more noteworthy. The average price per ton at the ovens was the highest recorded in a period of twenty-three years, and the total value reached the high figure of $63,339,167, an increase over 1901 of $18,893,244, or 42.5 per cent. The value of the coal used in the manufacture of coke in 1902 exceeded that of 1901 by $7,932,563, from which it appears that the value of the coke product increased $10,970,681 over and above the increased value of the coal used in its production. In 1901 the highest price obtained for Connellsville furnace coke was $4.25. In September and October of 1902, while the contract coke was nominally quoted at $3 per ton, consumers were paying from $10 to $12 per ton for prompt delivery, and $15 was reported as paid for this fuel at one time. With the termination of the anthracite strike in the latter part of October prices for coke quickly declined, but in December of 1902 furnace coke for prompt delivery was still commanding $5 and $6 per ton, and contracts for delivery in the first six months of 1903 were made at from $3.75 to $4 per ton.

Gas, coke, tar, and ammonia.—The aggregate value of all the products obtained from the distillation of coal in gas works or retort ovens in 1902 was $43,869,440. About two-thirds of this amount, or $29,342,881, was represented by the value of the gas produced. The value of the coke produced was $11,267,608, and the tar was worth, at the works, $1,873,966. The total quantity of ammoniacal liquor sold was 49,490,609 gallons, containing 14,683,374 pounds NH_3, and was worth at the works $1,065,300. In addition to this there was an actual production of 11,276,502 pounds of sulphate, which sold for $319,685.

Petroleum.—The total production of crude petroleum in the United States in 1902 was 88,766,916 barrels, as against 69,389,194 barrels in 1901, an increase of 19,377,722 barrels, or 27.92 per cent, over the production of 1901 and of 39.52 per cent over that of 1900. The greatest portion of the increase in 1902 came from Texas and California, the gain over 1901 being 13,690,000 barrels, or 311.6 per cent for Texas and 5,197,938 barrels, or 59.16 per cent, for California. The increase in Indiana in 1902 over 1901 was 1,723,810 barrels, or about 30 per cent. Louisiana produced for the first time in 1902, the production being 548,617 barrels. The increase over 1901 in the production of Kansas was 152,598 barrels, or about 85 per cent. Kentucky and Tennessee increased their production in 1902 by 48,072 barrels, or nearly 35.02 per cent. Indian Territory increased 37,000 barrels and

Wyoming 853 barrels as compared with 1901. The largest decrease in production in 1902 as compared with 1901 was in West Virginia, where it amounted to 663,781 barrels, or about 4.5 per cent, and Ohio in 62 fields showed a decrease of 633,852 barrels, or nearly 3 per cent. The decrease in Pennsylvania was 561,888 barrels, or about 7 per cent; in Colorado, 63,619 barrels, or about 13.81 per cent. The percentages of production for fields show a remarkable change from 1900 to 1902. In 1900 the percentages were: Appalachian field, 57.05; Lima-Indiana field, 34.20; all other fields, 8.75. In 1902 the respective percentages were: Appalachian field, 36.07; Lima-Indiana field, 26.31; all other fields, about 37.62. The value of crude petroleum produced during 1902 was $71,178,910, or 80.19 cents per barrel, as compared with $66,417,335, or 95.7 per barrel, in 1901—a decrease of 15.51 cents per barrel, or 16 per cent, in 1902.

Natural gas.—The value of the natural gas produced in 1902 increased to $30,867,668, as compared with $27,067,500 in 1901, with $23,698,674 in 1900, and with $20,074,873 in 1899—a gain of 13 per cent in 1902 over 1901.

STRUCTURAL MATERIALS.

Stone.—The value of all kinds of building stone produced in the United States during 1902 amounted to $64,559,099, as compared with $55,615,926 in 1901, with $44,321,345 in 1900, and with $44,090,670 in 1899.

Clay products.—The activity in all branches of the clay-working industries noted in the reports as true of 1899, 1900, and 1901 continued during 1902. The value of all clay products as reported to this office in 1902 was $122,169,531, as compared with $110,211,587 in 1901 and with $96,212,345 in 1900. The brick and tile products in 1902 were valued at $98,042,078, as compared with $87,747,727 in 1901 and with $76,413,775 in 1900. The pottery products were valued in 1902 at $24,127,453, as compared with $22,463,860 in 1901 and with $19,798,570 in 1900.

The clay mined and sold by those not manufacturing the product themselves in 1902 was valued at $2,061,072, as compared with $2,576,932 in 1901 and with $1,840,377 in 1900.

Cement.—The total production of hydraulic cement in the United States in 1902 was 25,753,504 barrels, valued at $25,366,380, as compared with 20,068,737 barrels, valued at $15,786,789, in 1901, and with 17,231,150 barrels, valued at $13,283,581, in 1900. The Portland cement production in 1902 was 17,230,644 barrels, valued at $20,864,078, as compared with 12,711,225 barrels, valued at $12,532,360, in 1901, and with 8,482,020 barrels, valued at $9,280,525, in 1900, an increase, as compared with 1900, in quantity of about 100 per cent and in value of over 50 per cent. The number of plants using Portland cement increased from 50 in 1900 to 56 in 1901, and to 65 in 1902. The production of natural-rock cement in 1902 was 8,044,305 barrels, valued at $4,076,630, as compared with 7,084,823 barrels, valued at $3,056,278, in 1901, and with 8,383,519 barrels, valued at $3,728,848, in 1900. The production of slag cement amounted to 478,555 barrels, valued at $425,672, in 1902, as compared with 272,689 barrels, valued at $198,151, in 1901, and with 365,611 barrels, valued at $274,208, in 1900.

ABRASIVE MATERIALS.

Carborundum.—There was a slight decrease in the quantity of carborundum—3,741,500 pounds produced in 1902, as compared with 3,838,175 pounds in 1901—due in part to lack of a sufficient supply of raw materials, a result of the anthracite coal strike. The value of the carborundum varies from 8 to 10 cents per pound.

Corundum and emery.—The combined production of corundum and emery in 1902 amounted to 4,251 short tons, valued at $104,605, as compared with 4,305 short tons, valued at $146,040, in 1901, a decrease of 54 tons in quantity and of $41,435 in value.

Crushed steel.—The production of crushed steel in 1902 was 735,000 pounds, as compared with 690,000 pounds in 1901, and the product is quoted at 5½ cents per pound free on board at Pittsburg.

Crystalline quartz.—In 1902 the production of crystalline quartz included under abrasives amounted to 15,104 short tons, valued at $84,335, as compared with 14,050 short tons, valued at $41,500, in 1901. This large variation in value is due to the fact that in 1902 the value reported was in some cases that of the quartz after it had been crushed or ground. The actual value of the crude quartz produced in 1902 was $43,085.

Garnet.—The production of abrasive garnet in the United States during 1902 amounted to 3,926 short tons, valued at $132,820, as compared with 4,444 short tons, valued at $158,100, in 1901, and with 3,185 short tons, valued at $123,475, in 1900. As reported to the Survey the prices varied from $20 to $60 a ton, the highest price being obtained for the North Carolina garnet. The average value per ton of the production in 1902 was $35.10, as compared with $35.57 per ton in 1901 and with $38.77 in 1900.

Grindstones.—The total value of all kinds of grindstones produced during 1902 was $667,431, as compared with $580,703 in 1901, an increase of $86,728. The production of 1900, valued at $710,026, still remains the largest on record for any year. It should be remembered, however, that the price per ton has decreased from $15 to from $8 to $10, and that therefore the tonnage of grindstones used has correspondingly increased within the last few years. The imports for 1902 amounted in value to $76,906, as compared with $88,871 in 1901 and with $92,581 in 1900.

Infusorial earth and tripoli.—In 1902 the production of infusorial earth and tripoli amounted to 5,665 short tons, valued at $53,244, including 175 short tons mined as a by-product and valued at $1,436, an increase of 1,645 tons in quantity and of $294 in value, as compared with the production of 4,020 tons, valued at $52,950, in 1901.

Millstones and buhrstones.—The value of the production of millstones and buhrstones in 1902 was $59,808, an increase of $2,629 over the value of 1901, which was $57,179. The value for 1902 was almost twice the value of the production of 1900, which amounted to $32,858. From 1886 to 1894 there was a very large decrease—from $140,000 to $13,887—in the production of buhrstones. Since 1894 there has been a gradual increase in the production.

Oilstones and whetstones.—There was a decided increase in the domestic commercial production of oilstones and whetstones during 1902, the value of which amounted to $221,762, as compared with $158,300 in 1901, an increase in 1902 of $63,462. Until 1902, the year of maximum production was 1899, when the value of the output amounted to $208,283. The crude production of oilstones and whetstones in 1902, as reported by the Census, was valued at $113,968.

Pumice.—The volcanic-ash deposits in Nebraska have been worked to some extent during 1902, the product being used in the manufacture of certain soaps and scouring powders. The production of pumice amounted to 700 short tons, valued at $2,750.

CHEMICAL MATERIALS.

Arsenious oxide.—The domestic production of arsenious oxide (white arsenic) in 1902 was 1,353 short tons, valued at $81,180, as compared with 300 short tons, valued at $18,000, in 1901. The entire product was made by the Puget Sound Reduction Company at Everett, Wash., which began the manufacture of this important substance in 1901. The largely increased output in 1902 is a sign of the success of the new industry.

Borax.—The reported returns for 1902 gave an aggregate commercial production of crude borax of 2,600 short tons, valued at $91,000, of refined borax and boric acid, amounting to 17,404 short tons, valued at $2,447,614, of which it was stated that 862 short tons, valued at $155,000, were boric acid. This gives a total production for 1902 of 20,004 short tons, valued at $2,538,614. The production during 1901 was 17,887 short tons of crude borax and 5,344 short tons of refined borax, with a total value of $1,012,118.

Bromine.—The production of bromine in 1902, including the amount of bromine contained in potassium bromide, amounted to 513,890 pounds, valued at $128,472, as compared with 522,043 pounds, valued at $154,572, in 1901, a decrease for the year of 38,153 pounds in quantity and of $26,100 in value. The price per pound during 1902 averaged 25 cents, as compared with 28 cents in 1901 and with 29 cents in 1900. There has been practically no change in the bromine industry in the United States in 1902.

Fluorspar.—There was a large increase in the production of fluorspar in 1902 over that of 1901, due partly to its increased use for metallurgic purposes. The total production in 1902 was 48,018 short tons, valued at $271,832, as compared with 19,586 tons, valued at $113,803, in 1901. This increase in production was not due to any one State, but there was a large increase in production in both Illinois and Kentucky, and also an increase in Arizona. The average price of crude fluorspar was reported as $5.19 per ton, as compared with $5 in 1901, and the average price of ground fluorspar was $9.98 per ton, as compared with $9.22 in 1901. In addition to this production there were 800 short tons, valued at $3,850, mined but not marketed in 1902.

Gypsum.—The production of gypsum, particularly for the manufacture of calcined plaster, continues to show a remarkable gain. The output of crude gypsum in 1902 was 816,478 short tons, valued in its first marketable condition at $2,089,341, as compared with 633,791 short tons, valued at $1,506,641, in 1901, and with 595,462 short tons, valued at $1,627,203, in 1900. The production in 1899 was 486,235 short tons, and in 1898 it was 291,638 short tons. The greatly increased production of the last four years is attributable to the largely increased use of plaster of Paris in the large modern buildings and in the manufacuture of staff for temporary buildings.

Marls.—The production of marls in the United States in 1902 was 12,439 short tons, valued at $12,741.

Phosphate rock.—The total commercial production of phosphate rock reported to the Survey in 1902 amounted to 1,490,314 long tons, valued at $4,693,444, as compared with 1,483,723 long tons, valued at $5,316,403, in 1901, an increase in quantity of 6,591 tons and a decrease in value of $622,959. The total quantity of phosphate rock reported as mined during 1902 was 1,548,720 long tons, valued at $4,922,943, as compared with 1,440,408 long tons in 1901.

Salt.—The salt product includes salt in the form of brine used in large quantities for the manufacture of soda ash, sodium bicarbonate, caustic soda, and other sodium salts. The domestic production of salt in 1902 amounted to 23,849,221 barrels of 280 pounds net, valued at $5,668,636, as compared with 20,556,661 barrels, valued at $6,617,449, in 1901, and with 20,869,342 barrels, valued at $6,944,603, in 1900.

Sulphur and pyrite.—The domestic production of sulphur and of pyrite for the manufacture of sulphuric acid amounted in 1902 to 207,874 long tons, valued at $947,089, as compared with a combined production of 241,691 long tons, valued at $1,257,879, in 1901. The production of sulphur was from Louisiana, Nevada, and Utah, named in the order of the importance of their outputs. Oregon and Idaho reported no production in 1902. The greater part of the output of pyrite was derived from Virginia, Georgia, North Carolina, Colorado, and Massachusetts, named in the order of production.

PIGMENTS.

Barytes.—The production of crude barytes in 1902 was considerably in excess of that of the year before, amounting to 61,668 short tons, valued at $203,154, as compared with 49,070 tons, valued at $157,844, in 1901. This is an increase of 12,598 tons in quantity and of $45,310 in value.

Cobalt oxide.—The domestic production of cobalt oxide in 1902 was 3,730 pounds, valued at $6,714, as compared with 13,360 pounds, valued at $24,048, in 1901, a decrease in quantity of 9,630 pounds. All the cobalt oxide was obtained as a by-product in smelting lead ores at Mine Lamotte, Mo.

Mineral paints.—The commercial production of mineral paints in 1902 amounted to 73,049 short tons, valued at $944,332, as compared with 61,460 short tons, valued at $789,962, in 1901. The production of crude mineral paints in 1902 is reported as 35,479 short tons, valued at $360,885, including 4,500 tons, valued at $18,000, of ocher and metallic paint reported as mined but not marketed in 1902.

Zinc white.—The production of zinc white in 1902 amounted to 52,645 short tons, valued at $4,016,499, as compared with 46,500 short tons, valued at $3,720,000, in 1901.

MISCELLANEOUS.

Asbestos.—The commercial production of asbestos in the United States in 1902 was chiefly from the mines at Sall Mountain, White County, Ga., with smaller quantities from Hillsdale, Berkshire County, Mass. This production was 1,005 short tons, valued at $16,-200, an increase of 258 tons in quantity and of $2,702 in value over the production of 1901, which was 747 short tons, valued at $13,498. The production in 1900 was 1,054 short tons, valued at $16,310. In addition there were reported as produced but not marketed in 1902 1,500 short tons of crude asbestos, valued at $30,000.

Asphaltum.—Under this title are included the various bitumens or hydrocarbons not discussed under the heading "Petroleum" in the volume on Mineral Resources. The commercial production of asphaltum in 1902 was 105,458 short tons, valued at $765,048, as compared with 63,134 short tons, valued at $555,335, in 1901—a large increase, amounting in quantity to 42,324 short tons and in value to $209,713. The production of crude asphaltum in 1902 is reported as 66,238 short tons, valued at $236,728.

Bauxite.—In 1902 the production of bauxite increased to 29,222 long tons, valued at $128,206, as compared with 18,905 long tons, valued at $79,914, in 1901. Georgia yielded the greater bulk of the product, the remainder being supplied by Alabama and Arkansas.

Chromic iron ore.—California was the one State to produce any chromite during 1902, the quantity being 315 long tons, valued at $4,567, a decrease of 53 tons in quantity and of $1,223 in value, as compared with the production of 1901, which was 368 long tons, valued at $5,790.

Feldspar.—The production of feldspar in 1902 was 45,287 short tons, valued at $250,424, as against 34,741 short tons, valued at $220,422, in 1901.

Fibrous talc.—This variety of talc or soapstone occurs in but one locality in the United States—Gouverneur, St. Lawrence County, N. Y. It is used principally as makeweight in the manufacture of paper. In 1902 the production was 71,100 short tons, valued at $615,350, an increase of $131,750 in value and of only 1,900 tons in quantity, as compared with the production of 69,200 short tons, valued at $483,600, in 1901.

Flint.—The production of flint in 1902 was 36,365 short tons, valued at $144,209, as compared with 34,420 short tons, valued at $149,297, in 1901.

Fuller's earth.—As reported for the Survey, the production of fuller's earth in 1902 showed a decrease in quantity and an increase in value, being 11,492 short tons, valued at $98,144, as compared with 14,112 short tons, valued at $96,835, in 1901. The maximum production of fuller's earth was obtained in 1897, when the production was 17,113 short tons.

Glass sand.—The production of glass sand in 1902 was 943,135 short tons, valued at $807,797; the production of engine, furnace, building, molding, and other sands, mined incidentally, was 904,776 short tons, valued at $615,817—a total production of 1,847,901 short tons of sand, valued at $1,423,614.

Graphite.—The commercial production of crystalline graphite during 1902 amounted to 3,936,824 pounds, valued at $126,144, as compared with 3,967,612 pounds, valued at $135,914, in 1901, and with 5,507,855 pounds, valued at $178,761, in 1900. The commercial production of amorphous graphite in 1902 was 4,739 short tons, valued at $55,964, as compared with 809 short tons, valued at $31,800, in 1901. The decline in value was due to a proportionate increase in the production of the lower grades. Considerable development and exploratory work was done during the year in Montana, Wyoming, North Carolina, and New Mexico. In addition, 30,000 pounds of refined graphite, valued at $1,800, and 20,716 short tons of crude graphite, valued at $43,600, were reported as produced but not marketed in 1902. This gives a total production of 3,966,824 pounds of refined graphite and of 25,455 short tons of amorphous graphite, with a total value of $227,508, as produced in 1902. The production of artificial graphite was 2,358,828 pounds, valued at $110,700, the average price being 4.69 cents per pound, as compared with 2,500,000 pounds, valued at $119,000, in 1901, the average price being 4.75 cents per pound.

Limestone for iron flux.—The quantity of limestone used for fluxing in blast furnaces in 1902 was 11,878,675 long tons, valued at $5,271,252, as compared with 8,540,168 long tons, valued at $4,659,836, in 1901, and with 7,495,435 long tons, valued at $3,687,394, in 1900.

Magnesite.—The production of megnesite in the United States continues to be limited to California, and during the year 1902 the commercial production reported was 3,466 short tons, valued at $21,362—a large decrease as compared with the production in 1901, which was 13,172 short tons, valued at $43,057. Of the 1902 production, 380 tons, valued at $1,723, were sold in 1902, but were mined previously.

Mica.—The production of mica in 1902 was as follows: 373,266 pounds of plate or sheet mica, valued at $83,843; 1,028 short tons of scrap mica, valued at $13,081; and 372 short tons of rough mica, valued at $21,925—a total value of $118,849.

Mineral waters.—The total production of mineral waters for 1902 was 64,859,451 gallons, valued at $8,793,761, as compared with 55,771,181 gallons, valued at $7,586,962, in 1901—a gain in quantity of 9,088,263 gallons and in value of $1,206,799.

Monazite.—The production of monazite is confined exclusively to North Carolina and South Carolina, by far the larger quantity being obtained from the former State, and in 1902 this amounted to 802,000 pounds, valued at $64,160, as compared with 748,736 pounds, valued at $59,262, in 1901—an increase in quantity of 53,264 pounds and in value of $4,898. The price per pound received by the miners for the monazite produced in 1902 varied from 2.5 to 8 cents, according to the percentage of thoria.

Precious stones.—The value of the gems and precious stones found in the United States in 1902 was $328,450, as compared with $289,050 in 1901, with $233,170 in 1900, and with $185,770 in 1899. There has been a great advance in the lapidary industry in the United States since 1894. The fact that larger establishments have been formed, which are able to purchase the rough diamonds in greater quantities, has placed our American diamond cutters in a position equal to that held by the cutters of Amsterdam, Antwerp, and Paris. The cutting of our native gems has also grown to the proportions of an industry, notably in the case of the beryls and the amethyst found in North Carolina and Connecticut; the turquoise from New Mexico, Arizona, Nevada, and California; the fine-colored and deep-blue sapphires found in Montana; the colored tourmalines of San Joaquin County, Cal.; the chrysoprase mine of Visalia, Tulare County, Cal.; the garnets of Arizona and New Mexico, and the pale-purple garnets of North Carolina.

Rutile.—The production of rutile in 1902 was less than in 1901.

Soapstone.—Exclusive of the production of fibrous talc from Gouverneur, N. Y., the production of talc and soapstone in 1902 amounted to 26,854 short tons, valued at $525,157, as compared with 28,643 tons, valued at $424,888, in 1901—a decrease of 1,789 tons in quantity and an increase of $100,269 in value. The output for 1900 was 27,943 short tons, valued at $383,541, and for 1899 it was 24,765 short tons, valued at $330,805.

Mineral products of the United

	Product.	1901.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, spot value .... long tons..	15,878,354	$242,174,000
2	Silver, coining value .... fine ounces..	55,214,000	71,387,800
3	Gold, coining value .... do....	3,805,500	78,666,700
4	Copper, value at New York City .... pounds..	602,072,519	87,300,515
5	Lead, value at New York City .... short tons..	270,700	23,280,200
6	Zinc, value at New York City .... do....	140,822	11,265,760
7	Quicksilver, value at San Francisco .... flasks..	29,727	1,382,305
8	Aluminum, value at Pittsburg .... pounds..	7,150,000	2,238,000
9	Antimony, value at San Francisco .... short tons..	2,639	539,902
10	Nickel, value at Philadelphia .... pounds..	6,700	3,551
11	Tin .... do....	None.	....
12	Platinum, value (crude) at San Francisco .... troy ounces..	1,408	27,526
13	Total value of metallic products	....	518,266,259
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal .... short tons..	225,828,149	236,422,049
15	Pennsylvania anthracite .... long tons..	60,242,560	112,504,020
16	Natural gas	....	27,067,500
17	Petroleum .... barrels..	69,389,194	66,417,335
18	Brick clay	....	13,800,000
19	Cement .... barrels..	20,068,737	15,786,789
20	Stone	....	55,615,926
21	Corundum and emery .... short tons..	4,305	146,040
22	Crystalline quartz .... do....	14,050	41,500
23	Garnet for abrasive purposes .... do....	4,444	158,100
24	Grindstones	....	580,703
25	Infusorial earth and tripoli .... short tons..	4,020	52,950
26	Millstones	....	57,179
27	Oilstones, etc	....	158,300
28	Arsenious oxide .... short tons..	300	18,000
29	Borax (refined) .... do....	5,344	697,307
30	Borax (crude) .... do....	17,887	314,811
31	Bromine .... pounds..	552,043	154,572
32	Fluorspar .... short tons..	19,586	113,803
33	Gypsum .... do....	633,791	1,506,641
34	Lithium .... do....	1,750	43,200
35	Marls .... do....	99,880	124,880
36	Phosphate rock .... long tons..	1,483,723	5,316,403
37	Pyrite .... do....	241,691	1,257,879
38	Salt .... barrels..	20,566,661	6,617,449
39	Sulphur .... short tons..	(*a*)	(*a*)
40	Barytes (crude) .... do....	49,070	157,844
41	Cobalt oxide .... pounds..	13,360	24,048
42	Mineral paints .... short tons..	61,460	789,962
43	Zinc white .... do....	46,500	3,720,000
44	Asbestos .... short tons..	747	13,498
45	Asphaltum .... do....	63,134	555,335
46	Bauxite .... long tons..	18,905	79,914
47	Chromic iron ore .... do....	368	5,790
48	Clay (all other than brick) .... short tons..	....	2,576,932
49	Feldspar .... do....	34,741	220,422
50	Fibrous talc .... do....	69,200	483,600
51	Flint .... do....	34,420	149,297
52	Fuller's earth .... do....	14,112	96,835
53	Glass sand .... do....	....	....
54	Graphite (crystalline) .... pounds..	3,967,612	167,714
55	Graphite (amorphous) .... short tons..	809	
56	Limestone for iron flux .... long tons..	8,540,168	4,659,836
57	Magnesite .... short tons..	13,172	43,657
58	Manganese ore .... long tons..	11,995	116,722
59	Mica (sheet) .... pounds..	360,060	98,859
60	Mica (scrap) .... short tons..	2,171	19,719
61	Mineral waters .... gallons sold..	55,771,188	7,586,962
62	Monazite .... pounds..	748,736	59,262
63	Ozocerite (refined) .... do....	None.	None.
64	Precious stones	....	289,050
65	Pumice stone .... short tons..	None.	None.
66	Rutile .... pounds..	44,250	5,710
67	Soapstone .... short tons..	28,643	424,888
68	Uranium and vanadium .... do....	375	....
69	Total value of nonmetallic mineral products	....	567,318,592
70	Total value of metallic products	....	518,266,259
71	Estimated value of mineral products unspecified	....	1,000,000
72	Grand total	....	1,086,584,851

a Combined with pyrite.

States in 1901 and 1902.

1902.		Increase (+) or decrease (−) in 1902.		Per cent of increase (+) or decrease (−).		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
17,821,307	$372,775,000	+ 1,942,953	+$130,601,000	+ 12.24	+ 53.93	1
55,500,000	71,757,575	+ 286,000	+ 369,775	+ .52	+ .52	2
3,870,000	80,000,000	+ 64,500	+ 1,333,300	+ 1.69	+ 1.69	3
659,508,644	76,568,954	+57,436,065	− 10,731,561	+ 9.53	− 12.29	4
270,000	22,140,000	− 700	− 1,140,200	− .26	− 4.90	5
156,927	14,625,596	+ 16,105	+ 3,359,836	+ 11.44	+ 29.82	6
34,291	1,467,848	+ 4,564	+ 85,543	+ 15.35	+ 6.19	7
7,300,000	2,284,590	+ 150,000	+ 46,590	+ 2.10	+ 2.08	8
3,561	634,506	+ 922	+ 94,604	+ 34.94	+ 17.52	9
5,748	2,701	− 952	− 850	− 14.21	− 23.93	10
....	....	....	....	....	....	11
94	1,814	− 1,314	− 25,712	− 93.32	− 93.41	12
....	642,258,584	....	+ 123,992,325	....	+ 23.92	13
260,216,844	290,858,483	+34,388,695	+ 54,436,434	+ 15.23	+ 23.03	14
36,940,710	76,173,586	−23,301,850	− 36,330,434	− 38.68	− 32.29	15
....	30,867,668	....	+ 3,800,168	....	+ 14.04	16
88,766,916	71,178,910	+19,377,722	+ 4,761,575	+ 27.92	+ 7.17	17
....	15,000,000	....	+ 1,200,000	....	+ 8.70	18
25,753,504	25,366,380	+ 5,684,767	+ 9,579,591	+ 28.33	+ 60.68	19
....	64,559,099	....	+ 8,943,173	....	+ 16.08	20
4,251	104,605	− 54	− 41,435	− 1.25	− 28.37	21
15,104	84,335	+ 1,054	+ 42,835	+ 7.50	+103.21	22
3,926	132,820	− 518	− 25,280	− 11.66	− 15.99	23
....	667,431	....	+ 86,728	....	+ 14.94	24
5,665	53,244	+ 1,645	+ 294	+ 40.92	+ .55	25
....	59,808	....	+ 2,629	....	+ 4.60	26
....	221,762	....	+ 63,462	....	+ 40.09	27
1,353	81,180	+ 1,053	+ 63,180	+351.00	+351.00	28
17,404	2,447,614	+ 12,060	+ 1,750,307	+225.67	+251.01	29
2,600	91,000	− 15,287	− 223,811	− 85.46	71.09	30
513,890	128,472	− 38,153	− 26,100	− 6.91	− 16.89	31
48,018	271,832	+ 28,432	+ 158,029	+145.16	+138.88	32
816,478	2,089,341	+ 182,687	+ 582,700	+ 28.82	+ 38.68	33
1,245	25,750	− 505	− 17,450	− 28.86	− 40.39	34
12,439	12,741	− 87,441	− 112,139	− 87.55	− 80.80	35
1,490,314	4,693,444	+ 6,591	− 622,959	+ .44	− 11.72	36
207,874	947,089	− 33,817	− 310,790	− 13.99	− 24.71	37
23,849,221	5,668,636	+ 3,282,560	− 948,813	+ 15.96	− 14.34	38
(*a*)	(*a*)	....	....	....	....	39
61,668	203,154	+ 12,598	+ 45,310	+ 25.67	+ 28.71	40
3,730	6,714	− 9,630	− 17,334	− 72.08	− 72.08	41
73,049	944,332	+ 11,589	+ 154,370	+ 18.86	+ 19.54	42
52,645	4,016,499	+ 6,145	+ 296,499	+ 13.22	+ 7.97	43
1,005	16,200	+ 258	+ 2,702	+ 34.53	+ 20.02	44
105,458	765,048	+ 42,324	+ 209,713	+ 67.04	+ 37.76	45
29,222	128,206	+ 10,317	+ 48,292	+ 54.57	+ 60.43	46
315	4,567	− 53	− 1,223	− 14.40	− 21.12	47
1,455,357	2,061,072	....	− 515,860	....	− 20.02	48
45,287	250,424	+ 10,546	+ 30,002	+ 30.36	+ 13.61	49
71,100	615,350	+ 1,900	+ 131,750	+ 2.75	+ 27.24	50
36,365	144,209	+ 1,945	− 5,088	+ 5.65	− 3.41	51
11,492	98,144	− 2,620	+ 1,309	− 18.57	+ 1.35	52
943,135	807,797	....	....	....	....	53
3,936,824	182,108	− 30,788	+ 14,394	− .78	+ 8.58	54
4,739		+ 3,930		+485.78		55
11,878,675	5,271,252	+ 3,338,507	+ 611,416	+ 39.09	+ 13.12	56
3,466	21,362	− 9,706	− 21,695	− 73.69	− 50.39	57
16,477	177,911	+ 4,482	+ 61,189	+ 37.37	+ 52.42	58
419,266	84,843	+ 59,206	− 14,016	+ 16.44	− 14.18	59
1,377	34,006	− 794	+ 14,287	− 36.57	+ 72.45	60
64,859,451	8,793,761	+ 9,088,263	+ 1,206,799	+ 16.30	+ 15.91	61
802,000	64,160	+ 53,264	+ 4,898	+ 7.11	+ 8.26	62
None.	None.	....	....	....	....	63
....	328,450	....	+ 39,400	....	+ 13.63	64
700	2,750	....	....	....	....	65
....	....	....	....	....	....	66
26,854	525,157	− 1,789	+ 100,269	− 6.25	+ 23.60	67
3,810	48,125	+ 3,435	....	+916.00	....	68
....	617,380,831	....	+ 50,072,089	....	+ 8.82	69
....	642,258,584	....	+123,992,325	....	+ 23.92	70
....	1,000,000	....	....	....	....	71
....	1,260,639,415	....	+174,064,414	....	+ 16.02	72

Mineral products of the United States

	Product.	1880. Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia..........long tons..	3,375,912	$89,315,569
2	Silver, coining value..........fine ounces..	30,320,000	39,200,000
3	Gold, coining value..........do....	1,741,500	36,000,000
4	Copper, value at New York City..........pounds..	60,480,000	11,491,200
5	Lead, value at New York City..........short tons..	97,825	9,782,500
6	Zinc, value at New York City..........do....	23,239	2,277,432
7	Quicksilver, value at San Francisco..........flasks..	59,926	1,797,780
8	Nickel, value at Philadelphia..........pounds..	233,893	257,282
9	Aluminum, value at Pittsburg..........do....	....	....
10	Antimony, value at San Francisco..........short tons..	50	10,000
11	Platinum (crude), value at San Francisco..........troy ounces..	100	400
12	Total value of metallic products..........	....	190,132,163
	NONMETALLIC (SPOT VALUES).		
13	Bituminous coal..........long tons..	38,242,641	53,443,718
14	Pennsylvania anthracite..........do....	25,580,189	42,196,678
15	Stone..........do....	....	18,356,055
16	Petroleum..........barrels..	26,286,123	24,183,233
17	Lime..........do....	28,000,000	19,000,000
18	Natural gas..........	....	....
19	Cement..........barrels..	2,072,943	1,852,707
20	Salt..........do....	5,961,060	4,829,566
21	Phosphate rock..........long tons..	211,377	1,123,823
22	Limestone for iron flux..........do....	4,500,000	3,800,000
23	Mineral waters..........gallons sold..	2,000,000	500,000
24	Zinc white..........short tons..	10,107	763,738
25	Potters' clay..........do....	28,877	200,457
26	Mineral paints..........do....	3,604	135,840
27	Borax..........pounds..	3,692,443	277,233
28	Gypsum..........short tons..	90,000	400,000
29	Grindstones..........	....	500,000
30	Fibrous talc..........short tons..	4,210	54,730
31	Pyrite..........long tons..	2,000	5,000
32	Soapstone..........short tons..	8,441	66,665
33	Manganese ore..........long tons..	5,761	86,415
34	Asphaltum..........short tons..	444	4,440
35	Precious stones..........	....	100,000
36	Bromine..........pounds..	404,690	114,752
37	Corundum..........short tons..	1,044	29,280
38	Barytes (crude)..........do....	20,000	80,000
39	Graphite..........pounds..	....	49,800
40	Millstones..........	....	200,000
41	Oilstones, etc.[a]..........pounds..	420,000	8,000
42	Marls..........short tous..	1,000,000	500,000
43	Flint..........long tons..	20,000	80,000
44	Fluorspar..........short tons..	4,000	16,000
45	Chromic iron ore..........long tons..	2,288	27,808
46	Infusorial earth..........short tons..	1,833	45,660
47	Feldspar..........long tons..	12,500	60,000
48	Mica..........pounds..	81,669	127,825
49	Cobalt oxide..........do....	7,251	24,000
50	Slate ground as a pigment..........short tons..	1,000	10,000
51	Sulphur..........do....	600	21,000
52	Asbestos..........do....	150	4,312
53	Rutile..........pounds..	100	400
54	Lithographic stone..........short tons..	....	....
55	Total value of nonmetallic mineral products..........	....	173,279,135
56	Total value of metallic products..........	....	190,132,163
57	Estimated value of mineral products unspecified..........	....	6,000,000
58	Grand total..........	....	369,411,298

[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

for the calendar years 1880–1902.

1881.		1882.		1883.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,144,254	$87,029,334	4,623,323	$106,336,429	4,595,510	$91,910,200	1
33,077,000	43,000,000	36,197,695	46,800,000	35,733,622	46,200,000	2
1,676,300	34,700,000	1,572,186	32,500,000	1,451,249	30,000,000	3
71,680,000	12,175,600	91,646,232	16,038,091	117,151,795	18,064,807	4
117,085	11,240,160	132,890	12,624,550	143,957	12,322,719	5
26,800	2,680,000	33,765	3,646,620	36,872	3,311,106	6
60,851	1,764,679	52,732	1,487,042	46,725	1,253,632	7
265,668	292,235	281,616	309,777	58,800	52,920	8
....	....	....	....	83	875	9
50	10,000	60	12,000	60	12,000	10
100	400	200	600	200	600	11
....	192,892,408	....	219,755,109	....	203,128,859	12
48,179,475	60,224,344	60,861,190	76,076,487	68,531,500	82,237,800	13
28,500,016	64,125,036	31,358,264	70,556,094	34,336,469	77 257,055	14
....	20,000,000	....	21,000,000	....	20,000,000	15
27,661,238	25,448,339	30,510,830	24,065,988	23,449,633	25,790,252	16
30,000,000	20,000,000	31,000,000	21,700,000	32,000,000	19,200,000	17
....	....	....	215,000	....	475,000	18
2,500,000	2,000,000	3,250,000	3,672,750	4,190,000	4,293,500	19
6,200,000	4,200,000	6,412,373	4,320,140	6,192,231	4,211,042	20
266,734	1,980,259	332,077	1,992,462	378,380	2,270,280	21
6,000,000	4,100,000	3,850,000	2,310,000	3,814,273	1,907,136	22
3,700,000	700,000	5,000,000	800,000	7,529,423	1,119,603	23
10,000	700,000	10,000	700,000	12,000	840,000	24
28,000	200,000	33,600	240,000	35,840	250,000	25
6,000	100,000	7,000	105,000	7,000	84,000	26
4,046,000	304,461	4,236,291	338,903	6,500,000	585,000	27
85,000	350,000	100,000	450,000	90,000	420,000	28
....	500,000	....	700,000	....	600,000	29
5,000	60,000	6,000	75,000	6,000	75,000	30
10,000	60,000	12,000	72,000	25,000	137,500	31
7,000	75,000	6,000	90,000	8,000	150,000	32
4,895	73,425	4,532	67,980	6,155	92,325	33
2,000	8,000	3,000	10,500	3,000	10,500	34
....	110,000	....	150,000	....	207,050	35
300,000	75,000	250,000	75,000	301,100	72,264	36
500	80,000	500	80,000	550	100,000	37
20,000	80,000	20,000	80,000	27,000	108,000	38
400,000	30,000	425,000	34,000	575,000	46,000	39
....	150,000	....	200,000	....	150,000	40
500,000	8,580	600,000	10,000	600,000	10,000	41
1,000,000	500,000	1,080,000	540,000	972,000	486,000	42
25,000	100,000	25,000	100,000	25,000	100,000	43
4,000	16,000	4,000	20,000	4,000	20,000	44
2,000	30,000	2,500	50,000	3,000	60,000	45
1,000	10,000	1,000	8,000	1,000	5,000	46
14,000	70,000	14,000	70,000	14,100	71,112	47
100,000	250,000	100,000	250,000	114,000	285,000	48
8,280	25,000	11,653	32,046	1,096	2,795	49
1,000	10,000	2,000	24,000	2,000	24,000	50
600	21,000	600	21,000	1,000	27,000	51
200	7,000	1,200	36,000	1,000	30,000	52
200	700	500	1,800	550	2,000	53
50	1,000	....	....	....	....	54
....	206,783,144	....	231,340,150	....	243,812,214	55
....	192,892,408	....	219,755,109	....	203,128,859	56
....	6,500,000	....	6,500,000	....	6,500,000	57
....	406,175,552	....	457,595,259	....	453,441,073	58

Mineral products of the United States for

	Product.	1884. Quantity.	1884. Value.
	METALLIC.		
1	Pig iron, value at Philadelphia ....long tons..	4,097,868	$73,761,624
2	Silver, coining value ....fine ounces..	37,744,605	48,800,000
3	Gold, coining value ....do....	1,489,949	30,800,000
4	Copper, value at New York City ....pounds..	145,221,934	17,789,687
5	Lead, value at New York City ....short tons..	139,897	10,537,042
6	Zinc, value at New York City ....do....	38,544	3,422,707
7	Quicksilver, value at San Francisco ....flasks..	31,913	936,327
8	Nickel, value at Philadelphia ....pounds..	64,550	48,412
9	Aluminum, value at Pittsburg ....do....	150	1,350
10	Antimony, value at San Francisco ....short tons..	60	12,000
11	Platinum (crude), value at San Francisco ....troy ounces..	150	450
12	Total value of metallic products	....	186,109,599
	NONMETALLIC (SPOT VALUES).		
13	Bituminous coal ....long tons..	73,730,539	77,417,066
14	Pennsylvania anthracite ....do....	33,175,756	66,351,512
15	Stone ....do....	....	19,000,000
16	Petroleum ....barrels..	24,218,438	20,595,966
17	Lime ....do....	37,000,000	18,500,000
18	Natural gas	....	1,460,000
19	Brick clay	....	....
20	Clay (all other than brick) ....short tons..	39,200	270,000
21	Cement ....barrels..	4,000,000	3,720,000
22	Salt ....do....	6,514,937	4,197,734
23	Phosphate rock ....long tons..	431,779	2,374,784
24	Limestone for iron flux ....do....	3,401,930	1,700,965
25	Mineral waters ....gallons sold..	10,215,328	1,459,143
26	Zinc white ....short tons..	13,000	910,000
27	Mineral paints ....do....	7,000	84,000
28	Borax ....pounds..	7,000,000	490,000
29	Gypsum ....short tons..	90,000	390,000
30	Grindstones	....	570,000
31	Fibrous talc ....short tons..	10,000	110,000
32	Pyrite ....long tons..	35,000	175,000
33	Soapstone ....short tons..	10,000	200,000
34	Manganese ore ....long tons..	10,180	122,160
35	Asphaltum ....short tons..	3,000	10,500
36	Precious stones	....	222,975
37	Bromine ....pounds..	281,100	67,464
38	Corundum ....short tons..	600	108,000
39	Barytes (crude) ....do....	25,000	100,000
40	Graphite ....pounds..	....	....
41	Millstones	....	150,000
42	Oilstones, etc.[a] ....pounds..	800,000	12,000
43	Marls ....short tons..	875,000	437,500
44	Flint ....long tons..	30,000	120,000
45	Fluorspar ....short tons..	4,000	20,000
46	Chromic iron ore ....long tons..	2,000	35,000
47	Infusorial earth ....short tons..	1,000	5,000
48	Feldspar ....long tons..	10,900	55,112
49	Mica ....pounds..	147,410	368,525
50	Cobalt oxide ....do....	2,000	5,100
51	Slate ground as a pigment ....short tons..	2,000	20,000
52	Sulphur ....do....	500	12,000
53	Asbestos ....do....	1,000	30,000
54	Rutile ....pounds..	600	2,000
55	Lithographic stone ....short tons..	....	....
56	Total value of nonmetallic mineral products	....	221,879,506
57	Total value of metallic products	....	186,109,599
58	Estimated value of mineral products unspecified	....	5,000,000
59	Grand total	....	412,989,105

[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

the calendar years 1880-1902—Continued.

1885.		1886.		1887.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,044,425	$64,712,400	5,683,329	$95,195,760	6,417,148	$121,925,800	1
39,910,279	51,600,000	39,445,312	51,000,000	41,269,240	53,350,000	2
1,538,376	31,800,000	1,881,250	35,000,000	1,596,500	33,000,000	3
170,962,607	18,292,999	161,235,381	16,527,651	185,227,331	21,115,916	4
129,412	10,469,431	130,629	12,200,749	145,700	13,113.000	5
40,688	3,539,856	42,641	3,752,408	50,340	4,782,300	6
32,073	979,189	29,981	1,060,000	33,825	1,429,000	7
277,904	179,975	214,992	127,157	205,566	133,200	8
283	2,550	3,000	27,000	18,000	59,000	9
50	10,000	35	7,000	75	15,000	10
250	187	50	100	448	1,838	11
	181,586,587		214,897,825		248,925,054	12
64,840,668	82,347,648	73,707,957	78,481,056	87,887,360	98,004,656	13
34,228,548	76,671,948	34,853,077	76,119,120	37,578,747	84,552,181	14
	19,000,000		19,000,000		25,000,000	15
21,847,205	19,198,243	28,064,841	19,996,313	28,278,866	18,877,094	16
40,000,000	20,000,000					17
	4,857,200		10,012,000		15,817,500	18
			6,200,000		7,000,000	19
40,320	275,000	44,800	325,000	48,160	340,000	20
4,150,000	3,492,500	4,500,000	3,990,000	6,692,744	5,674,377	21
7,038,653	4,825,345	7,707,081	4,736,585	7,831,962	4,093,846	22
437,856	2,846,064	430,549	1,872,936	480,558	1,836,818	23
3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200	24
9,148,401	1,312,845	8,950,317	1,284,070	8,259,609	1,261,463	25
15,000	1,050,000	18,000	1,440,000	18,000	1,440,000	26
3,950	43,575	18,800	315,000	22,000	330,000	27
8,000,000	480,000	9,778,290	488,915	11,000,000	550,000	28
90,405	405,000	95,250	428,625	95,000	425,000	29
	500,000		250,000		224,400	30
10,000	110,000	12,000	125,000	15,000	160,000	31
49,000	220,500	55,000	220,000	52,000	210,000	32
10,000	200,000	12,000	225,000	12,000	225,000	33
23,258	190,281	30,193	277,636	34,524	333,844	34
3,000	10,500	3,500	14,000	4,000	16,000	35
	209,900		119,056		163,600	36
310,000	89,900	428,334	141,350	199,087	61,717	37
600	108,000	645	116,190	600	108,000	38
15,000	75,000	10,000	50,000	15,000	75,000	39
327,883	26,231	415,525	33,242	416,000	34,000	40
	100,000		140,000		100,000	41
1,000,000	15,000	1,160,000	15,000	1,200,000	16,000	42
875,000	437,500	800,000	400,000	600,000	300,000	43
30 000	120,000	30,000	120,000	32,000	128,000	44
5,000	22,500	5,000	22,000	5,000	20,000	45
2,700	40,000	2,000	30,000	3,000	40,000	46
1,000	5,000	1,200	6,000	3,000	15,000	47
13,600	68,000	14,900	74,500	10,200	61,200	48
92,000	161,000	40,000	70,000	70,000	142,250	49
68,723	65,373	35,000	36,878	18,340	18,774	50
1,975	24,687					51
715	17,875	2,500	75,000	3,000	100,000	52
300	9,000	200	6,000	150	4,500	53
600	2,000	600	2,000	1,000	3,000	54
						55
	241,312,093		230,088,769		270,989,420	56
	181,586,587		214,897,825		248,925,054	57
	5,000,000		800,000		800,000	58
	427,898,680		445,786,594		520,714,474	59

Mineral products of the United States for

	Product.	1888.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia ....long tons..	6,489,738	$107,000,000
2	Silver, coining value............fine ounces..	45,783,632	59,195,000
3	Gold, coining value............do....	1,604,927	33,175,000
4	Copper, value at New York City ....pounds..	231,270,622	33,833,954
5	Lead, value at New York City............short tons..	151,919	13,399,256
6	Zinc, value at New York City............do....	55,903	5,500,855
7	Quicksilver, value at San Francisco ....flasks..	33,250	1,413,125
8	Aluminum, value at Pittsburg ....pounds..	19,000	65,000
9	Antimony, value at San Francisco............short tons..	100	20,000
10	Nickel, value at Philadelphia............pounds..	204,328	127,632
11	Tin ....do....	....	....
12	Platinum (crude), value at San Francisco............troy ounces..	500	2,000
13	Total value of metallic products............	....	253,731,822
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal............short tons..	102,039,838	101,860,529
15	Pennsylvania anthracite............long tons..	41,624,611	89,020,483
16	Stone	....	25,500,000
17	Petroleum ....barrels..	27,612,025	17,947,620
18	Natural gas	....	22,629,875
19	Brick clay............	....	7,500,000
20	Clay (all other than brick)............short tons..	41,160	300,000
21	Cement............barrels..	6,503,295	5,021,139
22	Mineral waters ....gallons sold..	9,578,648	1,679,302
23	Phosphate rock ....long tons..	448,567	2,018,552
24	Salt............barrels..	8,055,881	4,374,203
25	Limestone for iron flux ....long tons..	5,438,000	2,719,000
26	Zinc white ....short tons..	20,000	1,600,000
27	Gypsum ....do....	110,000	550,000
28	Borax ....pounds..	7,589,000	455,340
29	Mineral paints............short tons..	26,500	405,000
30	Grindstones............	....	281,800
31	Fibrous talc ....short tons..	20,000	210,000
32	Asphaltum ....do....	53,800	331,500
33	Soapstone ....do....	15,000	250,000
34	Precious stones	....	139,850
35	Pyrite............long tons..	54,331	167,658
36	Corundum............short tons..	589	91,620
37	Oilstones, etc. [a]............pounds..	1,500,000	18,000
38	Mica ....do....	48,000	70,000
39	Barytes (crude) ....short tons..	20,000	110,000
40	Bromine ....pounds..	307,386	95,290
41	Fluorspar............short tons..	6,000	30,000
42	Feldspar ....long tons..	8,700	50,000
43	Manganese ore ....do....	29,198	279,571
44	Flint ....do....	30,000	127,500
45	Graphite ....pounds..	400,000	33,000
46	Bauxite ....long tons..	....	....
47	Sulphur ....short tons..	....	....
48	Marls............do....	300,000	150,000
49	Infusorial earth ....do....	1,500	7,500
50	Millstones	....	81,000
51	Chromic iron ore............long tons..	1,500	20,000
52	Cobalt oxide ....pounds..	8,491	15,782
53	Magnesite ....short tons..	....	....
54	Asbestos............do....	100	3,000
55	Rutile............pounds..	1,000	3,000
56	Ozocerite (refined) ....do....	43,500	3,000
57	Total value of nonmetallic mineral products............	....	286,150,114
58	Total value of metallic products	....	253,731,822
59	Estimated value of mineral products unspecified............	....	900,000
60	Grand total	....	540,781,936

[a] Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished product.

the calendar years 1880–1902—Continued.

1889.		1890.		1891.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
7,603,642	$120,000,000	9,202,703	$151,200,410	8,279,870	$128,337,985	1
51,354,851	66,396,988	54,500,000	70,464,645	58,330,000	75,416,565	2
1,590,869	32,886,744	1,588,880	32,845,000	1,604,840	33,175,000	3
231,246,214	26,907,809	265,115,133	30,848,797	295,812,076	38,455,300	4
156,397	13,794,235	143,630	12,668,166	178,554	15,534,198	5
58,860	5,791,824	63,683	6,266,407	80,873	8,033,700	6
26,484	1,190,500	22,926	1,203,615	22,904	1,036,386	7
47,468	97,335	61,281	61,281	150,000	100,000	8
115	28,000	938	177,508	1,289	217,957	9
252,663	151,598	223,488	134,093	118,498	71,099	10
....	....	....	....	125,289	25,058	11
500	2,000	600	2,500	100	500	12
....	267,247,033	....	305,872,422	....	300,403,748	13
95,685,543	94,504,745	111,320,016	110,420,801	117,901,237	117,188,400	14
40,714,721	65,879,514	41,489,858	66,383,772	45,236,992	73,944,735	15
....	42,809,706	....	47,000,000	....	47,294,746	16
35,163,513	26,963,340	45,822,672	35,365,105	54,291,980	30,526,553	17
....	21,097,099	....	18,742,725	....	15,500,084	18
....	8,000,000	....	8,500,000	....	9,000,000	19
329,665	635,578	392,000	756,000	448,000	900,000	20
7,000,000	5,000,000	8,000,000	6,000,000	8,222,792	6,680,951	21
12,780,471	1,748,458	13,907,418	2,600,750	18,392,732	2,996,259	22
550,245	2,937,776	510,499	3,213,795	587,988	3,651,150	23
8,005,565	4,195,412	8,776,991	4,752,286	9,987,945	4,716,121	24
6,318,000	3,159,000	5,521,622	2,760,811	5,000,000	2,300,000	25
16,970	1,357,600	....	1,600,000	23,700	1,600,000	26
267,769	764,118	182,995	574,523	208,126	628,051	27
8,000,000	500,000	9,500,000	617,500	13,380,000	869,700	28
34,307	483,766	47,732	681,992	49,652	678,478	29
....	439,587	....	450,000	....	476,113	30
23,746	244,170	41,354	389,196	53,054	493,068	31
51,735	171,537	40,841	190,416	45,054	242,264	32
12,715	231,708	13,670	252,309	16,514	243,981	33
....	188,807	....	118,833	....	235,300	34
93,705	202,119	99,854	273,745	106,536	338,880	35
2,245	105,565	1,970	89,395	2,265	90,230	36
5,982,000	32,980	....	69,909	1,375,000	150,000	37
49,500	50,000	60,000	75,000	75,000	100,000	38
19,161	106,313	21,911	86,505	31,069	118,363	39
418,891	125,667	387,847	104,719	343,000	54,880	40
9,500	45,835	8,250	55,328	10,044	78,330	41
6,970	39,370	8,000	45,200	10,000	50,000	42
24,197	240,559	25,684	219,050	23,416	239,129	43
21,113	89,730	13,000	57,400	15,000	60,000	44
....	72,662	....	77,500	....	110,000	45
728	2,366	1,844	6,012	3,593	11,675	46
1,150	7,850	....	....	1,200	39,600	47
139,522	63,956	153,620	69,880	135,000	67,500	48
3,466	23,372	2,532	50,240	....	21,988	49
....	35,155	....	23,720	....	16,587	50
2,000	30,000	3,599	53,985	1,372	20,580	51
13,955	31,092	6,788	16,291	7,200	18,000	52
....	....	....	....	439	4,390	53
30	1,800	71	4,560	66	3,960	54
1,000	3,000	400	1,000	300	800	55
50,000	2,500	350,000	26,250	50,000	7,000	56
....	282,623,812	....	312,776,503	....	321,767,846	57
....	267,247,033	....	305,872,422	....	300,403,748	58
....	1,000,000	....	1,000,000	....	1,000,000	59
....	550,870,845	....	619,648,925	....	623,171,594	60

Mineral products of the United States for

	Product.	1892. Quantity.	1892. Value.
	METALLIC.		
1	Pig iron, spot value ... long tons..	9,157,000	$131,161,039
2	Silver, coining value ... fine ounces..	63,500,000	82,099,150
3	Gold, coining value ... do....	1,596,375	33,000,000
4	Copper, value at New York City ... pounds..	352,971,744	37,977,142
5	Lead, value at New York City ... short tons..	173,654	13,892,320
6	Zinc, value at New York City ... do....	87,260	8,027,920
7	Quicksilver, value at San Francisco ... flasks..	27,993	1,245,689
8	Aluminum, value at Pittsburg ... pounds..	259,885	172,824
9	Antimony, value at San Francisco ... short tons..	1,790	276,416
10	Nickel, value at Philadelphia ... pounds..	92,252	50,739
11	Tin ... do....	162,000	32,400
12	Platinum, value (crude) at San Francisco ... troy ounces..	80	550
13	Total value of metallic products ...	...	307,936,189
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal ... short tons..	126,856,567	125,124,381
15	Pennsylvania anthracite ... long tons..	46,850,450	82,442,000
16	Natural gas ...	...	14,800,714
17	Petroleum ... barrels..	50,509,136	26,034,196
18	Brick clay ...	...	9,000,000
19	Cement ... barrels..	8,758,621	7,152,750
20	Stone ...	...	48,706,625
21	Corundum and emery ... short tons..	1,771	181,300
22	Crystalline quartz ... do....	...	...
23	Garnet for abrasive purposes ... do....	...	...
24	Grindstones ...	...	272,244
25	Infusorial earth and tripoli ... short tons..	...	43,655
26	Millstones ...	...	23,417
27	Oilstones, etc ...	...	146,730
28	Borax ... pounds..	13,500,000	900,000
29	Bromine ... do....	379,480	64,502
30	Fluorspar ... short tons..	12,250	89,000
31	Gypsum ... do....	256,259	695,492
32	Marls ... do....	125,000	65,000
33	Phosphate rock ... long tons..	681,571	3,296,227
34	Pyrite ... do....	109,788	305,191
35	Salt ... barrels..	11,698,890	5,654,915
36	Sulphur ... short tons..	2,688	80,640
37	Barytes (crude) ... do....	32,108	130,025
38	Cobalt oxide ... pounds..	7,869	15,738
39	Mineral paints ... short tons..	51,704	767,766
40	Zinc white ... do....	27,500	2,200,000
41	Asbestos ... do....	104	6,416
42	Asphaltum ... do....	87,680	445,375
43	Bauxite ... long tons..	10,518	34,183
44	Chromic iron ore ... do....	1,500	25,000
45	Clay (all other than brick) ... short tons..	470,400	1,000,000
46	Feldspar ... do....	16,800	75,000
47	Fibrous talc ... do....	41,925	472,485
48	Flint ... do....	22,400	80,000
49	Fuller's earth ... do....	...	...
50	Graphite ... pounds..	...	104,000
51	Limestone for iron flux ... long tons..	5,172,114	3,620,480
52	Magnesite ... short tons..	1,004	10,040
53	Manganese ore ... long tons..	13,613	129,586
54	Mica ... pounds..	75,000	100,000
55	Mineral waters ... gallons sold..	21,876,604	4,905,970
56	Monazite ... pounds..	...	...
57	Ozocerite (refined) ... do....	60,000	8,000
58	Precious stones ...	...	312,050
59	Pumice stone ... short tons..	...	...
60	Rutile ... pounds..	100	300
61	Soapstone ... short tons..	23,908	437,449
62	Total value of nonmetallic mineral products ...	...	339,958,842
63	Total value of metallic products ...	...	307,936,189
64	Estimated value of mineral products unspecified ...	...	1,000,000
65	Grand total ...	...	648,895,031

the calendar years 1880–1902—Continued.

1893.		1894.		1895.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
7,124,502	$84,810,426	6,657,388	$65,007,247	9,446,308	$105,198,550	1
60,000,000	77,575,757	49,501,122	64,000,000	55,727,000	72,051,000	2
1,739,081	35,950,000	1,910,816	39,500,000	2,254,760	46,610,000	3
339,785,972	32,054,601	364,866,808	33,141,142	385,913,404	38,012,470	4
163,982	11,839,590	159,331	9,942,254	170,000	11,220,000	5
78,832	6,306,560	75,328	5,288,026	89,686	6,278,020	6
30,164	1,108,527	30,416	934,000	36,104	1,337,131	7
339,629	266,903	550,000	316,250	920,000	464,600	8
1,503	270,540	1,387	249,706	2,013	304,169	9
49,399	22,197	9,616	3,269	10,302	3,091	10
8,938	1,788	None.	...	None.	...	11
75	517	100	600	150	900	12
...	250,207,406	...	218,382,494	...	281,479,931	13
128,385,231	122,751,618	118,820,405	107,653,501	135,118,193	115,749,771	14
48,185,306	85,687,078	46,358,144	78,488,063	51,785,122	82,019,272	15
...	14,346,250	...	13,954,400	...	13,006,650	16
48,412,666	28,932,326	49,344,516	35,522,095	52,892,276	57,632,296	17
...	9,000,000	...	9,000,000	...	9,000,000	18
8,002,467	6,262,841	8,362,245	5,030,081	8,731,401	5,482,254	19
...	33,885,573	...	36,534,788	...	33,319,131	20
1,713	142,325	1,495	95,936	2,102	106,256	21
...	...	6,024	18,054	9,000	27,000	22
...	...	...	...	...	...	23
...	338,787	...	223,214	...	205,768	24
...	22,582	2,584	11,718	4,954	20,514	25
...	16,645	...	13,887	...	22,542	26
...	135,173	...	136,873	...	155,881	27
8,699,000	652,425	14,680,130	974,445	11,918,000	595,900	28
348,399	104,520	379,444	102,450	517,421	134,343	29
12,400	84,000	7,500	47,500	4,000	24,000	30
253,615	696,615	239,312	761,719	265,503	807,447	31
75,000	40,000	75,000	40,000	60,000	30,000	32
941,368	4,136,070	996,949	3,479,547	1,038,551	3,606,094	33
75,777	256,552	105,940	363,134	99,549	322,845	34
11,816,772	4,051,668	12,967,417	4,739,285	13,669,649	4,423,084	35
1,200	42,000	500	20,000	1,800	42,000	36
28,970	88,506	23,335	86,983	21,529	68,321	37
8,422	10,346	6,763	10,145	14,458	20,675	38
37,724	530,384	41,926	498,093	50,695	621,552	39
24,059	1,804,420	19,987	1,399,090	20,710	1,449,700	40
50	2,500	325	4,463	795	13,525	41
47,779	372,232	60,570	353,400	68,163	348,281	42
9,079	29,507	11,066	35,818	17,069	44,000	43
1,450	21,750	3,680	53,231	1,740	16,795	44
448,000	900,000	403,200	800,000	403,200	800,000	45
20,578	68,307	19,264	167,000	8,523	30,000	46
35,861	403,436	39,906	435,060	39,240	370,895	47
33,231	63,792	42,560	319,200	13,747	21,038	48
...	...	...	...	6,900	41,400	49
843,103	63,232	918,000	64,010	...	52,582	50
3,958,055	2,374,833	3,698,550	1,849,275	5,247,949	2,623,974	51
704	7,040	1,440	10,240	2,200	17,000	52
7,718	66,614	6,308	53,635	9,547	71,769	53
66,971	88,929	...	52,388	...	55,831	54
23,544,495	4,246,734	21,569,608	3,741,846	21,463,543	4,254,237	55
130,000	7,600	546,855	36,193	1,573,000	137,150	56
...	...	...	...	None.	None.	57
...	264,041	...	132,250	...	113,621	58
...	...	...	...	...	...	59
...	...	150	450	100	350	60
21,071	255,067	23,144	401,325	21,495	266,495	61
...	323,257,318	...	307,714,785	...	338,172,239	62
...	250,207,406	...	218,382,494	...	281,479,931	63
...	1,000,000	...	1,000,000	...	1,000,000	64
...	574,464,724	...	527,097,279	...	620,652,170	65

Mineral products of the United States for

	Product.	1896.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, spot value ......long tons..	8,623,127	$90,250,000
2	Silver, coining value ......fine ounces..	58,834,800	76,069,236
3	Gold, coining value ......do....	2,568,132	53,088,000
4	Copper, value at New York City ......pounds..	460,061,430	49,456,603
5	Lead, value at New York City ......short tons..	188,000	10,528,000
6	Zinc, value at New York City ......do....	81,499	6,519,920
7	Quicksilver, value at San Francisco ......flasks..	30,765	1,075,449
8	Aluminum, value at Pittsburg ......pounds..	1,300,000	520,000
9	Antimony, value at San Francisco ......short tons..	2,478	347,539
10	Nickel, value at Philadelphia ......pounds..	17,170	4,464
11	Tin ......do....	None.	......
12	Platinum, value (crude) at San Francisco ......troy ounces..	163	944
13	Total value of metallic products	......	287,860,155
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal ......short tons..	137,640,276	114,891,515
15	Pennsylvania anthracite ......long tons..	48,523,287	81,748,651
16	Natural gas	......	13,002,512
17	Petroleum ......barrels..	60,960,361	58,518,709
18	Brick clay	......	9,000,000
19	Cement ......barrels..	9,513,473	6,473,213
20	Stone	......	30,142,661
21	Corundum and emery ......short tons..	2,120	113,246
22	Crystalline quartz ......do....	6,000	18,000
23	Garnet for abrasive purposes ......do....	......	......
24	Grindstones	......	326,826
25	Infusorial earth and tripoli ......short tons..	3,846	26,792
26	Millstones	......	22,567
27	Oilstones, etc	......	127,098
28	Borax ......pounds..	13,508,000	675,400
29	Bromine ......do....	546,580	144,501
30	Fluorspar ......short tons..	6,500	52,000
31	Gypsum ......do....	224,139	573,344
32	Marls ......do....	60,000	30,000
33	Phosphate rock ......long tons..	930,779	2,803,372
34	Pyrite ......do....	115,483	320,163
35	Salt ......barrels..	13,850,726	4,040,839
36	Sulphur ......short tons..	5,260	87,200
37	Barytes (crude) ......do....	17,068	46,513
38	Cobalt oxide ......pounds..	10,700	15,301
39	Mineral paints ......short tons..	48,032	530,455
40	Zinc white ......do....	20,000	1,400,000
41	Asbestos ......do....	504	6,100
42	Asphaltum ......do....	80,503	577,563
43	Bauxite ......long tons..	18,364	47,338
44	Chromic iron ore ......do....	786	6,667
45	Clay (all other than brick) ......short tons..	403,200	800,000
46	Feldspar ......do....	10,203	35,200
47	Fibrous talc ......do....	46,089	399,443
48	Flint ......do....	12,458	24,226
49	Fullers earth ......do....	9,872	59,360
50	Graphite (crystalline) ......pounds..	535,858	48,460
51	Graphite (amorphous) ......short tons..	760	
52	Limestone for iron flux ......long tons..	4,120,102	2,060,000
53	Magnesite ......short tons..	1,500	11,000
54	Manganese ore ......long tons..	10,088	90,727
55	Mica (sheet) ......pounds..	......	65,441
56	Mica (scrap) ......short tons..	......	1,750
57	Mineral waters ......gallons sold..	25,795,312	4,136,192
58	Monazite ......pounds..	30,000	1,500
59	Ozocerite (refined) ......do....	None.	None.
60	Precious stones	......	97,850
61	Pumice stone ......short tons..	......	......
62	Rutile ......pounds..	100	350
63	Soapstone ......short tons..	22,183	354,065
64	Total value of nonmetallic mineral products	......	333,954,110
65	Total value of metallic products	......	287,860,155
66	Estimated value of mineral products unspecified	......	1,000,000
67	Grand total	......	622,814,265

the calendar years 1880–1902—Continued.

1897.		1898.		1899.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
9,652,680	$95,122,299	11,773,934	$116,557,000	13,620,703	$245,172,654	1
53,860,000	69,637,172	54,438,000	70,384,485	54,764,500	70,806,626	2
2,774,935	57,363,000	3,118,398	64,463,000	3,437,210	71,053,400	3
494,078,274	54,080,180	526,512,987	61,865,276	568,666,921	101,222,712	4
212,000	14,885,728	222,000	16,650,000	210,500	18,945,000	5
99,980	8,498,300	115,399	10,385,910	129,051	14,840,865	6
26,648	993,445	31,092	1,188,627	30,454	1,452,745	7
4,000,000	1,500,000	5,200,000	1,716,000	5,200,000	1,716,000	8
3,061	442,300	3,238	532,101	2,861	559,189	9
23,707	7,823	11,145	3,956	22,541	8,566	10
None.	....	None.	....	None.	....	11
150	900	225	1,913	300	1,800	12
....	302,531,147	....	343,748,268	....	525,779,557	13
147,617,519	119,595,224	166,593,623	132,608,713	193,323,187	167,952,104	14
46,974,714	79,301,951	47,663,076	75,414,537	53,944,647	88,142,130	15
....	13,826,422	....	15,296,813	....	20,074,873	16
60,475,516	40,874,072	55,364,233	44,193,359	57,070,850	64,603,904	17
....	8,000,000	....	9,000,000	....	11,250,000	18
10,989,463	8,178,283	12,111,208	9,859,501	15,520,445	12,889,142	19
....	34,667,772	....	36,607,264	....	44,090,670	20
2,165	106,574	4,064	275,064	4,900	150,600	21
7,500	22,500	8,312	23,990	13,600	39,000	22
2,554	80,853	2,967	86,850	2,765	98,325	23
....	368,058	....	489,769	....	675,586	24
3,833	22,835	2,733	16,691	4,334	37,032	25
....	25,932	....	25,934	....	28,115	26
....	149,970	....	180,738	....	208,283	27
16,000,000	1,080,000	16,000,000	1,120,000	40,714,000	1,139,882	28
487,149	129,094	486,979	126,614	433,004	108,251	29
5,062	37,159	7,675	63,050	15,900	96,650	30
288,982	755,864	291,638	755,280	486,235	1,287,080	31
60,000	30,000	60,000	30,000	60,000	30,000	32
1,039,345	2,673,202	1,308,885	3,453,460	1,515,702	5,084,076	33
143,201	391,541	193,364	593,801	174,734	543,249	34
15,973,202	4,920,020	17,612,634	6,212,554	19,708,614	6,867,467	35
2,275	45,590	1,200	32,960	4,830	107,500	36
26,042	58,295	31,306	108,339	41,894	139,528	37
19,520	31,232	6,247	9,371	10,230	18,512	38
60,913	795,793	58,850	694,856	63,111	728,389	39
25,000	1,750,000	33,000	2,310,000	40,146	3,211,680	40
580	6,450	605	10,300	681	11,740	41
75,945	664,632	76,337	675,649	75,085	553,904	42
20,590	57,652	25,149	75,437	35,280	125,598	43
None.	None.	None.	None.	None.	None.	44
....	1,000,000	....	1,384,766	....	1,645,328	45
12,516	43,100	13,440	32,395	24,202	211,545	46
57,009	396,936	54,356	411,430	54,655	438,150	47
13,466	26,227	21,425	42,670	29,852	180,345	48
17,113	112,272	14,860	106,500	12,381	79,644	49
1,254,402	54,277	2,360,000	75,200	2,900,732	167,106	50
1,108		890		2,324		51
4,247,688	2,124,000	5,275,819	2,638,000	6,707,435	4,695,205	52
1,143	13,671	1,263	19,075	1,280	18,480	53
11,108	95,505	15,957	129,185	9,935	82,278	54
82,676	80,774	129,520	103,534	108,570	70,587	55
740	14,452	3,999	27,564	1,505	50,878	56
23,255,911	4,599,106	28,853,464	8,051,833	39,562,136	6,948,030	57
44,000	1,980	250,776	13,542	350,000	20,000	58
None.	None.	None.	None.	None.	None.	59
....	130,675	....	160,920	....	185,770	60
158	....	600	13,200	400	10,000	61
100	350	140	700	230	1,030	62
21,923	365,629	22,231	287,112	24,765	330,805	63
....	327,705,927	....	353,848,520	....	445,428,431	64
....	302,531,147	....	343,748,268	....	525,779,557	65
....	1,000,000	....	1,000,000	....	1,000,000	66
....	631,237,074	....	698,596,788	....	972,208,008	67

Mineral products of the United States for the calendar years 1880–1902—Continued.

Product.	1900.	
	Quantity.	Value.
METALLIC.		
Pig iron, spot value...long tons	13,789,242	$259,944,000
Silver, coining value...fine ounces	57,647,000	74,533,495
Gold, coining value...do	3,829,897	79,171,000
Copper, value at New York City...pounds	606,117,166	98,494,039
Lead, value at New York City...short tons	270,824	23,561,688
Zinc, value at New York City...do	123,886	10,654,196
Quicksilver, value at San Francisco...flasks	28,317	1,302,586
Aluminum, value at Pittsburg...pounds	7,150,000	1,920,000
Antimony, value at San Francisco...short tons	4,226	837,896
Nickel, value at Philadelphia...pounds	9,715	3,886
Tin...do	None.	....
Platinum, value (crude) at San Francisco...troy ounces	400	2,500
Total value of metallic products	....	550,125,286
NONMETALLIC (SPOT VALUES).		
Bituminous coal...short tons	212,316,112	220,930,313
Pennsylvania anthracite...long tons	51,221,353	85,757,851
Natural gas	....	23,698,674
Petroleum...barrels	63,620,529	75,989,313
Brick clay	....	12,000,000
Cement...barrels	17,231,150	13,283,581
Stone	....	44,321,345
Corundum and emery...short tons	4,305	102,715
Crystalline quartz...do	14,461	40,705
Garnet for abrasive purposes...do	3,185	123,475
Grindstones	....	710,026
Infusorial earth and tripoli...short tons	3,615	24,207
Millstones	....	32,858
Oilstones, etc	....	174,087
Borax...short tons	a 1,602	170,036
	b 24,235	848,215
Bromine...pounds	521,444	140,790
Fluorspar...short tons	18,450	94,500
Gypsum...do	594,462	1,627,203
Lithium...do	520	....
Marls...do	60,000	30,000
Phosphate rock...long tons	1,491,216	5,359,248
Pyrite...do	204,615	749,991
Salt...barrels	20,869,342	6,944,603
Sulphur...short tons	3,525	88,100
Barytes (crude)...do	67,680	188,089
Cobalt oxide...pounds	6,471	11,648
Mineral paints...short tons	72,222	881,363
Zinc white...do	48,840	3,667,210
Asbestos...do	1,054	16,310
Asphaltum...do	54,389	415,958
Bauxite...long tons	23,184	89,676
Chromic iron ore...do	140	1,400
Clay (all other than brick)	....	1,840,377
Feldspar...short tons	24,821	180,971
Fibrous talc...do	63,500	499,500
Flint...do	32,495	86,351
Fuller's earth...do	9,698	67,535
Graphite (crystalline)...pounds	5,507,855	197,579
Graphite (amorphous)...short tons	611	
Limestone for iron flux...long tons	7,495,435	3,687,394
Magnesite...short tons	2,252	19,333
Manganese ore...long tons	11,771	100,289
Mica (sheet)...pounds	456,283	92,758
Mica (scrap)...short tons	5,497	55,202
Mineral waters...gallons sold	47,558,784	6,245,172
Monazite...pounds	908,000	48,805
Ozocerite (refined)...do	None.	None.
Precious stones	....	233,170
Pumice stone...short tons	None.	None.
Rutile...pounds	300	1,300
Soapstone...short tons	27,943	383,541
Total value of nonmetallic mineral products	....	512,252,767
Total value of metallic products	....	550,425,286
Estimated value of mineral products unspecified	....	1,000,000
Grand total	....	1,063,678,053

a Refined. *b* Crude.

Mineral products of the United States for the calendar years 1880–1902—Continued.

Product.	1901. Quantity.	Value.
METALLIC.		
Pig iron, spot value .... long tons..	15,878,354	$242,174,000
Silver, coining value .... fine ounces..	55,214,000	71,387,800
Gold, coining value .... do....	3,805,500	78,666,700
Copper, value at New York City .... pounds..	602,072,519	87,300,515
Lead, value at New York City .... short tons..	270,700	23,280,200
Zinc, value at New York City .... do....	140,822	11,265,760
Quicksilver, value at San Francisco .... flasks..	29,727	1,382,305
Aluminum, value at Pittsburg .... pounds..	7,150,000	2,238,000
Antimony, value at San Francisco .... short tons..	2,639	539,002
Nickel, value at Philadelphia .... pounds..	6,700	3,551
Tin .... do....	None.	....
Platinum, value (crude) at San Francisco .... troy ounces..	1,408	27,526
Total value of metallic products	....	518,266,259
NONMETALLIC (SPOT VALUES).		
Bituminous coal .... short tons..	225,828,149	236,422,049
Pennsylvania anthracite .... long tons..	60,242,560	112,504,020
Natural gas	....	27,067,500
Petroleum .... barrels..	69,389,194	66,417,335
Brick clay	....	13,800,000
Cement .... barrels..	20,068,737	15,786,789
Stone	....	55,615,926
Corundum and emery .... short tons..	4,305	146,040
Crystalline quartz .... do....	14,050	41,500
Garnet for abrasive purposes .... do....	4,444	158,100
Grindstones	....	580,703
Infusorial earth and tripoli .... short tons..	4,020	52,950
Millstones	....	57,179
Oilstones, etc	....	158,300
Arsenous oxide .... short tons..	300	18,000
Borax .... do....	*a*5,344	697,307
	*b*17,887	314,811
Bromine .... pounds..	552,043	154,572
Fluorspar .... short tons..	19,586	113,803
Gypsum .... do....	633,791	1,506,641
Lithium .... do....	1,750	43,200
Marls .... do....	99,880	124,880
Phosphate rock .... long tons..	1,483,723	5,316,403
Pyrite .... do....	241,691	1,257,879
Salt .... barrels..	20,566,661	6,617,449
Sulphur	(*c*)	(*c*)
Barytes (crude) .... short tons..	49,070	157,844
Cobalt oxide .... pounds..	13,360	24,048
Mineral paints .... short tons..	61,460	789,962
Zinc white .... do....	46,500	3,720,000
Asbestos .... do....	747	13,498
Asphaltum .... do....	63,134	555,335
Bauxite .... long tons..	18,905	79,914
Chromic iron ore .... do....	368	5,790
Clay (all other than brick)	....	2,576,932
Feldspar .... short tons..	34,741	220,422
Fibrous talc .... do....	69,200	483,600
Flint .... do....	34,420	149,297
Fuller's earth .... do....	14,112	96,835
Graphite (crystalline) .... pounds..	3,967,612	167,714
Graphite (amorphous) .... short tons..	809	
Limestone for iron flux .... long tons..	8,540,168	4,659,836
Magnesite .... short tons..	13,172	43,057
Manganese ore .... long tons..	11,995	116,722
Mica (sheet) .... pounds..	360,060	98,859
Mica (scrap) .... short tons..	2,171	19,719
Mineral waters .... gallons sold..	55,771,188	7,586,962
Monazite .... pounds..	748,736	59,262
Ozocerite (refined) .... do....	None.	None.
Precious stones	....	289,050
Pumice stone .... short tons..	None.	None.
Rutile .... pounds..	44,250	5,710
Soapstone .... short tons..	28,643	424,888
Uranium and vanadium .... do....	375	....
Total value of nonmetallic mineral products	....	567,318,592
Total value of metallic products	....	518,266,259
Estimated value of mineral products unspecified	....	1,000,000
Grand total	....	1,086,584,851

a Refined. *b* Crude. *c* Combined with pyrite.

Mineral products of the United States for the calendar years 1880–1902—Continued.

Product.	1902. Quantity.	1902. Value.
METALLIC.		
Pig iron (spot value) .... long tons..	17,821,307	$372,775,000
Silver, coining value .... fine ounces..	55,500,000	71,757,575
Gold, coining value .... do....	3,870,000	80,000,000
Copper, value at New York City .... pounds..	659,508,644	76,568,954
Lead, value at New York City .... short tons..	270,000	22,140,000
Zinc, value at New York City .... do....	156,927	14,625,596
Quicksilver, value at San Francisco .... flasks..	[a] 34,291	1,467,848
Aluminum, value at Pittsburg .... pounds..	7,300,000	2,284,590
Antimony, value at San Francisco .... short tons..	3,561	634,506
Nickel, value at Philadelphia .... pounds..	5,748	2,701
Tin .... do....	None.	....
Platinum, value (crude) at San Francisco .... troy ounces..	94	1,814
Total value of metallic products	....	642,258,584
NONMETALLIC (SPOT VALUES).		
Bituminous coal .... short tons..	260,216,844	290,858,483
Pennsylvania anthracite .... long tons..	36,940,710	76,173,586
Natural gas	....	30,867,668
Petroleum .... barrels..	[b] 88,766,916	71,178,910
Brick clay	....	15,000,000
Cement .... barrels..	25,753,504	25,366,380
Stone	....	64,559,099
Corundum and emery .... short tons..	4,251	104,605
Crystalline quartz .... do....	15,104	[c] 84,335
Garnet for abrasive purposes .... do....	3,926	132,820
Grindstones	....	667,431
Infusorial earth and tripoli .... short tons..	5,655	53,244
Millstones	....	59,808
Oilstones, etc	....	[c] 221,762
Arsenious oxide .... short tons..	1,353	81,180
Borax (refined) .... do....	[d] 17,104	2,447,614
Borax (crude) .... do....	2,600	91,000
Bromine .... pounds..	513,890	128,472
Fluorspar .... short tons..	[e] 48,018	271,832
Gypsum .... do....	816,478	2,089,341
Lithium .... do....	1,245	25,750
Marls .... do....	12,439	12,741
Phosphate rock .... long tons..	[f] 1,490,314	4,693,444
Pyrite .... do....	207,874	947,089
Salt .... barrels..	23,849,221	5,668,636
Sulphur .... short tons..	([g])	([g])
Barytes (crude) .... short tons..	61,668	203,154
Cobalt oxide .... pounds..	3,730	6,714
Mineral paints .... short tons..	[h] 73,049	944,332
Zinc white .... do....	52,645	4,016,499
Asbestos .... do....	[i] 1,005	16,200
Asphaltum .... do....	[j] 105,458	765,048
Bauxite .... long tons..	29,222	128,206
Chromic iron ore .... do....	315	4,567
Clay (all other than brick) .... short tons..	1,455,357	2,061,072
Feldspar .... do....	45,287	250,424
Fibrous talc .... do....	71,100	615,350
Flint .... do....	36,365	144,209
Fuller's earth .... do....	11,492	98,144
Glass sand .... do....	943,135	807,797
Graphite (crystalline) .... pounds..	[k] 3,936,824	182,108
Graphite (amorphous) .... short tons..	4,739	
Limestone for iron flux .... long tons..	11,878,675	5,271,252

[a] In addition the census reports 11,727 short tons of cinnabar, valued at $82,242, as mined but not marketed in 1902.
[b] In addition the census reports 508,386 barrels of petroleum, valued at $218,829, as produced but not marketed in 1902.
[c] Value of crude production as reported by the census: Crystalline quartz, $43,085; oilstones, $113,968.
[d] Production in 1902, as reported by the census, 19,142 short tons, valued at $2,383,614.
[e] In addition the census reports 800 short tons of fluorspar, valued at $3,850, as mined but not marketed in 1902.
[f] The total quantity of phosphate rock mined in 1902 was 1,548,720 long tons, valued at $4,922,943.
[g] Included under pyrite.
[h] Production of crude material of mineral paints was 35,479 short tons, valued at $360,885.
[i] In addition, 1,500 short tons of crude asbestos, valued at $30,000, are reported by the census as mined but not marketed in 1902.
[j] The production of the crude material is reported by the census as 66,238 short tons, valued at $236,728.
[k] In addition, graphite to the value of $45,400 is reported as mined but not marketed in 1902.

Mineral products of the United States for the calendar years 1880–1902—Continued.

Product.	1902. Quantity.	1902. Value.
NONMETALLIC (SPOT VALUES)—Continued.		
Magnesite.....short tons..	[a] 3,466	$21,362
Manganese ore.....long tons..	16,477	177,911
Mica (sheet).....pounds..	373,266	83,843
Mica (scrap).....short tons..	1,400	35,006
Mineral waters.....gallons sold..	64,859,451	8,793,761
Monazite.....pounds..	802,000	64,160
Ozocerite (refined).....do....	None.	.....
Precious stones.....	.....	328,450
Pumice stone.....short tons..	700	2,750
Rutile.....pounds..	([b])	.....
Soapstone.....short tons..	26,854	525,157
Uranium and vanadium.....do....	3,810	48,125
Total value of nonmetallic mineral products.....	.....	617,380,831
Total value of metallic products.....	.....	642,258,584
Estimated value of mineral products unspecified.....	.....	1,000,000
Grand total.....	.....	1,260,639,415

[a] The magnesite actually mined in 1902 is reported as 3,086 short tons, valued at $19,639.
[b] Included under estimated unspecified products.

IRON ORES.

By John Birkinbine.

PRODUCTION.

The production of iron ore in the United States in the year 1897 exceeded that of any preceding year, and since that date the annual output of the country has shown successive augmentation, until in the calender year 1902 the total reached 35,554,135 long tons. No other country has at any time reported a yearly production so great as that of the iron-ore mines of the United States in 1898 and in subsequent years. In the report for the year 1901 it was stated that the largest quantities of ore mined in any other country, according to official statistics, were 18,664,772 long tons mined in Germany and Luxemburg in the year 1900, and 18,031,957 long tons mined in Great Britain in the year 1882.

During the year ending December 31, 1902, the quantity of iron ore produced in the United States, determined from a compilation of reports furnished by operators throughout the country, amounted, as stated, to 35,554,135 long tons, valued at $65,412,950, an increase over 1901 of 6,666,656 long tons, or 23 per cent.

The iron ore produced in the year 1902 was obtained from mining operations carried on in 23 States and 2 Territories.

To indicate the rapid growth of the iron-ore industry in the United States during the six years mentioned above, the following table has been prepared:

Production of iron ore in United States, 1897–1902.

Year.	Quantity.	Increase over preceding year.	Percentage of increase over preceding year.
	Long tons.	*Long tons.*	
1897	17,518,046	1,512,597	9.5
1898	19,433,716	1,915,670	10.9
1899	24,683,173	5,249,457	27.0
1900	27,553,161	2,869,988	11.6
1901	28,887,479	1,334,318	4.8
1902	35,554,135	6,666,656	23.1

The increase in 1902 over the quantity of iron ore produced in 1897, which, as before stated, was the maximum output up to that time by the United States, is 18,036,089 tons, or 103 per cent, which shows that in six years the iron-ore output of the United States has doubled in quantity.

To summarize the work of the United States Geological Survey in collecting iron-ore statistics from the year 1889, when the first systematic effort in this direction was made, to and including the year 1902 the following table is presented:

Production of iron ore in the United States, 1889–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1889	14,518,041	1898	19,433,716
1890	16,036,043	1899	24,683,173
1891	14,591,178	1900	27,553,161
1892	16,296,666	1901	28,887,479
1893	11,587,629	1902	35,554,135
1894	11,879,679	Total for fourteen years	270,502,009
1895	15,957,614		
1896	16,005,449	Average for fourteen years	19,321,572
1897	17,518,046		

The average production and the grand total for fourteen years above mentioned are presented to emphasize the relative output of each year named and to indicate the magnitude of the industry. But the figures of annual output suggest that, while fluctuations in the iron and steel industry have caused marked variations, in iron-ore production a general advance is noted, the production of 1897 being less than 50 per cent of that of 1902.

PRODUCTION BY VARIETIES OF ORE.

As in former reports the iron ore mined has been divided into four general commercial classes, as follows:

1. *Red hematite*, including all anhydrous hematites (sesquioxides of iron) known by various names, such as red hematite, specular, micaceous, fossil, slate iron ore, martite, blue hematite, etc.

2. *Brown hematite*, including the varieties of hydrated sesquioxide of iron recognized as limonite, gothite, turgite, bog ores, pipe ores, etc.

3. *Magnetite*, those ores in which the iron occurs as magnetic oxide, and including some martite which is mined with the magnetite.

4. *Carbonate*, those ores which contain a considerable amount of carbonic acid, such as spathic ore, blackband, siderite, clay ironstone, etc.

The amount of red hematite ore mined in the year 1902 in the United States amounted to 30,532,149 long tons, or 85.9 per cent of the total for the United States, an increase of 6,526,124 long tons, or 27.2 per cent over the 1901 total of 24,006,025 long tons of red hematite.

Minnesota was the most important contributor of this class of ore, followed by Michigan and Alabama.

The total amount of brown hematite mined was 3,305,484 long tons, or 9.3 per cent of the output for the country, an increase of 288,769 tons, or 9.6 per cent over the 1901 total of 3,016,715 long tons of brown hematite. Alabama was the principal contributor, followed by Virginia and West Virginia and Tennessee.

Of the magnetic variety, 1,688,860 long tons, or 4.7 per cent of the total for the United States, were mined in 1902, a decline of 124,216 long tons, or 6.9 per cent from the 1901 total of 1,813,076 long tons of magnetite. Pennsylvania continued to be the principal producer, followed by New York and New Jersey.

The amount of carbonate ore mined in 1902 was 27,642 long tons, a decline of 24,021 long tons, or almost one-half of the 1901 total of 51,663 long tons. Nearly all of this carbonate ore was mined in the State of Ohio, a small amount being supplied by Maryland.

The quantities of the different varieties of iron ores contributed by the various States in 1902 are presented in the following table according to the importance of the States as producers. It will be noted, however, that in some cases the outputs for two or more States are combined in order not to divulge individual mine statistics:

Production of iron ore in the United States in 1902, by varieties.

[Long tons.]

State or Territory.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
Minnesota	15,137,650				15,137,650
Michigan	11,079,124		56,091		11,135,215
Alabama	2,565,635	1,008,839			3,574,474
Virginia and West Virginia	31,677	953,128	3,153		987,958
Tennessee	370,643	503,899			874,542
Pennsylvania	20,441	185,846	616,645		822,932
Wisconsin	758,316	25,680			783,996
New York	91,075	12,676	451,570		555,321
New Jersey			441,879		441,879
Georgia and North Carolina	117,812	216,242	30,836		364,890
Montana, New Mexico, Utah, and Wyoming	255,269	18,079	88,686		362,034
Colorado	4,375	288,922			293,297
Kentucky	42,195	28,811			71,006
Missouri	57,937	8,371			66,308
Connecticut, Massachusetts, and Vermont		29,093			29,093
Maryland		19,382		4,985	24,367
Ohio				22,657	22,657
Texas		6,516			6,516
Total	30,532,149	3,305,484	1,688,860	27,642	35,554,135

In the fourteen years which have elapsed since 1889, when statistics of the different varieties of iron ore were first collected by the United States Geological Survey, the red hematites have supplied 211,083,158 long tons, or 78.03 per cent of the total production; brown hematites 34,250,988 long tons, or 12.66 per cent; the magnetic deposits 23,213,553 long tons, or 8.58 per cent; and the carbonate ores 1,954,310 long tons, or 0.73 per cent.

The following table will show the amounts of the different classes of iron ore annually produced in the United States from 1889 to 1902, inclusive, and also the totals for the fourteen years:

Production of iron ores in the United States, by classes, 1889–1902.

[Maxima in italics.]

Year.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1889	9,056,288	2,523,087	2,506,415	*432,251*	14,518,041
1890	10,527,650	2,559,938	*2,570,838*	377,617	16,036,043
1891	9,327,398	2,757,564	2,317,108	189,108	14,591,178
1892	11,646,619	2,485,101	1,971,965	192,981	16,296,666
1893	8,272,637	1,849,272	1,330,886	134,834	11,587,629
1894	9,347,434	1,472,748	972,219	87,278	11,879,679
1895	12,513,995	2,102,358	1,268,222	73,039	15,957,614
1896	12,576,288	2,126,212	1,211,526	91,423	16,005,449
1897	14,413,318	1,961,954	1,059,479	83,295	17,518,046
1898	16,150,684	1,989,681	1,237,978	55,373	19,433,716
1899	20,004,399	2,869,785	1,727,430	81,559	24,683,173
1900	22,708,274	3,231,089	1,537,551	76,247	27,553,161
1901	24,006,025	3,016,715	1,813,076	51,663	28,887,479
1902	*30,532,149*	*3,305,484*	1,688,860	27,642	*35,554,135*
Total	211,083,158	34,250,988	23,213,553	1,954,310	270,502,009
Percentages of totals for 14 years	78.03	12.66	8.58	0.73	100.00
Percentages of total for 1902	85.87	9.30	4.75	.08	100.00

The red hematite mines attained their maximum production in the year 1902, and this was also the case with the brown hematite mines; the largest amount of magnetite, however, was contributed in the year 1890, and the maximum output of carbonate ore was in 1889.

In addition to the iron ore mined, 65,246 long tons of zinc residuum were used as iron ore in 1902.

In the year 1902 there were produced 192,285 long tons of concentrated ore which are included under the production of the respective States. In addition to the magnetically concentrated ore, a considerable amount of magnetically cobbed ore was obtained in the State of New Jersey, this method being adopted in place of sorting in the mine, the rock and ore being broken to convenient size, brought to the surface, and the iron ore removed from the rock by means of magnetic concentrating machines.

LAKE SUPERIOR REGION.

The greater part of the iron ore of the United States is supplied by the Lake Superior region, located in the States of Minnesota, Michigan, and Wisconsin, the maximum output of 26,977,404 long tons occurring in 1902, and representing 76 per cent of the total quantity of iron ore reported for the United States. This was an increase of 5,531,501 tons, or almost 26 per cent, over the production in 1901 of 21,445,903 long tons.

The Lake Superior region comprises five ranges, of which the oldest, the Marquette Range, located in the upper peninsula of Michigan, not far from the southern shore of Lake Superior, and first opened in 1854, has shipped to the present time 66,686,502 long tons. The production of this range in the year 1902 was 3,734,712 long tons, the largest amount mined in any year, with the exception of 1900, when the total was 3,945,068 long tons. Most of this ore is shipped from the ports of Marquette and Escanaba.

The second range, the Menominee, located in the States of Michigan and Wisconsin, was opened in 1877. The total shipments from it have been 42,267,233 long tons, and the maximum production 4,421,250 long tons, was in 1902. The greater portion of this ore is sent from the port of Escanaba, although a small amount goes by way of Gladstone.

In the year 1884 the Gogebic Range, in the States of Michigan and Wisconsin, and the Vermilion Range, in Minnesota, were opened. The Gogebic has shipped to date a total of 37,818,274 tons, the quantity produced in the year 1902 being 3,683,792 tons, most of which was forwarded from the ports of Ashland and Escanaba.

The Vermilion Range has shipped to the close of the year 1902 a total of 19,061,506 long tons, the production in the year 1902 being 2,057,532 long tons, and the greater portion of the ore being forwarded to lower Lake ports by way of Two Harbors.

The Mesabi Range, in the State of Minnesota, the latest of the Lake Superior ranges to be opened in the United States, dates from the year 1892. The total shipments to the close of 1902 have amounted to 53,747,807 long tons, the production in 1902 being 13,080,118 long tons. This production represents almost one-half of the entire output of the Lake Superior region, or 37 per cent of the total for the United States for 1902. The greater part of the ore is shipped from the ports of Two Harbors and Duluth, in Minnesota, and Superior, in Wisconsin.

A sixth range was opened in Canada in the year 1900, the total output to the close of 1902 amounting to 591,176 long tons, the greater portion of which was sent to the United States from the port of Michipicoten, in the province of Ontario.

This Canadian ore is not included in the table given below, which shows the production of each of the five ranges in the Lake Superior region from 1889 to 1902, inclusive.

Production of Lake Superior iron ores, by ranges, 1889–1902.

[Maxima in italics.]

Range.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Marquette	2,631,026	2,863,848	2,778,482	2,848,552	2,064,827	1,935,379	1,982,080
Menominee	1,876,157	2,274,192	1,856,124	2,402,195	1,563,049	1,255,255	1,794,970
Gogebic	2,147,923	2,914,081	2,041,754	3,058,176	1,466,815	1,523,451	2,625,475
Vermilion	864,508	891,910	945,105	1,226,220	815,735	1,055,229	1,027,103
Mesabi	....	....	....	29,245	684,194	1,913,234	2,839,350
Total	7,519,614	8,944,031	7,621,465	9,564,388	6,594,620	7,682,548	10,268,978

Range.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Marquette	2,418,846	2,673,785	2,987,930	3,634,596	*3,945,068*	3,597,089	3,734,712
Menominee	1,763,235	1,767,220	2,275,664	3,281,422	3,680,738	3,697,408	*4,421,250*
Gogebic	2,100,398	2,163,088	2,552,205	2,725,648	3,104,033	3,041,869	*3,683,792*
Vermilion	1,200,907	1,381,278	1,125,538	1,643,984	1,675,949	1,805,996	*2,057,532*
Mesabi	3,082,973	4,220,151	4,837,971	6,517,305	8,158,450	9,303,541	*13,080,118*
Total	10,566,359	12,205,522	13,779,308	17,802,955	20,564,238	21,445,903	26,977,404

From the foregoing it will be seen that in the year 1902 the Mesabi range ranked first, contributing 13,080,118 long tons, its maximum output. In 1902 the Menominee range continued to occupy second place, with its maximum production of 4,421,250 long tons. The Marquette range was third, with a total of 3,734,712, ranking next to its maximum year, 1900, when 3,945,068 long tons were won. The Gogebic range reached its maximum in 1902, contributing 3,683,792 long tons; and the Vermilion range also showed its maximum output of 2,057,532 long tons in 1902.

The following cargo analyses of Lake Superior iron ores shipped in 1902 were supplied through the courtesy of the Lake Superior Iron Ore Association:

Complete average cargo analyses of Lake Superior iron ores, season of 1902.

GOGEBIC RANGE.

[The upper line of figures opposite each ore represents its analysis when dried at 212° Fahrenheit; the lower line, when in its natural condition.]

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ashland	60.70	0.043	7.020	0.260	2.650	0.270	0.190	0.010	2.460	....
	54.10	.0383	6.256	.232	2.362	.241	.169	.0089	2.192	10.88
Anvil	61.625	.0495	6.05	.985	1.145	.335	.165	.0245	2.695	....
	53.20	.0427	5.22	.85	.988	.289	.14	.021	2.326	13.668
Anvil special[a]	52.00	.050	5.80	10.00	.97	.25	.17	.005	3.02	....
	45.76	.044	5.10	8.80	.85	.22	.149	.004	2.657	12.00
Argos	60.9000	.0804	6.8245	.327	....	....	....	....	....	....
	54.7491	.0722	6.1352	.293	....	....	....	....	....	10.1000
Atlantic	63.8850	.0455	4.1513	.568	....	....	....	....	....	....
	57.3961	.0364	3.7296	.510	....	....	....	....	....	10.1572
Aurora	62.4253	.0356	4.6409	....	....	....	....	....	....	....
	55.5731	.0316	4.1314	....	....	....	....	....	....	10.9766
Best	56.145	.058	12.16	.759	1.062	.625	.75	.009	3.195	....
	49.095	.0507	10.63	.66	.928	.546	.655	.0078	2.79	12.556
Bonnie	53.39	.0307	10.49	4.449	1.726	.16	.333	.0107	4.517	....
	47.618	.027	9.356	3.968	1.54	.14	.297	.009	4.028	10.81
Brotherton[a]	62.50	.028	7.20	.036	1.40	.16	.060	.016	1.25	....
	56.25	.0252	6.48	.0324	1.26	.144	.054	.0144	1.125	10.00
Buckeye	58.67	.071	9.35	.43	2.30	.60	.64	.020	2.00	....
	51.48	.062	8.20	.38	2.02	.53	.56	.018	1.75	12.26
Cary	60.02	....	7.01	.37	....	....	....	....	....	....
	54.7983	....	6.4001	.3378	....	....	....	....	....	8.70
Cary Empire	57.93	.064	5.33	3.72	1.05	.15	.19	.003	5.47	....
	52.2876	.0578	4.8109	3.3577	.9477	1354	.1715	.0027	4.9372	9.74
Chicago	55.0000	.0773	17.2284	.385	....	....	....	....	....	....
	54.7499	.0769	17.1500	.383	....	....	....	....	....	.4548
Chicago Soft[a]	61.50	.155	7.50	1.50	....	....	....	....	....	....
	56.580	.1426	6.900	1.380	....	....	....	....	....	8.00
Colby Bessemer	62.750	.037	4.050	.420	1.290	.157	.106	.007	4.300	....
	57.579	.0339	3.716	.385	1.184	.144	.097	.006	3.946	8.240
Hennepin	56.19	.062	10.10	.36	1.23	.25	.09	.015	2.70	....
	50.419	.055	9.06	.32	1.10	.22	.08	.013	2.42	10.27
Iron Belt	60.50	.045	8.75	.36	1.50	.35	.39	.030	3.90	....
	53.32	.040	7.71	.32	1.32	.31	.34	.026	3.44	11.86
Ironton	61.700	.053	7.470	.970	1.230	.330	.260	.006	3.980	....
	55.592	.0477	6.730	.874	1.108	.297	.234	.005	3.586	9.900
Jack Pot[a]	52.90	.035	....	....	....	....	....	....	....	....
	46.05	.030	....	....	....	....	....	....	....	12.95
Lawrence	62.30	.056	4.64	.48	1.32	.120	.110	.011	4.01	....
	56.01	.050	4.17	.43	1.19	.11	.10	.010	3.60	10.10
Lyon[a]	58.75	.048	9.75	.20	1.03	.95	.40	.040	3.40	....
	52.875	.0432	8.775	.180	.927	.855	.360	.0360	3.060	10.00
Melrose[a]	62.00	.045	5.47	.77	1.385	.21	.105	.025	4.27	....
	55.256	.040	4.875	.686	1.23	.187	.0935	.022	3.80	10.876
Melrose No. 2[a]	62.00	.050	5.00	.59	1.05	.16	.20	.013	4.54	....
	55.775	.045	4.498	.53	.94	.14	.179	.0116	4.08	10.04
Meteor	55.200	.038	11.850	.320	1.220	.240	.160	.007	1.770	....
	49.470	.0340	10.619	.286	1.093	.215	.143	.006	1.586	10.380

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

GOGEBIC RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Mikado	58.32	0.153	12.16	0.35	1.06	0.56	0.15	0.003	1.71	....
	51.0475	.1339	10.6436	.3064	.9278	.4902	.1313	.0026	1.4968	12.47
Montreal	64.04	.042	3.62	.35	.78	.110	.130	.019	3.48	....
	57.79	.038	3.27	.32	.70	.10	.12	.017	3.14	9.76
Montrose [a]	61.00	.080	5.15	....	1.08	.17	.13	.011	3.31	....
	48.40	.063	4.60	....	.964	.15	.116	.0098	2.957	10.65
Nelson	48.99	.053	10.85	7.33	....	....	....	....	....	....
	43.429	.04698	9.618	6.498	....	....	....	....	....	11.35
New Era [a]	58.00	.040	10.05	.90	1.23	.26	.14	.011	4.41	....
	51.27	.035	8.883	.795	1.087	.229	.12	.0097	3.897	11.61
New Era No. 2 [a]	58.00	.080	10.05	.90	1.23	.26	.14	.011	4.41	....
	51.27	.0707	8.88	.795	1.087	.229	.12	.0097	3.897	11.61
Newport [a]	56.18	.031	4.19	6.22	.81	.22	.18	.008	5.15	....
	50.23	.0277	3.74	5.56	.72	.19	.16	.007	4.60	10.58
Norrie	63.1454	.0380	4.0328	....	....	....	....	....	....	....
	56.3080	.0338	3.5961	....	....	....	....	....	....	10.8280
Norden	62.6500	.0737	3.1994	....	....	....	....	....	....	....
	56.2023	.0661	2.8701	....	....	....	....	....	....	10.2916
Ottawa	58.12	.071	6.64	2.35	1.45	.10	.15	.02	4.62	....
	52.51	.064	6.00	2.12	1.31	.09	.14	.018	4.17	9.65
Ottawa Mang	54.45	.068	4.36	6.80	1.18	.12	.09	.005	6.76	....
	49.10	.061	3.93	6.13	1.06	.11	.08	.004	6.10	9.82
Palms [a]	62.00	.045	5.27	.99	.91	.19	.18	.0115	4.24	....
	54.975	.0399	4.67	.877	.806	.168	.16	.010	3.76	11.33
Rand	62.7052	.0410	2.9546	2.055	....	....	....	....	....	....
	55.2636	.0361	2.6039	1.811	....	....	....	....	....	11.8676
Rowe	57.82	.047	10.69	.9956	1.085	.194	.14	.024	3.40	....
	50.898	.041	9.41	.876	.955	.17	.12	.021	2.99	11.97
Sunday Lake [a]	62.30	.029	7.34	.460	1.029	.080	.050	.007	1.950	....
	56.25	.0261	6.606	.414	.9261	.072	.045	.0063	1.655	10.00
Taylor	58.50	.055	9.180	.240	3.770	.250	.230	.014	2.410	....
	52.15	.049	8.184	.214	3.361	.223	.205	.0125	2.148	10.85
Tilden	63.4163	.0478	3.2222	.761	....	....	....	....	....	....
	55.6552	.0419	2.8278	.667	....	....	....	....	....	12.2384
Upson	57.795	.0715	9.225	.81	2.095	.26	.43	.010	4.15	....
	51.217	.063	8.175	.717	1.856	.23	.38	.0088	3.677	11.38
Winona	57.200	.046	8.000	2.180	.900	.210	.090	.006	2.180	....
	51.137	.0411	7.152	1.949	.805	.188	.080	.005	1.949	10.600
Wisconsin	50.71	.053	9.77	7.22	....	....	....	....	....	....
	44.670	.04669	8.606	6.360	....	....	....	....	....	11.91
Yale	61.68	.040	5.30	.32	.64	.07	.16	.001	4.95	....
	55.49	.036	4.77	.29	.58	.06	.14	.0009	4.45	10.03

MARQUETTE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Abbotsford	61.9697	0.0323	8.0341	....	....	....	....	....	....	....
	61.1659	.0318	7.9298	....	....	....	....	....	....	1.2971
Alford	63.4584	.0469	5.8448	....	....	....	....	....	....	....
	56.4514	.0417	5.1994	....	....	....	....	....	....	11.0419

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

MARQUETTE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Angeline, hard	66.51	0.013								
	63.29	.012								4.88
Angenline hematite	64.63	.044								
	57.54	.038								10.97
Angeline, South	62.43	.112								
	56.22	.100								9.94
Averhart	59.5500	.0200	10.8700							
	54.7860	.0184	10.0004							8.0000
Barrow [a]	42.43	.040	33.46							
	38.90	.037	30.68							8.31
Barasa [a]	57.30	.103	10.100	0.170	2.250	1.140	0.300		3.000	
	50.997	.0916	8.989	.1513	2.002	1.014	.267		2.670	11.00
Beaufort	51.74	.26	7.93	.15	1.01	2.44	2.58	0.080	11.02	
	47.44	.238	7.27	.14	.93	2.24	2.37	.073	10.10	8.32
Bessie	51.4000	.4144	14.3809							
	49.9180	.4024	13.9662							2.8833
Bell	36.6000	.0368	42.4808							
	36.1757	.0363	41.9882							1.1594
Bedford	59.3900	.1467	7.8204							
	52.8402	.1305	6.9579							11.0284
Beresford	62.4700	.1040	6.0968							
	61.7958	.1028	6.0310							1.0792
Bigelow [a]	52.50	.050	20.00	.12	2.10	.26	.12	.016	2.53	
	47.775	.045	18.20	.109	1.91	.236	.109	.014	2.30	9.00
Buffalo	61.0000	.0949	5.2074	.329						
	52.9069	.0823	4.5165	.285						13.2674
Cambria [a]	60.41	.053	6.64	.98	2.63	.90	.32	.010	2.71	
	53.698	.047	5.90	.87	2.337	.80	.28	.0088	2.408	11.11
Cambridge	59.88	.892	5.47	.294	1.11	2.07	.39	.032	1.85	
	51.766	.771	4.72	.254	.959	1.78	.33	.027	1.59	13.55
Cameo	58.0300	.0936	6.4878	.321						
	50.7763	.0819	5.6768	.280						12.5000
Castleford	55.9000	.0872	14.4248							
	55.0777	.0859	14.2126							1.4710
Champion No. 1, crushed [a]	64.00	.060	4.55	.20	2.38	.32	.29	.013		
	63.49	.0595	4.51	.198	2.36	.317	.288	.0129		.80
Champion, hematite [a]	52.25	.397	9.84	.28	1.67	3.16	1.81	.053	6.35	
	47.76	.363	8.99	.256	1.53	2.89	1.65	.048	5.80	8.60
Chatford [a]	50.00	.150	23.00							
	45.490	.1364	20.925							9.02
Chester No. 1 [a]	45.35	.061	28.54	.33	1.75	.89	.65	.009	1.78	
	41.85	.0567	26.542	.3069	1.6275	.8277	.6045	.0083	1.6554	6.95
Chester No. 2	40.80	.027	36.16	.478	1.422	.22	.25	.006	2.12	
	38.72	.0252	33.809	.4469	1.3296	.2057	.2338	.0056	1.982	6.50
Cliffs Shaft, crushed	62.40	.109	4.180	.220	2.250	1.410	.970	.021	1.450	
	61.60	.1076	4.126	.217	2.221	1.392	.957	.0207	1.431	1.29
Cliffs Shaft, lump	63.00	.114	4.330	.140	1.98	.830	.550	.019	1.030	
	62.75	.1135	4.313	.139	1.97	.827	.548	.0189	1.026	.40
Comrade	55.20	.102	12.360	.070	4.160	.490	2.040	.023	1.070	
	54.51	.1007	12.205	.069	4.108	.484	2.014	.0227	1.057	1.25
East New York	59.38	.046	9.17	.14	2.48	.39	.41	.017	1.77	
	52.759	.0408	8.147	.12	2.20	.346	.36	.015	1.57	11.15

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

MARQUETTE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Imperial[a]	52.44	0.256	13.49	0.198	1.20	1.37	1.39	0.011	7.38	....
	47.03	.229	12.10	.177	1.076	1.228	1.246	.009	6.62	10.32
Jackson, South	43.83	.078	28.87	2.35	1.60	.16	.08	.017	3.53	....
	40.3455	.0718	26.5748	2.1632	1.4728	.1473	.0736	.0156	3.2494	7.95
Lake	60.70	.109	5.740	.520	2.860	.520	.490	.011	3.520	....
	53.42	.096	5.052	.458	2.517	.458	.431	.0097	3.098	11.99
Lake Bessemer	64.10	.040	5.200	.240	1.450	.270	.130	.010	1.150	....
	56.50	.0353	4.584	.212	1.278	.238	.115	.0089	1.014	11.85
Lillie[a]	60.85	.085	6.16	.34	2.10	.41	.09	.013	3.34	....
	53.35	.074	5.388	.297	1.837	.358	.078	.0110	2.92	12.52
Michigamme	60.30	.103	10.610	.190	2.270	.700	.820	.022	.100	....
	59.59	.102	10.485	.188	2.243	.692	.810	.0217	.099	1.18
Mitchell	60.62	.168	....	....	....	....	....	....	....	....
	53.98	.105	....	....	....	....	....	....	....	10.94
Moore[a]	36.78	.045	43.09	....	....	....	....	....	....	....
	35.860	.0438	42.012	....	....	....	....	....	....	2.50
Negaunee	60.1174	.0605	7.3142	.344	....	....	....	....	....	....
	53.5723	.0539	6.5178	.306	....	....	....	....	....	10.8872
Negaunee non-Bessemer[a]	59.00	.160	8.50	....	....	....	....	....	....	....
	51.920	.1408	7.480	....	....	....	....	....	....	12.00
Norfolk Bess, crushed[a]	55.55	.055	15.26	.27	3.35	.38	.21	.034	.15	....
	54.91	.0543	15.08	.267	3.31	.376	.208	.0336	.148	1.15
Norfolk non-Bess. crushed[a]	57.17	.126	13.91	.27	3.08	.38	.21	.034	.15	....
	56.51	.1245	13.75	.267	3.04	.376	.208	.0336	.148	1.15
Princeton No. 1[a]	63.00	.055	2.30	.43	1.37	1.05	.93	.021	1.60	....
	52.768	.046	1.926	.36	1.147	.879	.778	.017	1.34	16.24
Princeton No. 2	61.30	.133	6.88	.276	1.29	1.29	.82	.028	1.62	....
	51.277	.111	5.75	.230	1.07	1.07	.68	.023	1.35	16.35
Republic crushed	65.85	.047	....	....	....	....	....	....	....	....
	65.356	.0466	....	....	....	....	....	....	....	.75
Republic magnetic	68.74	.070	....	....	....	....	....	....	....	....
	68.327	.0695	....	....	....	....	....	....	....	.60
Republic specular	67.77	.050	....	....	....	....	....	....	....	....
	67.004	.0494	....	....	....	....	....	....	....	1.13
Richmond	43.600	.034	36.200	.040	.640	.490	.110	.004	2.740	....
	43.046	.0336	35.740	.039	.632	.483	.108	.0039	2.705	1.270
Rose[a]	60.50	.150	6.41	.33	2.45	.50	.18	.029	2.16	....
	54.45	.135	5.769	.297	2.20	.45	.16	.026	1.94	10.00
Salisbury	60.30	.110	6.530	.360	2.680	.520	.690	.012	2.450	....
	52.62	.096	5.698	.314	2.339	.454	.602	.0105	2.138	12.74
Scotch	61.00	.129	7.300	.100	3.220	.540	.730	.017	.550	....
	60.17	.127	7.200	.0986	3.176	.533	.720	.0168	.543	1.36
Sheffield	61.11	.027	....	....	....	....	....	....	....	....
	58.77	.025	....	....	....	....	....	....	....	3.82
Tilden Silica	42.80	.032	36.280	.130	.820	.250	.160	.010	5.40	....
	42.27	.0316	35.834	.128	.810	.247	.158	.0099	.533	1.23

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

MENOMINEE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Atfield	61.8691	0.0564	3.6436	....	....	....	....	0.3656	....	....
	55.3271	.0504	3.2583	....	....	....	....	.3269	....	10.5744
Armenia	56.400	.243	10.000	0.220	2.400	1.500	1.650	.007	1.470	....
	50.619	.2181	8.975	.197	2.154	1.346	1.481	.006	1.319	10.250
Ajax	54.0548	.0614	13.4520	....	....	....	....	....	....	....
	50.6296	.0575	12.5996	....	....	....	....	....	....	6.3366
Bangor	59.2500	.3579	7.3693	....	....	....	....	....	....	....
	52.9735	.3199	6.5886	....	....	....	....	....	....	10.5933
Baltic	58.59	.504	4.11	.27	2.88	.61	.63	.045	6.32	....
	53.8325	.4631	3.7763	.2481	2.6461	.5605	.5788	.0413	5.8068	8.12
Barfield	59.5000	.1080	5.6132	....	....	....	....	.2320	....	....
	53.2288	.0966	5.0215	....	....	....	....	.2075	....	10.5398
Barton	58.0134	.4622	5.0797	....	....	....	....	....	....	....
	53.1330	.4233	4.6523	....	....	....	....	....	....	8.4125
Basic	56.500	.294	6.490	3.550	1.860	1.280	2.490	.009	3.200	....
	51.895	.2700	5.961	3.260	1.708	1.175	2.287	.008	2.939	8.150
Bristol	56.65	.635	3.84	.96	1.87	1.34	.64	.019	7.55	....
	52.97	.594	3.59	.90	1.75	1.25	.60	.018	7.06	6.49
Chapin	59.0985	.0636	7.2419	....	....	....	....	....	....	....
	55.2423	.0594	6.7693	....	....	....	....	....	....	6.5250
Clearfield [a]	59.50	.140	6.00	....	....	....	....	....	....	....
	51.913	.1221	5.235	....	....	....	....	....	....	12.75
Clifford	40.24	.014	39.31	.10	.85	.22	.12	.009	.52	....
	39.25	.0136	38.34	.098	.83	.21	.117	.0088	.51	2.47
Columbia No. 1	56.60	.392	12.17	.19	3.85	.21	.23	.021	1.50	....
	50.89	.35	10.94	.17	3.46	.188	.206	.0188	1.348	10.08
Crystal Falls	58.600	.720	4.130	.250	1.910	2.650	1.180	.007	3.400	....
	53.443	.6566	3.766	.228	1.742	2.417	1.076	.006	3.101	8.800
Davidson	55.75	.158	7.40	.15	3.46	1.40	2.60	.21	4.75	....
	49.90	.141	6.62	.13	3.10	1.25	2.33	.19	4.25	10.50
Davy	40.385	.0298	35.89	.132	1.028	1.01	1.313	.020	2.04	....
	39.876	.029	35.438	.13	1.015	.997	1.296	.0197	2.01	1.258
Florence	54.845	.341	5.95	.327	3.667	1.935	2.93	.1215	5.59	....
	49.85	.310	5.408	.297	3.33	1.758	2.66	.110	5.08	9.106
Genesee [a]	59.100	.690	6.050	.440	1.650	2.300	1.200	.008	3.000	....
	53.840	.6286	5.511	.401	1.503	2.095	1.093	.007	2.733	8.900
Granada	61.2676	.0619	5.3786	....	....	....	....	....	....	....
	56.4036	.0569	4.9515	....	....	....	....	....	....	7.9389
Gray	44.5000	.0361	23.1477	....	....	....	....	....	....	....
	44.2084	.0358	22.9960	....	....	....	....	....	....	.6552
Groveland	51.300	.046	11.220	1.100	2.490	3.510	4.620	.008	5.290	....
	49.222	.0441	10.765	1.055	2.389	3.367	4.433	.007	5.076	4.050
Great Western	58.100	.305	6.600	1.250	1.980	1.210	2.040	.008	2.950	....
	53.243	.2795	6.048	1.145	1.814	1.109	1.869	.007	2.703	8.360
Hemlock	56.10	.206	6.24	.29	2.99	2.71	2.26	.010	4.54	....
	53.1828	.1953	5.9155	.2749	2.8345	2.5691	2.1425	.0095	4.3039	5.20
Hiawatha	55.50	.252	7.28	.60	2.52	.28	.21	.019	7.65	....
	51.6316	.2344	6.7725	.5581	2.3443	.2604	.1953	.0176	7.1167	6.97
Hope	59.6000	.3670	7.9800	....	....	....	....	....	....	12.5600
	52.1142	.3209	6.9777	....	....	....	....	....	....	....
Keel Ridge [a]	40.64	.046	37.42	.20	.90	1.35	1.00	.006	....	....
	39.46	.045	36.33	.19	.87	1.31	.97	.0058	....	2.90

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

MENOMINEE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Kimball[a]	55.700	0.660	6.300	0.210	1.600	2.500	1.900	0.008	3.100	....
	51.133	.6059	5.783	.193	1.469	2.295	1.744	.007	2.846	8.200
Lamont	56.350	.650	7.500	.460	3.010	1.590	1.230	.008	2.100	....
	51.335	.5921	6.832	.419	2.742	1.448	1.120	.007	1.913	8.900
Lerida	60.3828	.0749	5.9892	....	....	....	....	....	....	....
	56.6648	.0702	5.6204	....	....	....	....	....	....	6.1573
Lincoln	57.200	.336	7.740	.640	2.170	1.430	1.860	.008	2.690	....
	52.166	.3064	7.059	.584	1.979	1.304	1.696	.007	2.453	8.800
Loretto	58.85	.019	11.01	.22	1.82	.35	.80	.025	.91	....
	54.189	.017	10.138	.20	1.675	.32	.736	.023	.837	7.92
Manganate No. 1	53.41	.674	3.52	3.13	2.43	1.94	1.40	.035	7.67	....
	49.57	.626	3.27	2.90	2.26	1.80	1.30	.032	7.12	7.19
Manganate No. 2	51.10	.655	4.36	5.04	2.80	1.80	1.50	.040	7.50	....
	47.36	.607	4.04	4.67	2.60	1.67	1.39	.037	6.95	7.31
Monongahela,	52.33	.109	15.59	.23	3.84	.29	.50	.020	3.50	....
Non-Bess.[a]	47.25	.098	14.08	.21	3.47	.26	.45	.018	3.16	9.70
Michigan No. 1	58.9000	.2192	4.6185	....	....	....	....	....	....	....
	54.8565	.2041	4.3014	....	....	....	....	....	....	6.8651
Millie	60.02	.025	5.54	.12	.76	1.93	2.40	.016	3.21	....
	56.30	.023	5.196	.11	.71	1.81	2.25	.015	3.01	6.197
Northwestern	59.70	.070	10.04	.17	1.38	.74	.67	.012	1.50	....
	52.2375	.0613	8.7850	.1488	1.2075	.6475	.5863	.0105	1.3125	12.50
Paint River[a]	56.300	.640	6.900	.480	2.900	1.540	1.100	.009	2.800	....
	51.233	.5824	6.279	.437	2.639	1.401	1.001	.008	2.548	9.000
Pewabic	64.64	.010	4.15	.14	.94	.57	1.25	.003	1.04	....
	59.1715	.0092	3.7989	.1282	.8605	.5218	1.1443	.0027	.9520	8.46
Pewabic Genoa	43.92	.010	32.02	.08	1.38	.60	1.47	.006	1.21	....
	41.5615	.0095	30.3005	.0757	1.3059	.5678	1.3911	.0057	1.1450	5.37
Quinnesec (Non-	58.200	.890	5.350	.170	.800	.850	.880	.006	2.400	....
Bess.)	55.657	.8511	5.116	.162	.765	.813	.841	.005	2.295	4.370
Quinnesec (Sili-	44.100	.025	34.910	.140	1.070	.440	.650	.008	1.930	....
cious Bess.)	43.129	.0244	34.141	.136	1.046	.430	.636	.007	1.887	2.200
Rosen[a]	56.80	.345	5.06	.232	3.09	1.09	1.361	.112	4.71	....
	52.051	.3161	4.636	.2126	2.831	.998	1.2472	.1026	4.316	8.36
Russell	53.69	.063	10.03	.257	2.581	2.145	3.357	.016	4.005	....
	49.765	.058	9.296	.238	2.39	1.988	3.11	.0148	3.71	7.31
San Jose	64.75	.017	4.15	.24	1.21	.29	.33	.011	.62	....
	60.45	.0158	3.87	.22	1.129	.27	.308	.010	.578	6.639
Tobin	59.050	.700	7.370	.432	1.700	2.200	1.100	.009	2.980	....
	53.854	.6384	6.721	.394	1.550	2.006	1.003	.008	2.718	8.800
Toledo	55.06	.012	15.86	.13	1.47	.65	1.59	.004	1.25	....
	50.8259	.0111	14.6404	.1200	1.3570	.6000	1.4677	.0037	1.1539	7.69
Tyrone	58.48	.050	8.78	.13	1.10	1.14	1.88	.002	1.87	....
	54.2811	.0464	8.1496	.1207	1.0210	1.0581	1.7450	.0019	1.7357	7.18
Verona	40.76	.012	37.85	.15	1.34	.17	.96	.019	.81	....
	39.2356	.0116	36.4344	.1444	1.2899	.1636	.9241	.0183	.7797	3.74
Vivian[a]	41.00	.016	33.41	.12	2.01	1.30	1.59	.010	2.98	....
	39.4092	.0154	32.1137	.1153	1.9320	1.2496	1.5283	.0096	2.8644	3.88
Walpole	59.24	.100	9.05	.15	1.51	1.25	2.55	.003	1.97	....
	55.8574	.0943	8.5332	.1414	1.4238	1.1786	2.4044	.0028	1.8575	5.71

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

MESABI RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Adams	61.7468	0.0356								
	55.5110	.0320								10.0989
Adams No. 2	59.8548	.0722	3.6357	0.615						
	52.4985	.0633	3.1888	.539						12.2902
Admiral[a]	63.800	.027	4.900	.300	0.620	0.230	0.180	0.006	2.140	
	58.824	.0249	4.518	.277	.572	.212	.166	.005	1.973	7.800
Agnew[a]	61.00	.045								
Albany[a]	60.00	.073	4.10	.84	1.72	.15	.42	.028	6.36	
	53.4000	.0650	3.6490	.7476	1.5308	.1335	.3738	.0249	5.6604	11.00
Audrey No. 2	57.5531	.0690	5.9864							
	50.1229	.0600	5.2135							12.9102
Beaver	62.546	.0876	3.34	.446	1.994	.18	.146	.018	4.16	
	55.47	.0776	2.96	.395	1.768	.159	.129	.0159	3.689	11.309
Biwabik No. 1	63.70	.039	2.54	.48	.91	.24	.09	.008	4.48	
	58.64	.035	2.33	.44	.83	.22	.08	.007	4.12	7.93
Biwabik No. 2[a]	62.00	.045	2.54	.48	.91	.24	.09	.008	4.48	
	57.04	.0414	2.33	.44	.83	.22	.08	.007	4.12	8.00
Butler	63.05	.048	2.25	.52	1.06	.24	.32	.016	5.19	
	57.33	.043	2.04	.47	.96	.21	.29	.014	4.71	9.09
Cass[a]	59.10	.049	8.90	.368	1.39	.16	.12	.006	3.42	
	53.19	.0441	8.01	.3312	1.251	.144	.108	.0054	3.078	10.00
Chisholm	61.6745	.0423	5.6499							
	55.8332	.0382	5.1147							9.4711
Clairton[a]	60.00	.059								
	54.00	.0531								10.00
Clark	61.6866	.0314	5.4583							
	55.7389	.0283	4.9320							9.6418
Commodore[a]	63.100	.039	4.150	.200	1.210	.240	.060	.004	3.400	
	57.232	.0354	3.764	.181	1.097	.217	.054	.003	3.084	9.300
Columbia[a]	57.52	.066	8.89	.56	3.94	.13	.13	.016	4.58	
	49.28	.056	7.62	.48	3.37	.11	.11	.014	3.92	14.33
Corsica	58.14	.045	8.03	.81	.94	.11	.08	.007	6.70	
	51.7330	.0400	7.1451	.7207	.8364	.0979	.0712	.0062	5.9617	11.02
Crosby[a]	58.00	.040								
	52.20	.0360								10.00
Croxton	61.32	.065	3.52	.44	.525	.09	.13	.015	5.53	
	55.188	.0585	3.168	.396	.4725	.081	.117	.0135	4.977	10.00
Cyprus[a]	61.61	.070	2.40	.20	.60	.35	.15	.04	8.50	
	54.8329	.0623	2.1360	.1780	.5340	.3115	.1335	.0356	7.5650	11.00
Dailey	59.1651	.0565	4.1535	.667						
	50.6734	.0483	3.5573	.571						14.3526
Duluth	60.4744	.0489	4.4084							
	54.5094	.0440	3.9735							9.8636
Elba	61.45	.039	3.91	1.13	.95	.12	.10	.009	5.30	
	55.6860	.0353	3.5432	1.0240	.8609	.1087	.0906	.0082	4.8029	9.38
Fayal	63.0750	.0353								
	57.3040	.0320								9.1494
Franklin	59.82	.041								
	55.506	.038								7.21

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Genoa	62.5909	0.0340								
	57.0257	.0309								8.8914
Grant	61.04	.055	4.55							
	52.976	.047	3.94							13.21
Hartley	62.9217	.0433								
	56.6558	.0389								9.9582
Island	60.6199	.0701	4.0791							
	53.8156	.0622	3.6212							11.2245
Johnston[a]	61.00	.080								
	54.90	.072								10.00
Jordan	62.100	.059	4.610	0.520	0.729	1.630	0.160	0.008	0.683	
	55.890	.0531	4.149	.468	.656	1.467	.144	.007	.615	10.000
Juniata	61.4324	.0536	5.7327	.276	2.2707					
	52.6330	.0467	5.0048	.240	1.9824					12.6959
Hale-Kanawha	59.10	.069	8.78	.45	1.19	.95	.14	.010	2.09	
	53.1718	.0619	7.884	.4041	1.068	.8531	.1257	.0088	1.8768	10.20
Hawkins[a]	58.00	.045								
Laura[a]	61.50	.065								
	54.335	.0578								11.00
La Rue[a]	59.00	.045	8.25	.60	1.25	.15	.10	.020	4.50	
	53.69	.0409	7.5075	.5460	1.1375	.1365	.0910	.0182	4.095	9.00
Leetonia Bessemer[a]	61.20	.050	2.91	.64	.62	.27	.15	.020		
	55.08	.045	2.619	.576	.558	.243	.135	.018		10.00
Leetonia Non-Bessemer	60.58	.062	3.03	.60	.87	.21	.15	.014		
	54.522	.0558	2.727	.54	.783	.189	.135	.0126		10.00
Leonard[a]	60.00	.071								
Lincoln	59.47	.032	8.96							
	53.95	.029	8.41							9.28
Longyear[a]	60.00	.081	7.80	.99	1.72	.15	.13	.001	3.92	
	54.00	.0729	7.02	.891	1.548	.135	.117	.0009	3.528	10.00
Mahoning	63.824	.048	2.72	.52	1.855	.16	.096	.0156	3.22	
	57.156	.043	2.43	.465	1.66	.14	.086	.014	2.88	10.446
Malta	63.64	.029	4.52	.61	.78	.17	.13	.011	2.71	
	58.3642	.0266	4.1453	.5594	.7153	.1559	.1192	.0101	2.4853	8.29
Minorca[a]	61.00	.031	7.70	.67	1.17	.20	.16	.007	2.61	
	55.7723	.0283	7.0401	.6126	1.0697	.1829	.1463	.0064	2.3863	8.57
Morrow Bessemer[a]	60.80	.044	6.95	.58	1.15	.25	.09	.009		
	55.632	.04026	6.359	.5307	1.0522	.2287	.0823	.0082		8.50
Morrow Non-Bessemer	60.35	.063	7.45	.60	1.27	.30	.08	.011	4.00	
	55.431	.05786	6.8428	.5511	1.1664	.2765	.0734	.0101	3.674	8.15
Mountain	63.9791	.0417	3.9765	.198	1.8364					
	56.0996	.0365	3.4867	.173	1.6102					12.3158
Mountain Special	61.7674	.0474	6.1154	.253	2.0917					
	53.8977	.0413	5.3362	.220	1.8252					12.7408
Oliver	62.7719	.0505	4.6050	.233	2.1265					
	55.0772	.0443	4.0405	.204	1.8658					12.2582
Pearce	62.30	.041	4.46	.12	1.51	.14	.12	.044	3.43	
	56.331	.03707	4.0327	.1085	1.3653	.1265	.1085	.0397	3.1014	9.58

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Penobscot	60.68	0.0433	6.58	0.625	1.9607	0.173	0.103	0.0143	3.47	....
	54.00	.0385	5.856	.556	1.745	.15	.09	.0127	3.088	10.997
Pillsbury	62.4946	.0339	....	....	....	....	....	....	....	....
	56.6388	.0307	....	....	....	....	....	....	....	9.3701
Pillsbury No. 2	58.8920	.0536	7.1588	....	....	....	....	....	....	....
	52.3197	.0476	6.3598	....	....	....	....	....	....	11.1599
Preble	60.4280	.0597	6.4672	.319	2.4279	....	....	....	....	....
	52.5941	.0519	5.6287	.277	2.1131	....	....	....	....	12.9641
Roberts	58.20	.025	13.95	.43	1.15	.20	.10	.034	2.25	....
	53.1075	.0228	12.7293	.3923	1.0493	.1825	.0912	.0310	2.0531	8.75
Sauntry[a]	61.00	.080	4.50	1.25	....	....	....	....	....	....
	53.680	.0704	3.960	1.100	....	....	....	....	....	12.00
Sauntry No. 2	61.9418	.0642	4.1400	.583	2.2960	....	....	....	....	....
	56.4167	.0584	3.7707	.530	2.0911	....	....	....	....	8.9199
Shenango[a]	64.00	.040	....	....	....	....	....	....	....	....
	56.32	.0352	....	....	....	....	....	....	....	12.00
Shilling	62.05	.061	2.97	.53	1.10	.18	.05	.011	6.13	....
	55.50	.054	2.65	.47	.98	.16	.04	.009	5.48	10.50
Sparta	62.53	.028	6.44	.52	.89	.17	.13	.010	2.25	....
	57.5589	.0258	5.9280	.4787	.8192	.1565	.1197	.0092	2.0711	7.95
Spruce No. 2[a]	59.00	.060	4.00	....	....	....	....	....	....	....
	50.740	.0516	3.440	....	....	....	....	....	....	14.00
Stephens[a]	60.00	.075	5.00	....	....	....	....	....	....	....
	52.500	.0656	4.375	....	....	....	....	....	....	12.50
Steese	63.40	.045	1.77	.88	1.31	.12	.09	.005	5.18	....
	59.34	.042	1.65	.82	1.22	.11	.08	.004	4.85	6.39
Stevenson	64.650	.039	3.250	.320	.870	.210	.160	.005	2.480	....
	59.349	.0358	2.983	.294	.799	.193	.147	.004	2.276	8.200
Thompson	62.8239	.0369	....	....	....	....	....	....	....	....
	56.3738	.0331	....	....	....	....	....	....	....	10.2670
Top Brown[a]	61.00	.070	6.23	.72	1.20	.17	.12	.008	4.56	....
	54.7597	.0628	5.5927	.6463	1.0772	.1526	.1077	.0072	4.0935	10.23
Troy[a]	55.00	.035	....	....	....	....	....	....	....	....
	....	....	....	....	....	....	....	....	....	....
Tubal	60.0173	.0687	....	....	....	....	....	....	....	....
	52.7397	.0604	....	....	....	....	....	....	....	12.1259
Union	59.49	.051	6.174	.967	1.748	.164	.13	.014	5.29	....
	53.868	.046	5.59	.875	1.58	.148	.117	.0126	4.79	9.45
Victoria	61.10	.051	....	....	....	....	....	....	....	....
	56.29	.046	....	....	....	....	....	....	....	7.87
Vulcan	59.61	.023	10.25	.37	.95	.18	.06	.008	2.22	....
	54.0305	.0208	9.2906	.3354	.8611	.1632	.0544	.0073	2.0122	9.36
Wallace	64.470	.055	3.310	.479	.900	.210	.160	.007	2.690	....
	58.087	.0495	2.982	.431	.811	.189	.144	.006	2.424	9.900
Winifred[a]	63.00	.045	....	....	....	....	....	....	....	....
	56.07	.0400	....	....	....	....	....	....	....	11.00

[a] Expected analysis for the season of 1903.

Complete average cargo analyses of Lake Superior iron ores, season of 1902—Continued.

VERMILION RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Jura	61.5000	0.0725	4.2850	....	....	....	....	....	....	....
	57.9876	.0683	4.0402	....	....	....	....	....	....	5.7112
Pioneer	64.2956	.0391	4.4581	....	....	....	....	....	....	....
	61.3606	.0373	4.2545	....	....	....	....	....	....	4.5649
Pilot	67.6439	.0313	1.7225	....	....	....	....	....	....	....
	66.1008	.0305	1.6832	....	....	....	....	....	....	2.2812
Red Lake	61.3400	.1319	5.9464	....	....	....	....	....	....	....
	59.6347	.1282	5.7810	....	....	....	....	....	....	2.7800
Savoy	64.4995	.0471	3.2413	....	....	....	....	....	....	....
	61.0864	.0446	3.0697	....	....	....	....	....	....	5.2917
Soudan	66.5000	.0743	1.8528	....	....	....	....	....	....	....
	65.6555	.0733	1.8292	....	....	....	....	....	....	1.2700
Soudan silicious	52.8916	.0515	23.0106	....	....	....	....	....	....	....
	51.1938	.0498	22.3642	....	....	....	....	....	....	3.2100
Vermilion	63.0000	.1406	4.2360	....	....	....	....	....	....	....
	62.3070	.1390	4.1894	....	....	....	....	....	....	1.1000
Vermilion lump	65.0000	.1366	2.3127	....	....	....	....	....	....	....
	64.5385	.1356	2.2962	....	....	....	....	....	....	.7100
Zenith	66.0615	.0405	3.1613	....	....	....	....	....	....	....
	62.0956	.0380	2.9715	....	....	....	....	....	....	6.0034

MICHIPICOTEN RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Helen	57.014	0.105	7.83	0.10	1.25	0.144	0.09	0.107	8.426	....
	53.42	.098	7.336	.09	1.17	.13	.08	.100	7.895	6.30

DISTRIBUTION OF IRON-ORE PRODUCTION IN 1902, BY STATES.

Following custom, a résumé of the quantities and character of iron ores mined in 1902 in the various States is presented, the data being arranged in the order of importance of the States as producers.

Minnesota.—The mines which are at present developed in the State of Minnesota are all found on the Mesabi and Vermilion ranges; they produced in the year 1902 15,137,650 long tons of iron ore, valued at $23,989,227, or an average of $1.58 per ton. This is an increase over the 1901 production (11,109,537 long tons) of 4,028,113 tons, or 36 per cent. This is certainly a phenomenal record; for it represents a larger quantity of iron ore than was mined in the whole of the United States prior to the year 1890; it also exceeds the quantities mined in 1891, 1893, and 1894. All of this ore was of the red hematite variety, giving Minnesota first rank in this class of ore, with 50 per cent of the total for the United States. It is probable that there has been more active exploitation in the year 1902 in Minnesota than in any of the other States, and a number of mines have been added to the producing list, some of which will be important contributors in the future. Some of the new exploitations furnish ore of a grade which, until the late abnormal demand, was deemed undesirable, no available market formerly existing for it.

Michigan.—Although the iron-ore production in the State of Michigan in the year 1902 (11,135,215 long tons) did not entitle it to first position, the production showed an increase of 1,481,148 tons over the 1901 output of 9,654,067 long tons. Of the output in 1902, 11,079,124 long tons were of the red hematite variety, in which Michigan took second place, and 56,091 tons were magnetite, giving it fifth rank among the producers of this class of ore.

Alabama.—Alabama occupies third position as an iron-ore producer, with a total output in 1902 of 3,574,474 long tons, of which 2,565,635 tons, or 72 per cent, were of the red hematite variety, and 1,008,839 long tons, or 28 per cent, were brown hematite, giving the State third and first ranks, respectively, as a producer of these classes of ores.

Virginia and West Virginia.—Statistics of the State of West Virginia have been included with those of Virginia in order to follow the practice of the United States Geological Survey of holding individual mine statistics confidential. The former State contributed but a small quota to the country's supply.

The total quantity furnished by these two States in the year 1902 was 987,958 long tons, an increase of 62,564 long tons, or 7 per cent, over the 1901 total of 925,394 long tons of ore. Of this amount 953,128 tons, or about 96.5 per cent, was of the brown hematite variety, 31,677 tons, or 3.2 per cent, red hematite, and 3,153 tons, or 0.3 per cent, magnetite. The two States combined occupy second position as producers of brown hematite ore, eleventh position in the red hematite class, and seventh in the magnetite class.

During the year 1902 a considerable amount of ore was brought into Virginia from the Lake Superior region and used to supplement the local ore supply.

Tennessee.—Tennessee increased its output from 789,494 long tons in 1901 to 874,542 long tons in 1902, a gain of 85,048 long tons, or 10.8 per cent. The greater part of this output, 503,899 tons, was of the brown hematite variety, and the remainder, 370,643 tons, was red hematite. The State occupied fifth position as a producer in 1902.

Pennsylvania.—Pennsylvania has fallen from fourth to sixth position as a producer of iron ore, owing mainly to the reduced output of one of the large producing mines. The total for the year 1902 was 822,932 long tons, a decrease of 217,752 tons from the 1901 production of 1,040,684 long tons. This State contributed three classes of ore; 616,645 tons were of the magnetite variety, 185,846 tons of the brown hematite variety, and 20,441 tons were red hematite. Consequently Pennsylvania ranks first, sixth, and twelfth, respectively, in the production of magnetite, brown hematite, and red hematite ores.

Wisconsin.—Wisconsin occupies seventh position as a producer, with a total of 783,996 long tons of iron ore, an increase of 45,128 long tons over the 1901 production of 738,868 long tons. Of this total, 758,316 long tons, or 96.7 per cent, were of the red hematite variety, and 25,680 tons, or 3.3 per cent, of the brown hematite variety.

New York.—In the year 1902 New York contributed 555,321 long tons of iron ore, an increase of 135,103 long tons, or 32 per cent, over the 1901 total of 420,218 long tons. The greater portion of this, 451,570 tons, was of the magnetite variety, obtained from the Lake Champlain district; 91,075 tons of the remainder were of the red hematite class, and 12,676 tons were brown hematite.

New Jersey.—The production of the New Jersey iron-ore mines in the year 1902 was 441,879 long tons, an increase of 39,890 long tons, or 9.9 per cent, over the 1901 output of 401,989 long tons. All of this ore was of the magnetite variety, in which class New Jersey occupies third position. There was considerable exploitation in 1902 of a number of iron-ore deposits formerly worked, which accounts for the augmented output.

Georgia and North Carolina.—These two States have been combined, but North Carolina's contribution is comparatively small. The total amount mined in 1902 was 364,890 long tons, of which 216,242 tons were brown hematite, 117,812 tons red hematite, and 30,836 tons magnetite.

Colorado.—Colorado holds twelfth rank as a producer of iron ore, having in the year 1902 contributed 293,297 tons of iron ore, which was used in the production of pig iron and as a flux in the smelters. This shows a falling off of 110,740 tons from the 1901 output of 404,037 tons. With the exception of 4,375 tons of red hematite, all of this ore was of the brown hematite variety. The ore which was sent to the smelters contained a mixture of iron and manganese, and often also a small percentage of silver. As the silver was insufficient to make it valuable as a precious-metal ore, it is classed as iron ore.

In the western States and Territories there has been a marked increase in the production of iron ore in order to supply the demands of the growing iron industry in Colorado and the demands of the smelters for argentiferous iron ores used as a flux in the production of the precious metals.

In the year 1902, Montana, New Mexico, Utah, and Wyoming produced a total of 362,034 long tons, of which 255,269 tons were of the red hematite variety, 88,686 tons were magnetite, and 18,079 tons of the brown hematite class.

Other States.—Kentucky and Missouri contributed both red and brown hematite, Maryland brown hematite and carbonate ore, and the

New England States brown hematite. Ohio's output was of the carbonate variety, in which class this State occupies first position. Texas contributed a small quantity of brown hematite.

PROMINENT IRON-ORE PRODUCERS.

During the year ending December 31, 1902, 126 iron-ore operations in the United States each produced 50,000 or more long tons of iron ore, the total for the 126 mines being 31,561,628 long tons, or 88.8 per cent of the production for the country.

Of these larger mining operations reported in the year 1902, 102 produced 28,584,023 long tons of red hematite; 14 contributed 1,303,484 long tons of brown hematite; 7 supplied 1,255,358 long tons of magnetite; 2 mines furnished a mixture of 330,439 long tons of red hematite and magnetite, and 1 mine a mixture of 88,324 long tons of red and brown hematite.

Of these larger mining operations 46 are in Michigan, 35 in Minnesota, 15 in Alabama, 7 in Tennessee, 5 in Wisconsin, 4 each in New Jersey and Virginia, 3 in New York, 2 each in Colorado and Georgia, and 1 each in Pennsylvania, Wyoming, and New Mexico.

Of these 126 operations 1 contributed over 1,800,000 long tons, 1 over 1,600,000 tons, 1 over 1,400,000 tons, 2 over 1,200,000 tons, 1 over 1,000,000 tons, 2 over 900,000 tons, 1 over 700,000 tons, 3 over 600,000 tons, 5 over 500,000 tons, 3 over 400,000 tons, 7 over 300,000 tons, 15 over 200,000 tons, 32 over 100,000 tons, and 52 between 50,000 and 100,000 long tons.

The following table gives a list of the larger mining operations of the United States in the year 1902, together with the States in which they are located and the quantity produced by each, except 15 mines producing 1,663,277 long tons, the managers of which objected to publication; but the totals of these unidentified mines have been grouped and placed at the end of the table:

Prominent iron-ore mines of the United States, with their production in 1902.

		Long tons.
Fayal, Minn		1,863,863
Mountain Iron and Rathbun, Minn		1,629,577
Stevenson, Minn		1,434,719
Adams, Mich		1,245,005
Red Mountain Group, Ala.:		
Fossil	754,524	
Muscado	454,057	
		1,208,581
Mahoning No. 3, Minn		1,035,215
Chapin, Mich		932,468
Norrie Group, Mich		923,352
Lake Superior, Mich		757,959
Pioneer, Minn		669,745

		Long tons.
Biwabik, Minn		623,045
Aragon, Mich		611,181
Cornwall, Pa		594,177
Chandler, Minn		593,750
Cleveland Iron Mining Company, Mich.:		
Cleveland Lake	484,432	
Cleveland Hard Ore	74,743	
		559,175
Pewabic, Mich		538,497
Spruce Mining Company, Minn		535,021
Aurora and Vaughn, Mich		492,940
Tilden, Mich		441,123
Hull, Minn		409,259
Buffalo, South Buffalo, Prince of Wales, and Queen, Mich		381,879
Genoa, Minn		380,238
Lake Angeline, Mich		376,600
Clark, Minn		348,518
Savoy-Sibley, Minn		324,865
Ashland, Mich		314,720
Minnesota Iron Company, Minn		307,166
Cliffs Shaft, Mich		280,193
Penn Iron Mining Company, Mich		263,069
Sauntry-Alpena, Minn		249,382
Newport and Bonnie, Mich		239,506
Riverton Group, Mich		231,512
Rust, Minn		228,953
Elba, Minn		227,465
Sharon, Minn		221,835
Malta, Minn		220,587
Brown Mining Company, Tenn		219,173
Sparta, Minn		212,310
Sunrise, Wyo		209,272
Chisholm, Minn		204,292
Champion, Mich		197,499
Crystal Falls, Mich		195,289
Sellers, Minn		193,650
Pillsbury, Minn		190,200
Cundy, Mich		183,052
Negaunee, Mich		180,516
Old Bed, N. Y		179,934
Salisbury, Mich		179,066
Carey, Wis		176,180
Penobscot, Minn		171,756
Atlantic, Wis		166,009
Zenith, Minn		162,006
Jordan, Minn		148,013
Duluth, Minn		142,952
Montreal and Ottawa, Wis		142,886
Sunday Lake, Mich		142,315
Hemlock River, Mich		135,010
Fierro, N. Mex		132,940
Bristol (Claire), Mich		131,700
Winthrop, Mich		129,496
Crudup Mining Company, Ala		120,250

	Long tons.
Port Henry No. 21, N. Y	119,467
Republic and West Republic, Mich	117,628
Mikado, Mich	112,014
Raimund, Ala	111,425
Clifford, Mich	110,505
Princeton, Mich	108,986
Oriskany, Va	108,610
Lincoln, Minn	106,158
Union, Minn	104,481
Armenia, Mich	102,623
Richards, N. J	100,656
Orient, Colo	99,165
Wharton Hibernia, N. J	97,596
Loretto, Mich	97,409
Baltic, Mich	96,618
Anvil, Mich	93,424
Rich Patch, Va	90,000
Chateaugay, N. Y	89,993
Volunteer, Mich	89,111
Franklin, Minn	88,102
Columbia, Mich	86,452
Mansfield, Mich	81,493
Hiawatha, Mich	80,000
Lillie, Mich	78,452
Corsica, Minn	74,818
Burt, Minn	74,716
Wood and De Camp, N. J	73,535
Tobin and Genesee, Mich	73,246
Grace's Gap, Ala	71,587
Quinnesec, Mich	70,095
Tannehill, Ala	68,921
Iron Belt, Wis	68,015
Estelle, Ga	64,422
Great Western, Mich	62,900
Hammond Brothers & Co., Ala	61,290
Cambria, Mich	59,926
Agnew, Minn	58,500
Mannie, Tenn	58,216
Minorca, Minn	57,799
Lone Pine 1, 2, and 3, Ala	57,749
Kawanee, Ala	57,192
Pearce, Minn	54,950
Lamont, Mich	54,266
Brotherton, Mich	53,971
Hillman, Ala	53,478
Grant, Minn	53,270
Commonwealth, Wis	52,015
Helen-Bess, Ala	51,794
Inman, Tenn	50,365
Richmond (Gribben), Mich	50,041
Total	29,898,351
Fifteen mines not reported by name	1,663,277
Total	31,561,628

No other country can equal this record of large producers. The table shows 10,272,780 long tons obtained from eight mines, and 16,248,270 long tons from 18 mines, all of which, with two exceptions, have their shipping operations limited by climatic conditions to about two hundred days annually.

TRANSPORTATION OF ORES.

A large proportion of the iron ore which is mined in the United States is transported long distances to points of consumption. The greater part of the iron ore mined in the Lake Superior region is sent by rail and boat to furnaces located in Michigan, Wisconsin, Illinois, Ohio, Pennsylvania, New York, New Jersey, Virginia, Kentucky, and Missouri. From Wyoming and New Mexico the ores are hauled by rail to the furnaces in Colorado, and the Lake Champlain magnetites are sent to Pennsylvania iron and steel works. From the ore deposits in the Lake Superior region that are located farthest from points of consumption, the ore is shipped by comparatively short hauls, from 15 to 90 miles, by rail to the upper Lake shipping ports, being forwarded thence by vessel to lower Lake receiving ports and there distributed by rail. The ores of the Vermilion Range are usually shipped from Two Harbors, in Minnesota; those of the Mesabi Range from Duluth and Two Harbors, in Minnesota, and Superior, in Wisconsin; those of the Gogebic Range from the ports of Ashland, in Wisconsin, and Escanaba, in Michigan; those of the Marquette Range from Marquette and Escanaba, both in the State of Michigan; and the ore from the Menominee Range is transported by Escanaba and Gladstone, Mich. The various railroads shipping the iron ore have extensive iron-ore docks at these shipping ports, and the following table, prepared by Mr. R. Angst, chief engineer of the Duluth and Iron Range Railroad, as revised to May 1, 1903, shows the number of these docks, their storage capacity, together with various details in regard to length and width of the docks, height from water to deck, angle of pockets, and length of spouts.

Record of ore docks on the Great Lakes, 1903.[a]

Railway.	Location.	Dock No.	Number of pockets.	Storage capacity.	Height, water to deck of dock.	Width of dock, outside to outside of partition posts.	Length of spouts.	Length of dock.	Angle of pockets.
				Tons.	*Feet. in.*	*Feet. in.*	*Feet. in.*	*Feet.*	° ′
Chicago and Northwestern Railway	Escanaba, Mich	1	184	24,104	48 6	37 0	21 0	1,104	39 30
Do	do	2	320	58,000	70 0	50 2	30 0	1,920	45 0
Do	do	3	226	30,284	52 8	37 0	27 0	1,356	45 0
Do	do	4	250	32,750	59 2	37 0	30 0	1,500	45 0
Do	do	5	232	43,152	53 3	37 0	21 8	1,392	40 0
Do	Ashland, Wis	1	234	36,036	54 0	46 8	27 0	1,404	39 30
Do	do	2	234	25,740	57 8	46 0	27 0	1,404	42 0
Duluth and Iron Range Railroad	Two Harbors, Minn	1	202	40,400	59 6	49 0	27 0	[b] 1,388	38 42
Do	do	2	208	41,600	57 6	49 0	27 0	1,280	38 42
Do	do	3	90	16,200	52 0	49 0	25 0	572	38 42
Do	do	4	168	26,960	62 0	49 0	29 0	1,112	38 42
Do	do	5	168	33,600	54 6	49 0	25 0	1,112	38 42
Duluth, Missabe and Northern Railway	Duluth, Minn	1	384	57,600	53 0	49 0	27 9	2,336	45 0
Do	do	2	384	69,120	57 6	49 0	27 9	2,336	45 0
Do	do	3	192	40,320	67 ½	59 0	27 9	1,152	45 0
Duluth, South Shore and Atlantic Railway	Marquette, Mich	1	270	27,000	45 0	40 0	20 4	1,700	39 0
Do	do	4	200	28,000	47 3	36 8	21 1	1,200	39 45
Lake Superior and Ishpeming Railway	do	1	200	36,000	54 0	50 0	24 7	1,232	38 40
Great Northern Railway	Superior, Wis	1	250	40,500	57 0	49 8	27 2	1,525	45 0
Do	do	2	350	87,500	73 0	62 8	32 4	2,100	45 0
Do	do	3	160	40,000	73 0	62 8	32 4	960	45 0
Minneapolis, St. Paul and Sault Sainte Marie Railway	Gladstone, Mich	1	120	15,000	47 0	37 0	21 8	768	40 0
Wisconsin Central Railway	Ashland, Wis	1	314	48,356	66 2	36 0	27 0	1,908	50 45
Chicago, Milwaukee and St. Paul Railway	Escanaba, Mich	1	240	50,400	66 6	52 0	120–27 0 120–29 0	1,500	45 0
Algoma Central and Hudson Bay Railway	Michipicoten, Ontario	1	12	....	43 4	25 0	22 6	311¾	44 0

[a] Revised to May 1, 1903.

[b] 312 feet single pockets, 1,076 feet double pockets.

In the year 1902 the total amount of iron ore sent forward from Two Harbors was 5,605,185 long tons, an increase over 1901 of 586,988 long tons. Duluth was a close second, with 5,598,408 long tons; Escanaba was third, with 5,413,704 long tons; Superior fourth, with 4,180,578 long tons; Ashland fifth, shipping 3,553,119 tons; Marquette sixth, with 2,595,010 tons; and Gladstone occupied seventh position, shipping 92,375 long tons.

The total shipments by lake during the year 1902, as reported by the Iron Trade Review, amounted to 27,038,379 long tons. The shipments of iron ore from the different Lake ports, together with the all-rail shipments, from 1895 to 1902, inclusive, are given in the following table. The shipments for the year 1902 are the maximum, and show an increase of 6,981,904 tons over the total for 1901:

Lake shipments of iron ore, 1895–1902.

Shipping port.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Two Harbors	2,118,156	1,813,992	2,651,465	2,693,245	3,973,733	4,007,294	5,018,197	5,605,185
Escanaba	2,860,172	2,321,931	2,302,121	2,803,513	3,720,218	3,436,734	4,022,668	5,413,704
Duluth	1,598,783	1,988,932	2,376,064	2,635,262	3,509,965	3,888,986	3,437,955	5,598,408
Ashland	2,350,219	1,566,236	2,067,637	2,391,088	2,703,447	2,633,687	2,886,252	3,553,119
Marquette	1,079,485	1,564,813	1,945,519	2,245,965	2,733,596	2,661,861	2,354,284	2,595,010
Superior	117,884	167,245	531,825	550,403	878,942	1,522,899	2,321,077	4,180,578
Gladstone	109,211	220,887	341,014	335,956	381,457	418,854	117,089	92,375
Total	10,233,910	9,644,036	12,215,645	13,655,432	17,901,358	18,570,315	20,157,522	27,038,379
All-rail shipments	195,127	290,792	253,993	369,241	350,446	489,078	431,715	531,952
Grand total	10,429,037	9,934,828	12,469,638	14,024,673	18,251,804	19,059,393	20,589,237	27,570,331

Although the greater portion of this iron ore was sent to the lower Lake receiving ports, a considerable quantity went directly to furnaces at Chicago and Milwaukee, and to blast furnaces in the State of Michigan. On the other hand, some iron ore was shipped to lower Lake ports from the Michipicoten Range, in Canada, the ore thus sent forward in 1902 amounting to 207,596 tons. The remainder of the production of this range for 1902, 383,580 tons, was shipped directly to Canadian furnaces at Hamilton and Midland. The quantity of iron ore received at lower Lake ports in the year 1902 amounted to 22,649,424 long tons. In the table given below it will be noted that the ports of Cleveland, Ashtabula, and Conneaut, Ohio, are closely grouped, the three having received in 1902, 13,970,424 long tons, or 62 per cent of the total Lake shipments.

Buffalo and Tonawanda, N. Y., rank next, with 2,256,798 long tons; followed by Erie, Pa., and Fairport, Lorain, Toledo, Huron, and Sandusky, Ohio.

Iron-ore receipts at Lake Erie ports, 1895–1902.

Port.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio ...	2,474,791	2,272,822	3,001,914	2,684,563	3,341,526	3,709,486	3,981,170	4,796,805
Cleveland, Ohio....	2,312,370	2,313,170	2,456,704	2,645,318	3,222,582	3,376,644	3,831,060	4,873,318
Conneaut, Ohio	244,967	327,623	495,327	1,404,169	2,320,696	2,556,631	3,181,019	4,300,301
Buffalo and Tonawanda, N. Y......	719,742	545,101	797,446	1,075,975	1,530,016	1,616,919	1,475,386	2,256,798
Erie, Pa	811,989	847,849	1,311,526	1,092,364	1,309,961	1,240,715	1,379,377	1,717,268
Fairport, Ohio......	914,617	941,446	1,008,340	912,879	1,241,013	1,085,554	1,181,776	1,538,744
Toledo, Ohio	260,730	301,794	416,438	414,012	792,348	645,147	798,298	1,037,571
Lorain, Ohio	214,219	191,445	355,188	536,086	1,112,946	1,090,235	721,662	1,442,417
Huron, Ohio	146,442	226,515	198,231	126,755	263,600	321,914	431,311	520,646
Sandusky, Ohio	12,361	58,667	79,792	136,200	87,499	154,542	33,017	165,556
Total.........	8,112,228	8,026,432	10,120,906	11,028,321	15,222,187	15,797,787	17,014,076	22,649,424

When the ore is received at lower Lake ports it is either loaded directly into iron-ore cars and shipped to the blast furnaces, or it is stocked in immense piles on the docks, and, although the quantity forwarded directly to furnaces has increased in late years, large quantities are on hand at the various Lake Erie docks at the close of the navigation season to be drawn upon during the winter when transportation on the Great Lakes is prevented by ice.

The stock of ore on hand at lower lake ports on December 1, 1902, is given as 7,074,254 long tons, an increase of 1,214,591 tons over 1901. Ashtabula and Cleveland had nearly one-half of the total stocks of ore on hand December 1, 1902.

The following table shows the stocks of iron ore on hand at lower Lake ports at the close of navigation December 1, 1902, and also at the opening of navigation May 1, 1903, from 1895 to 1902 and 1903, inclusive:

Stocks of iron ore at lower lake ports, 1895–1903.

Port.	At close of navigation, December 1—							
	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio ...	1,301,302	1,441,666	1,835,694	1,732,671	1,902,598	1,811,459	1,769,145	1,967,136
Cleveland, Ohio....	1,200,792	1,419,311	1,478,355	1,175,970	1,200,806	1,337,445	1,378,060	1,500,604
Fairport, Ohio	605,470	773,905	825,312	719,794	692,147	611,717	710,590	924,236
Erie, Pa	335,718	355,222	484,871	439,167	361,335	480,734	470,718	722,966
Lorain, Ohio.......	224,264	231,288	317,509	324,034	337,822	251,838	195,863	328,304
Conneaut, Ohio	292,460	275,800	360,895	288,101	468,808	630,514	604,106	673,679
Toledo, Ohio	113,132	115,959	194,644	146,568	186,422	242,375	254,196	310,023
Huron, Ohio	101,000	200,075	230,029	139,982	164,480	211,377	231,501	232,764
Buffalo, N. Y	207,199	82,267	111,660	121,620	192,681	232,100	198,100	319,367
Sandusky, Ohio....	34,375	59,491	84,786	48,500	23,184	95,111	47,384	95,175
Total.........	4,415,712	4,954,984	5,923,755	5,136,407	5,530,283	5,904,670	5,859,663	7,074,254

Stocks of iron ore at lower lake posts, 1895–1903—Continued.

Port.	At opening of navigation, May 1—							
	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio ...	636,254	926,865	1,031,441	855,691	678,789	1,046,974	924,742	1,073,967
Cleveland, Ohio....	506,693	979,705	853,776	472,946	386,291	806,119	624,865	829,347
Fairport, Ohio	346,847	480,984	501,592	289,417	282,298	306,706	472,325	555,709
Erie, Pa	137,826	153,261	236,485	95,626	97,894	225,412	223,972	426,744
Lorain, Ohio.......	118,820	180,605	158,797	168,646	126,212	140,562	96,992	190,311
Conneaut, Ohio....	112,406	207,034	69,047	6,115	8,649	69,755	152,891	125,400
Toledo, Ohio.......	10,593	66,337	71,726	22,915	52,616	138,457	111,511	126,331
Huron, Ohio	55,173	162,292	143,170	82,055	48,412	135,043	129,635	147,817
Buffalo, N. Y.......	16,644	50,477	53,081	72,757	35,195	118,007	73,861	60,241
Sandusky, Ohio....	8,442	48,937	48,800	7,086	4,300	63,148	37,400	56,500
Total.........	1,949,698	3,256,497	3,167,915	2,073,254	1,720,656	3,050,183	2,848,194	3,592,367

VALUE OF IRON ORES.

The total value at the mines of the 35,554,135 long tons of iron ore produced in the United States during the year ending December 31, 1902, was $65,412,950, an average of $1.84 per ton, and an increase of 13 cents per ton, or 7.6 per cent, over the 1901 figures, $1.71 per long ton.

This valuation does not correspond to the selling prices of ores, nor is it presented as cost. The query by the United States Geological Survey, submitted to each mine, reads as follows: "Give total value on cars or carts, at the mine, of the iron ore produced during the year, royalty, if any, included, but exclusive of hauling to points of shipment or consumption. The gross commercial value of the ore at the mine, not cost or profit, is asked for."

The selling prices of ores are influenced by their composition, distance from market, etc., and in making up this selling price, cost, royalty, sinking fund, administration, profit, and transportation charges are considered.

The basis for fixing the value of Lake Superior iron ores adopted by the Bessemer Ore Association for the year 1902 was as follows:

Old Range Bessemer ores, basis price $4.50 per long ton, free on board at lower Lake ports, guaranteed to contain 63 per cent of metallic iron, 0.045 per cent of phosphorus, and 10 per cent of moisture when dried at 212° F., equivalent to 56.7 per cent metallic iron in the ore in its natural condition.

Old Range non-Bessemer ores, basis price $3.60 per ton, free on board at lower Lake ports, guaranteed to contain 60 per cent of iron and 12 per cent of moisture when dried at 212° F., equivalent to 52.8 per cent iron in the natural condition.

Mesabi Range Bessemer ores, basis price $4 per ton free on board at lower Lake ports, the guarantee of iron, phosphorus, and moisture being the same as for the Old Range Bessemer.

The Mesabi non-Bessemer ores had a basis price of $3.20 per ton free on board at lower Lake ports, and were guaranteed to contain 60 per cent of iron and 12 per cent of moisture. These ores are divided into three classes, according to their physical structure, as determined by sieve tests. The second class basis is 10 cents and the third class 25 cents per ton below the prices placed on the first class.

When the ores contain iron or phosphorus above or below the fixed guaranty the price is adjusted accordingly. The basis price of the Old Range Bessemer ore in 1902 was 25 cents per ton above that for 1901.

The reports from the various States show the highest average value per ton in 1902 was in Colorado, $3.52 per ton; but some of this ore contained in addition to iron some manganese and a small amount of precious metals, and had an augmented value as a fluxing medium and because of the relative high cost of labor. The lowest average value reported was in Texas, 99 cents per ton, this value being due to the fact that only a limited amount of ore was mined, principally by convict labor.

The production of iron ore in the United States in 1902, by States, together with the total value at the mines, and the average value per ton in each State, are given in the following table:

Quantity and value of iron ore produced in 1902, by States.

State.	Quantity.	Total value at mines.	Average value per ton.
	Long tons.		
Minnesota	15,137,650	$23,989,227	$1.58
Michigan	11,135,215	26,695,860	2.40
Alabama	3,574,474	3,936,812	1.10
Virginia and West Virginia	987,958	1,667,456	1.69
Tennessee	874,542	1,123,527	1.28
Pennsylvania	822,932	1,225,453	1.49
Wisconsin	783,996	1,800,864	2.30
New York	555,321	1,362,987	2.45
New Jersey	441,879	1,228,664	2.78
Georgia and North Carolina	364,890	505,488	1.39
Montana, New Mexico, Utah, and Wyoming	362,634	475,316	1.31
Colorado	293,297	1,032,053	3.52
Kentucky	71,006	86,169	1.21
Missouri	66,308	106,379	1.60
Connecticut, Massachusetts, and Vermont	29,093	81,374	2.80
Maryland	24,367	46,911	1.93
Ohio	22,657	41,976	1.85
Texas	6,516	6,434	.99
Total	35,554,135	65,412,950	1.84

STOCKS OF ORE.

In the States included in the Lake Superior iron-ore region the bulk of the ore mined is transported by water from shipping ports on Lakes Superior and Michigan to the receiving docks on Lake Erie. As traffic on the Great Lakes is suspended during the winter months, the ore which is mined during the time that navigation is closed must be stocked. For this reason, at the end of each calendar year large stocks of ore are reported by the mines in the States of Michigan, Minnesota, and Wisconsin. On December 31, 1902, the total stock for these three States was 3,578,809 tons, or about 93 per cent of the aggregate stock of iron ores for the United States, which amounted to 3,834,717 long tons. This total is 405,106 tons less than the quantity, 4,239,823 long tons, reported on hand December 31, 1901.

The stock of ore reported on hand at all mines represents 10.8 per cent of the production of iron ore in the United States for the year 1902.

The following table illustrates, by States, the stocks of ore on hand at the mines December 31, 1902:

Stocks of iron ore on hand at mines December 31, 1902.

State.	Quantity.	State.	Quantity.
	Long tons.		*Long tons.*
Minnesota	1,114,197	Colorado	
Michigan	2,286,195	Georgia and North Carolina	14,235
Alabama	58,969	Kentucky	
Virginia and West Virginia	15,126	Missouri	3,124
Tennessee	21,397	Connecticut, Massachusetts, and Vermont	2,026
Wisconsin	178,417	Maryland	183
Pennsylvania	10,211	Ohio	8,500
New York	57,856	Texas	8,000
New Jersey	36,121	Total	3,834,717
Montana, Nevada, New Mexico, Utah, and Wyoming	20,160		

IMPORTS.

Through the courtesy of the Bureau of Statistics of the Department of Commerce and Labor data have been secured showing the imports and exports of iron ore into and from the United States during the calendar year 1902.

From the table presented it will be seen that 1,165,470 long tons of iron ore were imported, which were valued at $2,583,077, an average value of $2.22 per ton. This is an increase of 198,520 tons, or 21 per cent over the quantity imported in 1901, 966,950 tons. The values of the iron ore, as given in the table, are those at the point of shipment, and do not include transport or duty charges. The high value given in some cases is due to the presence of some other chemical constituent than iron ore.

The following tables show the quantity and value of iron ores imported into the United States and the countries from which the ores were shipped from 1896 to 1902, inclusive, and also the imports by the domestic ports at which they were received.

Quantity and value of iron ores imported into the United States, 1896–1902, by countries

Imported from—	1896.		1897.		1898.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Cuba	380,551	$463,570	383,820	$454,709	165,623	$187,721
Spain	121,132	230,879	66,193	167,878	13,335	34,932
French Africa	79,661	163,517	3,504	7,785		
Italy	29,882	85,661				
Greece	33,750	34,520			7,200	26,581
Newfoundland and Labrador	20,800	20,965	29,250	29,431		
United Kingdom	8,528	23,155	358	4,091	683	5,385
Colombia	3,150	5,800				
Portugal	1,101	2,327	3,612	5,831		
Other countries	4,251	6,523	3,233	9,187	367	929
Total	682,806	1,036,917	489,970	678,912	187,208	255,548

Imported from—	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Cuba	360,813	$449,616	431,265	$537,496	526,583	$705,086	696,375	$1,576,619
Spain	145,206	339,058	253,694	494,668	180,810	399,364	153,527	338,259
French Africa	22,233	51,746	20,000	23,536			19,167	35,707
Italy	43,363	122,786	18,951	50,945				
Greece	16,765	27,556	23,350	31,685	12,950	42,896		
Newfoundland and Labrador	77,970	77,970	140,535	142,685	[a] 79,360	79,360	81,920	81,918
United Kingdom	172	994	397	3,274	490	15,939	1,269	17,882
Colombia			3,000	4,854				
British Columbia					2,875	4,313	5,661	9,312
Germany			145	1,339	400	3,415	361	3,478
Netherlands			181	854				
Quebec, Ontario, etc			5,588	10,139	163,383	408,431	203,824	509,711
Venezuela			700	1,621				
Sweden and Norway			25	100				
Belgium							500	4,850
France							2,866	5,341
Other countries	7,560	13,121			[b] 99	469		
Total	674,082	1,082,847	897,831	1,303,196	966,950	1,659,273	1,165,470	2,583,077

[a] Newfoundland only.
[b] Of this amount 87 tons, valued at $442, came from Mexico, and 12 tons, valued at $27, from the French West Indies.

Cuba is the most important contributor to the supply of iron ores of the United States, over one-half the total imports, 696,375 tons, having come from that island. The next largest supply, 203,824 tons, came from Canada, the greater portion being obtained from the Michipicoten Range, in the Province of Ontario, which was forwarded to the United States by way of the Great Lakes. There were 153,527 tons imported from Spain and 81,920 tons from Newfoundland, and Algeria (French Africa) supplied 19,167 tons. All of the other countries in the table were unimportant contributors

About one-half of the ore imported was received at the port of Baltimore, Md., and more than one-fourth at Philadelphia, Pa., the total for the two ports being 939,559 tons, or 81 per cent of the total, the same proportion as in 1901.

The figures by customs districts for the years 1898 to 1902, inclusive, are as follows:

Imports of iron ore into the United States, 1898–1902, by customs districts.

Port.	1898.		1899.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Baltimore, Md	144,213	$178,905	333,258	$516,888
Delaware			5,757	7,375
Philadelphia, Pa	42,861	74,226	330,594	549,130
New York, N. Y	119	1,815	120	703
Boston, Mass			75	175
Newport News, Va	15	602		
Norfolk and Portsmouth, Va				
Total Atlantic ports	187,208	255,548	669,804	1,074,271
Cape Vincent, N. Y			195	489
Buffalo Creek, N. Y			20	52
Cuyahoga, Ohio				
Champlain, N. Y			641	1,555
Detroit, Mich			304	168
Genesee, N. Y				
Oswegatchie, N. Y			125	260
Vermont			1,039	2,045
Erie				
Miami				
Total lake ports			2,324	4,569
Saluria, Tex. (total Gulf ports)			2	17
Puget Sound, Wash			1,912	3,746
San Francisco, Cal				
San Diego, Cal				
Los Angeles, Cal				
Total Pacific ports			1,912	3,746
Pittsburg, Pa			40	244
Evansville, Ind				
Total interior ports			40	244
Total imports	187,208	255,548	674,082	1,082,847

Imports of iron ore into the United States, 1898–1902, by customs districts—Continued.

Port.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Baltimore, Md	448,660	$629,507	484,035	$733,071	600,711	$1,401,326
Delaware	3,331	5,305				
Philadelphia, Pa	414,064	589,749	298,255	459,698	338,848	597,895
New York, N. Y	25,878	63,540	15,865	45,863	14,546	39,800
Boston, Mass	15	71			50	142
Newport News, Va					197	8,130
Norfolk and Portsmouth, Va.			1,850	1,850		
Total Atlantic ports	891,948	1,288,172	800,005	1,240,482	954,352	2,047,293
Cape Vincent, N. Y						
Buffalo Creek, N. Y	1,023	586	53,327	146,596	53,286	133,377
Cuyahoga, Ohio	2,456	6,141	107,810	256,936	123,476	308,951
Champlain, N. Y	236	520	63	149	34	38
Detroit, Mich	52	78	32	49	73	112
Genesee, N. Y	211	442				
Oswegatchie, N. Y	1,131	2,064	2,083	4,485	139	209
Vermont	257	454	48	186	18	72
Erie					22,821	57,024
Miami					3,962	9,905
Total lake ports	5,366	10,285	163,363	408,401	203,809	509,688
Saluria, Tex. (total Gulf ports)						
Puget Sound, Wash	424	3,781	2,875	4,313	5,661	9,312
San Francisco, Cal			550	4,875	1,241	12,581
San Diego, Cal			87	442		
Los Angeles, Cal					357	3,461
Total Pacific ports	424	3,781	3,512	9,630	7,259	25,354
Pittsburg, Pa	93	958	50	730	50	742
Evansville, Ind			20	30		
Total interior ports	93	958	70	760	50	742
Total imports	897,831	1,303,196	966,950	1,659,273	1,165,470	2,583,077

EXPORTS.

During the year 1902, 88,445 long tons of iron ore, valued at $294,168, were exported, nearly all of which were sent to Canadian blast furnaces to be used in the ore mixtures fed to blast furnaces.

The following table gives the ports from which the various quantities were exported during the years 1899, 1900, 1901, and 1902:

Exports of iron ore from the United States, 1899–1902.

Customs district.	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
New York							204	$2,227
Niagara	17,857	$30,000					802	1,708
Superior	11,389	20,012	11,004	$35,213	8,982	$19,754	19,157	63,772
Duluth	10,534	22,465	38,485	113,962	34,966	83,744	49,233	152,454
Paso del Norte	703	2,930						
Saluria	172	823						
Detroit	7	42	34	120	40	257	115	408
Huron	3	15						
Champlain					9,219	24,258	18,876	73,348
Newport News			8	128				
Buffalo Creek			120	300	9,849	31,061	58	251
Memphremagog			1,809	5,033	1,543	4,191		
Vermont					104	200		
Total	40,665	76,287	51,460	154,756	64,703	163,465	88,445	294,168

CUBA.

Cuban iron ores in the year 1902 were supplied by three producing companies from mines located in the province of Santiago de Cuba, in the southeastern portion of the island, close to the Caribbean Sea. The properties are owned and operated by United States companies, and all of the iron ore produced during the year 1902 was brought to this country. The three producing companies in 1902 were the Juragua Iron Company (Limited), which commenced shipments in the year 1884; the Spanish-American Company, which first shipped ore in 1895, and the Cuban Steel Ore Company, which commenced operations in 1901. The total quantity shipped by the three companies in 1902, 699,734 long tons, was the largest quantity yet forwarded in any one year. The Cuban Steel Ore Company went out of business at the end of the year 1902, and its mines are now closed.

In 1892 the Sigua Iron Company commenced operations, and shipped a few cargoes in that and the following year, after which mining ceased.

The following table, prepared by Mr. Josiah Monroe, shows the annual shipments from the various mines from the time they began operations to the close of the year 1902:

Shipments of iron ore from mines in the province of Santiago de Cuba.

Year.	Juragua Iron Company, Ltd.	Sigua Iron Company.	Spanish-American Iron Company.	Cuban Steel Ore Company.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1884	25,295				25,295
1885	80,716				80,716
1886	112,074				112,074
1887	94,240				94,240
1888	206,061				206,061
1889	260,291				260,291
1890	363,842				363,842
1891	264,262				264,262
1892	335,236	6,418			341,654
1893	337,155	14,020			351,175
1894	156,826				156,826
1895	307,503		74,991		382,494
1896	298,885		114,110		412,995
1897	[a]248,256		[b]206,029		454,285
1898	83,696		84,643		168,339
1899	161,783		215,406		377,189
1900	154,871		292,001		446,872
1901	199,764		[c]334,833	17,651	552,248
1902	221,039		455,105	23,590	699,734
Total	3,911,795	20,438	1,777,118	41,241	5,750,592

[a] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,537 tons were sent to foreign ports.
[c] Of this quantity, 12,691 tons were sent to foreign ports.

Total....... 70,160 tons sent to foreign ports.

STATISTICS OF THE AMERICAN IRON TRADE FOR 1902.

By James M. Swank,
General Manager of the American Iron and Steel Association.

BRIEF REVIEW OF THE IRON TRADE IN 1902.

The prosperity of the iron and steel industries of the United States, heretofore referred to, continued through the year 1902 and still continues in May, 1903. There have been, however, two serious checks to this prosperity, but happily these no longer exist, and the outlook for the continued prosperity of the iron trade of this country during the remainder of the present year is all that could be desired. The first of these checks was the anthracite coal strike, which began on May 12, 1902, and lasted until October 23 of the same year, when there was a general resumption of work at the mines. During the interval of twenty-three weeks the scarcity of anthracite coal restricted the operations of Eastern iron and steel manufacturers, but for several months there has been an abundance of anthracite coal for all purposes. The other check to the prosperity of the iron trade was caused by an aggravation in the last six months of 1902 and in the early months of 1903 of a previously existing trouble in the form of inadequate railway transportation. This hindrance to the prompt delivery of raw materials and the prompt removal of finished products has now been practically overcome. Owing to the influences already referred to and to the extraordinary demand for iron and steel, prices advanced somewhat in 1902, but most advances were checked early in 1903. For these combined reasons the imports of iron and steel greatly increased in 1902, and the exports decreased. At the present time the tendency is strongly toward decreased importations in 1903.

IMPORTS OF IRON AND STEEL.

The following table, compiled from the reports of the Bureau of Statistics of the Department of Commerce and Labor, gives the quantities of leading articles of iron and steel and of iron ore and manganese ore imported into the United States in the four calendar years 1899, 1900, 1901, and 1902.

Imports of iron and steel, 1899–1902.

Article.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Pig iron, spiegeleisen, and ferromanganese	40,393	52,565	62,930	625,383
Scrap iron and scrap steel	10,925	34,431	20,130	109,510
Bar iron	19,791	19,685	20,792	28,844
Iron and steel rails	2,134	1,448	1,905	63,522
Hoop, band, or scroll iron and steel	663	165	2,974	3,362
Steel ingots, billets, structural steel, etc	12,601	12,709	8,163	289,318
Sheet, plate, and taggers' iron and steel	7,043	5,143	5,621	7,156
Tin plates	58,915	60,386	77,395	60,115
Wire rods, iron and steel	17,964	21,092	16,804	21,382
Wire, and articles made from wire	2,363	1,848	4,129	3,468
Anvils	240	223	251	203
Chains	188	260	198	576
Total	173,220	209,955	221,292	1,212,839
Iron ore	674,082	897,831	966,950	1,165,470
Manganese ore	188,349	256,252	165,722	235,576

The total imports of iron and steel, including machinery, cutlery, firearms, etc., for which weights are not obtainable, amounted in foreign value to $41,468,826 in the calendar year 1902, against $20,395,015 in 1901, $20,443,911 in 1900, and $15,800,579 in 1899, an increase in 1902 as compared with 1901 of $21,073,811, or over 100 per cent.

Of the pig iron imported in recent years a large part was spiegeleisen and ferromanganese, which pay duty as pig iron, but in 1902 there was a great increase in the importations of foundry and Bessemer pig iron.

EXPORTS OF IRON AND STEEL.

The following table, also compiled from the reports of the Bureau of Statistics of the Department of Commerce and Labor, gives the exports of leading articles of iron and steel and of iron ore and locomotives in the calendar years 1899, 1900, 1901, and 1902.

Exports of iron and steel, 1899–1902.

Article.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Pig iron	228,678	286,687	81,211	27,487
Scrap and old, for remanufacture	76,663	49,328	14,199	9,411
Bar iron	10,898	13,299	17,708	22,249
Band, hoop, or scroll iron and steel	2,869	2,976	1,561	1,674
Bars or rods of steel not wire rods	30,429	81,366	27,397	9,300
Steel wire rods	16,992	10,652	8,165	24,613
Billets, ingots, and blooms	25,487	107,385	28,614	2,409
Cut nails and spikes	9,974	11,163	9,302	7,170
Wire nails	33,517	27,404	18,773	26,580

Exports of iron and steel, 1899–1902—Continued.

Article.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
All other nails, including tacks	2,076	1,812	1,896	2,244
Iron plates and sheets	6,196	9,331	6,909	3,434
Steel plates and sheets	50,635	45,534	23,923	14,866
Iron rails	6,442	5,374	901	211
Steel rails	271,272	356,245	318,055	67,455
Structural iron and steel	54,244	67,714	51,005	53,859
Wire	116,317	78,014	88,238	97,843
Total	942,689	1,154,284	700,857	370,805
Iron ore	40,665	51,460	64,703	88,445
Locomotives ... number	484	436	448	368

The total exports of iron and steel, which include locomotives, car wheels, machinery, castings, hardware, saws and tools, sewing machines, stoves, printing presses, boilers, etc., amounted in the calendar year 1902 to $97,892,036, against $102,534,575 in 1901, $129,633,480 in 1900, $105,690,047 in 1899, $82,771,550 in 1898, and $62,737,250 in 1897. The exports of iron and steel more than doubled in value from 1897 to 1900, but there was a shrinkage in 1901 as compared with 1900 of $27,098,905, or over 20 per cent. In 1902 there was a further shrinkage, but it was not so pronounced as in 1901, owing to the advance in prices.

EXPORTS OF AGRICULTURAL IMPLEMENTS.

The exports of agricultural implements, which are not included above, amounted in the calendar year 1902 to $17,981,597, against $16,714,308 in 1901, $15,979,909 in 1900, $13,594,524 in 1899, $9,073,384 in 1898, and $5,302,807 in 1897.

IMPORTS OF IRON ORE.

The following table, taken from the reports of the Bureau of Statistics of the Department of Commerce and Labor, gives the quantities and values of iron ore imported into the United States during the calendar years 1900, 1901, and 1902, by customs districts.

Imports of iron ore, by customs districts, 1900–1902.

District.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Baltimore	448,660	$629,507	484,035	$733,071	600,711	$1,401,326
New York	25,878	63,540	15,865	45,863	14,546	39,800
Philadelphia	414,064	589,749	298,255	459,698	338,848	597,895
Puget Sound	....	....	2,875	4,313	5,661	9,312
Vermont	257	454	48	186	18	72
All other	8,972	19,946	165,872	416,142	205,686	534,672
Total	897,831	1,303,196	966,950	1,659,273	1,165,470	2,583,077

The imports of iron ore in 1902 were almost 200,000 tons larger than in 1901, the increase being wholly due to increased imports from Cuba and Canada. Mr. Josiah Monroe, secretary and treasurer of the Juragua Iron Company, Limited, has kindly furnished the following detailed report of the shipments to the United States of Cuban iron ore in 1902, all the producing mines being located in the province of Santiago de Cuba.

The following companies shipped iron ore to the United States in 1902: The Juragua Iron Company, Limited, 221,039 long tons; the Spanish-American Iron Company, 455,105 tons; the Cuban Steel Ore Company, 23,590 tons; total shipments, 699,734 tons. The Cuban Steel Ore Company went out of business at the end of the year and its mines are closed. No iron ore was shipped from Cuba in 1902 to any other country than the United States.

Mr. Monroe also furnishes the following statistics of the total shipments of iron ore from Cuba from the beginning of shipments in 1884 to the close of 1902: By the Juragua Iron Company, Limited, 3,911,795 long tons; by the Sigua Iron Company, 20,438 tons; by the Spanish-American Iron Company, 1,777,118 tons, and by the Cuban Steel Ore Company, 41,241 tons; total, 5,750,592 tons.

LAKE SUPERIOR IRON-ORE SHIPMENTS.

The Iron Trade Review gives full details of the shipments of iron ore from the Lake Superior region in 1902 and in preceding years. Its figures show that the total shipments by water and by all-rail routes in 1902 amounted to 27,571,121 long tons, against 20,589,237 tons in 1901, an increase of 6,981,884 tons, or 33.9 per cent. The shipments in 1902 from the Helen mine, on the Canadian side, 298,420 tons, are not included. If added, we find that 27,776,619 tons of Lake Superior iron ore were shipped last year.

The Review says that 133 mines on the five Lake Superior ranges shipped iron ore last year, against 104 mines in 1901. The distribution is as follows: Marquette, 19; Menominee, 34; Gogebic, 27; Vermilion, 5; Mesabi, 48. The great gain was on the Mesabi range, where 17 new active mines appear. Strictly speaking, says the Review, more than 133 mines shipped iron ore last year, as the Cleveland-Cliffs Iron Company's mines on the Marquette range are considered as though they were one mine. There are other similar cases.

The shipments from the United States Steel Corporation's mines in 1902 amounted to 16,136,787 tons, or 58.5 per cent of the whole. This is apart from one-half of the 530,291 tons shipped from the Pewabic mine, in which the Carnegie Steel Company has a one-half interest, and also omitting the 28,106 tons shipped from the Iron Ridge mine in Wisconsin, belonging to the Illinois Steel Company. This mine is remote from the Lake Superior ranges and has never been included in Lake Superior statistics.

In the following tables the shipments of Lake Superior iron ore in the last four years are given by ranges and by ports and by all-rail routes. Shipments to local furnaces are included.

Shipments of Lake Superior iron ore by ranges, 1899–1902.

Range.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Marquette range	3,757,010	3,457,522	3,254,680	3,853,010
Menominee range	3,301,052	3,261,221	3,605,449	4,627,524
Gogebic range	2,795,856	2,875,295	2,938,155	3,663,484
Vermilion range	1,771,502	1,655,820	1,786,063	2,084,263
Mesabi range	6,626,384	7,809,535	9,004,890	13,342,840
Total	18,251,804	19,059,393	20,589,237	27,571,121

The Marquette range is wholly in Michigan, the Menominee and Gogebic ranges are partly in Michigan and partly in Wisconsin, and the Vermilion and Mesabi ranges are in Minnesota.

Shipments of Lake Superior iron ore by lake ports and all-rail routes, 1899–1902.

Port.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Escanaba	3,720,218	3,436,734	4,022,668	5,413,704
Marquette	2,733,596	2,661,861	2,354,284	2,595,010
Ashland	2,703,447	2,633,687	2,886,252	3,553,919
Two Harbors	3,973,733	4,007,294	5,018,197	5,605,185
Gladstone	381,457	418,854	117,089	92,375
Superior	878,942	1,522,899	2,321,077	4,180,568
Duluth	3,509,965	3,888,986	3,437,955	5,598,408
All rail	350,446	489,078	431,715	531,952
Total	18,251,804	19,059,393	20,589,237	27,571,121

RECEIPTS OF IRON ORE AT LAKE ERIE PORTS.

The Iron Trade Review annually publishes full statistics of the receipts of Lake Superior iron ore at Cleveland, Ashtabula, Buffalo, Conneaut, and other ports on Lake Erie, the principal receipts being at Ashtabula, Cleveland, and Conneaut; also the quantity left on the docks at the close of navigation. From these statistics the following statement for the years 1889 to 1902 is compiled:

Receipts of Lake Superior iron ore at Lake Erie ports, 1889–1902.

Year.	Receipts.	On dock.	Year.	Receipts.	On dock.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1889	5,856,344	2,607,106	1896	8,026,432	4,954,984
1890	6,874,664	3,893,487	1897	10,120,906	5,923,755
1891	4,939,684	3,508,489	1898	11,028,321	5,136,407
1892	6,660,734	4,149,451	1899	15,222,187	5,530,283
1893	5,333,061	4,070,710	1900	15,797,787	5,904,670
1894	6,350,825	4,834,247	1901	17,014,076	5,859,663
1895	8,112,228	4,415,712	1902	22,649,424	7,074,254

The receipts of Lake Superior iron ore at the ports of Buffalo (including Tonawanda), Erie, and Conneaut in the last seven years are given by the Review, as follows:

Receipts of Lake Superior iron ore at Buffalo, Erie, and Conneaut, 1896–1902.

Port.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Buffalo	545,101	797,446	1,075,975	1,530,016	1,616,919	1,475,386	2,256,798
Erie	847,849	1,311,526	1,092,364	1,309,961	1,240,715	1,379,377	1,717,268
Conneaut	327,623	495,327	1,404,169	2,320,696	2,556,631	3,181,019	4,300,301
Total	1,720,573	2,604,299	3,572,508	5,160,673	5,414,265	6,035,782	8,274,367

LARGEST SHIPPERS OF LAKE SUPERIOR IRON ORE.

The Lake Superior mines which shipped the largest quantities of iron ore in 1902 were the following: The Norrie, in the Gogebic range, 1,080,032 tons; Tilden, in the Gogebic range, 468,672 tons; Aurora, in the Gogebic range, 402,981 tons; Chandler, in the Vermilion range, 645,786 tons; Savoy, in the Vermilion range, 322,241 tons; Minnesota, in the Vermilion range, 275,168 tons; Pioneer, in the Vermilion range, 673,863 tons; Aragon, in the Menominee range, 646,203 tons; Chapin, in the Menominee range, 956,812 tons; Pewabic, in the Menominee range, 530,291 tons; Lake Angeline, in the Marquette range, 304,125 tons; Queen, in the Marquette range, 418,044 tons; Lake Superior, in the Marquette range, 832,796 tons; Cleveland-Cliffs, in the Marquette range, 1,104,864 tons; Mountain Iron, in the Mesabi range, 1,421,456 tons; Fayal, in the Mesabi range, 1,919,172 tons; Mahoning, in the Mesabi range, 1,038,645 tons; Adams, in the Mesabi range, 1,242,923 tons; and Stevenson, in the same range, 1,434,681 tons.

IMPORTS AND EXPORTS OF COAL AND COKE.

The exports of anthracite coal from this country in the calendar year 1899 amounted to 1,707,796 long tons, in 1900 to 1,654,610 tons, in 1901 to 1,993,307 tons, and in 1902 to 907,977 tons. The exports of bituminous coal in 1899 amounted to 4,044,354 long tons, in 1900 to 6,262,909 tons, in 1901 to 5,390,086 tons, and in 1902 to 5,218,969 tons. The imports of anthracite coal into this country in 1899 amounted to 61 tons, in 1900 to 118 tons, in 1901 to 286 tons, and in 1902 to 73,006 tons. The imports of bituminous coal in 1899 amounted to 1,400,461 tons, in 1900 to 1,909,258 tons, in 1901 to 1,919,962 tons, and in 1902 to 2,478,375 tons. The exports of coke in 1899 amounted to 280,196 tons, in 1900 to 376,999 tons, in 1901 to 384,330 tons, and in 1902 to 392,491 tons. These figures are obtained from the reports of the Bureau of Statistics of the Treasury Department.

SHIPMENTS OF COAL AND COKE.

Mr. H. P. Snyder, the editor of the Connellsville Courier, furnishes the following information with regard to the shipments of Connellsville coke: The total shipments of Connellsville coke in 1902, including the shipments from the Lower Connellsville region, amounted to 14,138,740 short tons of 2,000 pounds, against 12,609,949 tons in 1901, 10,166,234 tons in 1900, and 10,129,764 tons in 1899. Mr. Snyder says that the shipments from the Connellsville region proper in 1902 were practically the same as in the previous year. Of the shipments for 1902 over 2,000,000 tons came from the Lower Connellsville region. Coke shipments must not be confounded with coke production. The increased shipments of coke from the entire Connellsville region in 1902 over 1901 amounted to 1,528,791 tons. The shipments in 1902 would have been still further increased if transportation facilities had been equal to the demand for coke. Over 100,000 tons of coke were in stock piles at the end of the year awaiting shipment.

Concerning the prices paid for Connellsville coke during 1902 the Courier says that a careful estimate of the average price places it at $2.37 per short ton, at which rate the gross revenue of the region in that year was $33,508,714. The Courier adds:

> The price of coke during the greater part of the year was almost anything the operators chose to ask for it. Their contracts, of course, were filled at the contract prices. It would be impossible to give the monthly range of prices. Quotations were practically withdrawn the latter part of the year. Orders went begging. Furnace men with empty coke bins offered as much as $15 per ton for a few cars of quick-delivery coke. During the month of January there were actual sales as low as $1.75 per ton, but these were on contract. The transient price was in the neighborhood of $2.50. During February and March it rose to $3 and during April and May it went back to $2.50. After that time, as stated above, it commanded almost any price. During the last quarter of the year there were a number of sales at $7.50 to $11 per ton.

Very little coke has been sold in 1903 below $4 a ton, and none was sold below this price in the closing months of 1902. During the second half of this year the price is likely to be $4.

The shipments of anthracite coal from the Pennsylvania mines in 1902 amounted to 31,200,890 gross tons, against 53,568,601 tons in 1901 and 45,107,484 tons in 1900. These figures are furnished by W. W. Ruley, the anthracite coal statistician.

The shipments of Pocahontas Flat Top coke in 1902, the figures for which have been furnished by Mr. A. J. Hemphill, secretary of the Norfolk and Western Railway Company, amounted to 1,191,436 net tons, against 1,279,949 tons in 1901, 1,341,444 tons in 1900, and 1,317,246 tons in 1899.

The shipments of Cumberland coal from the mines of western Maryland and West Virginia in 1902 amounted to 6,288,867 gross tons, against 6,139,329 tons in 1901, 5,171,916 tons in 1900, and 6,131,461 tons in 1899.

AVERAGE MONTHLY PRICES OF IRON AND STEEL AT PHILADELPHIA AND PITTSBURG IN 1901 AND 1902.

In the following table are given the average monthly prices of various leading articles of iron and steel at Philadelphia and Pittsburg in 1901 and 1902. The prices named are per ton of 2,240 pounds, except for bar iron, which is quoted by the 100 pounds. At Philadelphia prices of bar iron are quoted from store, but at Pittsburg from mill. Prices of No. 1 anthracite foundry pig iron at Philadelphia are preserved for comparison with former years, this grade of pig iron having been the standard grade from 1842 until the present time.

Monthly prices of iron and steel at Philadelphia and Pittsburg in 1901 and 1902.

Month.	Old iron T rails at Philadelphia.	No 1 foundry pig iron at Philadelphia.	Gray forge pig iron—		Bessemer pig iron at Pittsburg.	Steel rails at mills in Pennsylvania.	Steel billets at mills at Pittsburg.	Best refined bar iron—	
			At Philadelphia.	At Pittsburg.				At Philadelphia.	At Pittsburg.
1901.	*Per long ton.*	*Per long ton.*	*Per long ton.*	*Per long ton.*	*Per long ton.*	*Per long ton.*	*Per long ton.*	*Per 100 pounds.*	*Per 100 pounds.*
January	$18.00	$16.05	$14.50	$13.25	$13.43	$26.00	$19.75	$1.75	$1.75
February	18.25	16.00	14.19	13.56	14.60	26.00	20.31	1.75	1.82
March	18.37	16.00	14.00	14.62	16.87	26.00	22.87	1.75	1.90
April	19.50	16.00	14.37	14.56	16.94	26.00	24.00	1.85	1.90
May	19.50	16.00	14.30	14.62	16.70	28.00	24.00	1.85	1.90
June	19.12	16.00	14.06	14.15	16.00	28.00	24.37	1.85	1.86
July	19.00	15.87	13.87	14.00	16.00	28.00	24.00	1.85	1.75
August	19.00	15.50	13.75	13.87	16.00	28.00	24.20	1.85	1.75
September	18.50	15.50	13.75	13.81	16.00	28.00	24.87	1.85	1.75
October	19.90	15.50	13.75	14.10	16.00	28.00	26.70	1.90	1.75
November	21.25	15.75	13.94	14.69	16.31	28.00	27.00	1.90	1.75
December	21.50	16.25	14.44	15.12	16.37	28.00	27.50	1.90	1.75
1902.									
January	21.30	17.55	15.65	16.00	16.70	28.00	27.60	1.90	1.87
February	21.25	18.37	16.62	16.37	16.94	28.00	29.37	2.00	1.90
March	23.00	19.44	17.75	17.44	17.37	28.00	31.25	2.10	1.90
April	25.25	20.37	18.19	18.56	18.75	28.00	31.50	2.10	1.95
May	25.00	21.00	18.35	19.75	20.75	28.00	32.20	2.15	2.02
June	24.50	22.87	19.44	20.06	21.56	28.00	32.37	2.20	2.10
July	24.70	24.20	20.80	21.00	21.60	28.00	31.75	2.20	1.86
August	24.00	24.50	21.00	20.69	22.19	28.00	31.75	2.20	1.95
September	24.25	24.50	20.50	20.81	22.50	28.00	31.00	2.20	2.00
October	24.80	24.45	20.25	21.60	23.00	28.00	30.40	2.20	1.92
November	24.25	24.87	20.94	21.06	23.81	28.00	28.50	2.20	1.85
December	23.62	24.20	20.90	20.55	22.92	28.00	29.20	2.20	2.00

AVERAGE MONTHLY PRICES OF CUT NAILS AT PHILADELPHIA.

The following table gives the average monthly base prices of cut nails, per keg of 100 pounds, from store at Philadelphia, since 1895, as reported by the Duncannon Iron Company:

Average monthly prices of cut nails at Philadelphia, 1895–1902.

Month.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
January	$1.00	$2.30	$1.60	$1.35	$1.40	$2.80	$2.25	$2.30
February	1.00	2.30	1.55	1.35	1.65	2.80	2.27	2.20
March	.95	2.45	1.55	1.30	1.75	2.80	2.27	2.25
April	.90	2.45	1.50	1.30	1.95	2.62	2.30	2.30
May	1.00	2.45	1.45	1.30	1.95	2.45	2.30	2.30
June	1.50	2.53	1.45	1.30	2.20	2.42	2.30	2.30
July	1.50	2.53	1.40	1.30	2.30	2.30	2.30	2.30
August	1.75	2.53	1.40	1.30	2.35	2.30	2.30	2.30
September	2.20	2.53	1.45	1.30	2.60	2.25	2.35	2.30
October	2.30	2.53	1.45	1.30	2.75	2.28	2.30	2.30
November	2.30	2.00	1.40	1.30	2.80	2.30	2.30	2.30
December	2.30	[a] 1.70	1.40	1.30	2.80	2.25	2.30	2.30
Average	1.56	2.36	1.47	1.31	2.21	2.46	2.29	2.29

[a] Early in 1893 the base price and schedule of extras of cut nails were changed to correspond with the wire-nail schedule, and in December, 1896, the schedule of extras was again changed to correspond with the new wire-nail schedule.

AVERAGE MONTHLY PRICES OF WIRE NAILS AT CHICAGO.

The following table, compiled from quotations in the Iron Age, gives the average monthly base prices of standard sizes of wire nails, per keg of 100 pounds, in carload lots, free on board at Chicago, from 1895 to 1902:

Average monthly prices of wire nails at Chicago, 1895–1902.

Month.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
January	$0.95	$2.42	$1.50	$1.55	$1.59	$3.53	$2.35	$2.16
February	.95	2.42	1.45	1.57	1.73	3.53	2.45	2.20
March	1.00	2.57	1.50	1.55	2.09	3.53	2.45	2.20
April	.95	2.55	1.45	1.47	2.25	3.28	2.45	2.20
May	1.10	2.70	1.42	1.45	2.35	2.53	2.45	2.20
June	1.50	2.70	1.42	1.43	2.60	2.48	2.45	2.20
July	1.95	2.70	1.35	1.36	2.70	2.43	2.45	2.20
August	2.20	2.70	1.37	1.36	2.80	2.43	2.45	2.20
September	2.40	2.70	1.50	1.45	3.10	2.35	2.45	2.15
October	2.40	2.70	1.52	1.47	3.20	2.35	2.42	2.05
November	2.42	2.70	1.50	1.40	3.28	2.35	2.35	2.00
December	2.42	[a] 1.60	1.50	1.37	3.53	2.35	2.25	2.00
Average	1.69	2.54	1.46	1.45	2.60	2.76	2.41	2.15

[a] A new nail card was adopted in December, 1896. The average price given for wire nails in December, 1896, on the new card, $1.60 per keg, would be equivalent to $1.10 per keg on the old card, showing a very great decrease in prices.

AVERAGE MONTHLY PRICES OF STEEL BARS AT PITTSBURG.

The following table, compiled from weekly quotations in the American Manufacturer, gives the average monthly prices of steel bars per 100 pounds at mills in Pittsburg from 1896 to 1902:

Average monthly prices of steel bars at Pittsburg, 1896–1902.

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
January	$1.20	$1.07	$1.00	$1.07	$2.25	$1.20	$1.58
February	1.20	1.05	1.00	1.09	2.25	1.27	1.50
March	1.16	1.00	.99	1.48	2.25	1.44	1.50
April	1.15	.95	.95	1.75	2.12	1.50	1.67
May	1.15	.92	.95	1.71	1.94	1.50	1.80
June	1.15	.90	.95	2.05	1.79	1.50	1.80
July	1.15	.90	.95	2.00	1.24	1.52	1.72
August	1.14	.90	.96	2.21	1.05	1.50	1.75
September	1.07	1.00	.99	2.50	1.12	1.50	1.75
October	1.05	1.00	1.00	2.60	1.15	1.52	1.69
November	1.07	1.00	1.01	2.46	1.18	1.60	1.60
December	1.10	1.00	1.00	2.25	1.20	1.60	1.68
Average	1.13	.97	.98	1.93	1.63	1.47	1.67

The lowest quoted price at which steel bars were sold at Pittsburg within the last seven years was 90 cents per 100 pounds, this price prevailing in June, July, and August, 1897.

AVERAGE YEARLY PRICES OF IRON AND STEEL.

The following table gives the average yearly prices of leading articles of iron and steel in Pennsylvania, also of wire nails at Chicago, from 1898 to 1902. These prices are obtained by averaging monthly quotations, and these have in turn been averaged from weekly quotations. The prices given are per ton of 2,240 pounds, except for bar iron and steel and for cut and wire nails, which are quoted by the 100 pounds and in 100-pound kegs:

Average yearly prices of leading articles of iron and steel, 1898–1902.

Article.	1898.	1899.	1900.	1901.	1902.
Old iron T rails at Philadelphia ....per long ton..	$12.39	$20.36	$19.51	$19.32	$23.83
No. 1 foundry pig iron at Philadelphia ....do....	11.66	19.36	19.98	15.87	22.19
Gray forge pig iron:					
At Philadelphia ....do....	10.23	16.60	16.49	14.08	19.20
At Pittsburg ....do....	9.18	16.72	16.90	14.20	19.49
Bessemer pig iron at Pittsburg ....do....	10.33	19.03	19.49	15.93	20.67
Steel rails at mills in Pennsylvania ....do....	17.62	28.12	32.29	27.33	28.00
Steel billets at mills at Pittsburg ....do....	15.31	31.12	25.06	24.13	30.57
Best bar iron:					
From store at Philadelphia ....per 100 pounds..	1.28	2.07	1.96	1.84	2.13
At mills at Pittsburg ....do....	1.07	1.95	2.15	1.80	1.94
Steel bars at mills at Pittsburg ....do....	.98	1.93	1.63	1.47	1.67
Cut nails from store at Philadelphia ....per keg..	1.31	2.21	2.46	2.29	2.29
Wire nails, base price, at Chicago ....do....	1.45	2.60	2.76	2.41	2.15

AVERAGE MONTHLY PRICES OF TIN PLATES.

In late years foreign tin plates have not been regularly quoted at New York. For this reason foreign prices subsequent to 1898 will not be found in the following table, which gives the average monthly prices of American Bessemer tin plates, I. C., 14 by 20, per box of 100 pounds, at mills in Pennsylvania, from January, 1899, to December, 1902, and which has been compiled for this report by Mr. W. P. Beaver, auditor of the American Tin Plate Company.

Average monthly prices of tin plates, 1899–1902.

Month.	Price.	Month.	Price.	Month.	Price.	Month.	Price.
1899.		1900.		1901.		1902.	
January	$3.00	January	$4.65	January	$4.00	January	$4.00
February	3.38	February	4.65	February	4.00	February	4.00
March	3.75	March	4.65	March	4.00	March	4.00
April	3.87	April	4.65	April	4.00	April	4.00
May	3.87	May	4.65	May	4.00	May	4.00
June	3.87	June	4.65	June	4.00	June	4.00
July	4.12	July	4.65	July	4.00	July	4.00
August	4.23	August	4.65	August	4.00	August	4.00
September	4.65	September	4.50	September	4.00	September	4.00
October	4.65	October	4.00	October	4.00	October	4.00
November	4.65	November	4.00	November	4.00	November	4.00
December	4.65	December	4.00	December	4.00	December	3.60
Average	4.06	Average	4.47	Average	4.00	Average	3.97

On March 1, 1903, the price of tin plates was advanced to $3.80 per box, owing to the increased cost of raw materials.

Foreign tin plates are imported only by the oil and canning interests in order that the benefit of the drawback system may be secured in the export trade.

PRODUCTION OF PIG IRON.

Twenty-two States made pig iron in 1902, against 21 in 1899 and 1900, and 20 in 1901. The total production of pig iron in 1902 was 17,821,307 long tons, against 15,878,354 tons in 1901, 13,789,242 tons in 1900, 13,620,703 tons in 1899, 11,773,934 tons in 1898, and 9,652,680 tons in 1897. The production in 1902 was 1,942,953 tons more than in 1901. The following table gives the half-yearly production in the last six years:

Half-yearly production of pig iron, 1897–1902.

Period.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
First half	4,403,476	5,869,703	6,289,167	7,642,569	7,674,613	8,808,574
Second half	5,249,204	5,904,231	7,331,536	6,146,673	8,203,741	9,012,733
Total	9,652,680	11,773,934	13,620,703	13,789,242	15,878,354	17,821,307

The following table gives the half-yearly production of pig iron by States in 1902, arranged according to geographical position:

Half-yearly production of pig iron, by States, 1902.

State.	1902. First half.	1902. Second half.	State.	1902. First half.	1902. Second half.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
Massachusetts	1,716	1,644	Kentucky	51,089	59,636
Connecticut	5,278	6,808	Tennessee	187,359	205,419
New York	186,523	214,846	Ohio	1,775,496	1,855,892
New Jersey	105,295	86,085	Illinois	879,800	850,420
Pennsylvania	4,045,965	4,071,835	Michigan	85,661	69,552
Maryland	148,619	154,610	Wisconsin, Minnesota	131,531	142,456
Virginia	263,233	273,983	Missouri, Colorado, Washington	133,237	136,693
North Carolina, Georgia	12,401	19,914	Total	8,808,574	9,012,733
Alabama	700,546	771,665			
Texas	1,528	1,567			
West Virginia	93,297	89,708			

The following table gives the production of pig iron by States in 1901 and 1902, in the order of their prominence in 1902:

Production of pig iron by States, 1901–2, by rank of production in 1902.

State.	1901.	1902.	State.	1901.	1902.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
Pennsylvania	7,343,257	8,117,800	New Jersey	155,746	191,380
Ohio	3,326,425	3,631,388	West Virginia	166,597	183,005
Illinois	1,596,850	1,730,220	Michigan	170,762	155,213
Alabama	1,225,212	1,472,211	Kentucky	68,462	110,725
Virginia	448,662	537,216	North Carolina, Georgia	27,333	32,315
New York	283,662	401,369	Connecticut	8,442	12,086
Tennessee	337,139	392,778	Massachusetts	3,386	3,360
Maryland	303,186	303,229	Texas	2,273	3,095
Wisconsin, Minnesota	207,551	273,987	Total	15,878,354	17,821,307
Missouri, Colorado, Washington	203,409	269,930			

All the above States, with the exception of Massachusetts and Michigan, made more pig iron in 1902 than in 1901.

The grouping of some of the States in the above tables and in some other tables is due to the fact that all statistics are received by the American Iron and Steel Association in strict confidence, making it necessary in some instances to resort to grouping to avoid disclosing the production of individual works.

PRODUCTION OF PIG IRON ACCORDING TO FUEL USED.

The production of pig iron in 1902, classified according to the fuel used, was as follows, compared with the four preceding years:

Production of pig iron according to fuel used, 1898–1902.

Fuel used.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Bituminous, chiefly coke	10,273,911	11,736,385	11,727,712	13,782,386	16,315,891
Anthracite and coke	1,180,999	1,558,521	1,636,366	1,668,808	1,096,040
Anthracite alone	22,274	41,031	40,682	43,719	19,207
Charcoal	296,750	284,766	339,874	360,147	378,504
Charcoal and coke	....	....	44,608	23,294	11,665
Total	11,773,934	13,620,703	13,789,242	15,878,354	17,821,307

The following table gives the production of bituminous pig iron by States in 1901 and 1902, according to their prominence in 1902:

Production of bituminous pig iron by States, 1901–2, according to rank in 1902.

State.	1901.	1902.	State.	1901.	1902.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
Pennsylvania	5,819,961	7,193,795	Maryland	297,826	301,501
Ohio	3,316,358	3,620,590	Wisconsin	172,278	233,286
Illinois	1,596,850	1,730,220	Colorado	155,664	210,147
Alabama	1,172,202	1,411,677	West Virginia	166,597	183,005
Virginia	446,188	535,174 (Virginia and North Carolina)	Kentucky	68,462	110,725
North Carolina	....		Minnesota	33,523 (Minnesota and Missouri)	44,786 (Minnesota and Missouri)
Tennessee	310,928	377,915	Missouri		
New York	225,549 (New York and New Jersey)	308,619	Total	13,782,386	16,315,891
New Jersey		54,451			

The table below gives the production of anthracite and mixed anthracite and coke pig iron by States from 1897 to 1902:

Production of anthracite and mixed anthracite and coke pig iron by States, 1897–1902.

State.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pennsylvania	837,081	1,102,592	1,420,618	1,440,139	1,518,535	919,775
New Jersey	95,696	100,681	163,853 (New Jersey and New York)	168,762	155,746	195,472 (New Jersey and New York)
New York	....	....		50,859	35,508	
Maryland	....	....	15,081	17,288	2,738	....
Total	932,777	1,203,273	1,599,552	1,677,048	1,712,527	1,115,247

The following table gives the production of charcoal pig iron by States in 1901 and 1902, according to their prominence in 1902:

Production of charcoal pig iron by States, 1901–2, according to rank in 1902.

State.	1901.	1902.	State.	1901.	1902.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
Michigan	170,762	155,213	Tennessee }	5,190	6,293
Alabama	53,010	60,534	Texas }		
Wisconsin }			Maryland }	5,096	4,400
Missouri }	49,495	55,698	Virginia }		
Washington }			Pennsylvania	4,761	4,230
New York	22,605	34,207	Massachusetts	3,386	3,360
Georgia	27,333	31,685	Total	360,147	378,504
Connecticut	8,442	12,086			
Ohio	10,067	10,798			

There were also produced in 1902 in Tennessee 11,665 tons of pig iron with mixed charcoal and coke, against 23,294 tons in 1901.

PRODUCTION OF BESSEMER PIG IRON.

The following table gives the production of Bessemer pig iron by States in each year from 1897 to 1902, in long tons. Bessemer pig iron made with charcoal as fuel is included. Low-phosphorus pig iron is included in the statistics for 1901 and 1902.

Production of Bessemer pig iron, by States, 1897–1902.

State.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pennsylvania	3,434,930	4,040,965	4,473,493	4,242,397	4,885,877	5,130,022
Ohio	1,027,897	1,570,535	1,852,965	1,898,663	2,637,091	2,927,605
Illinois	1,017,991	1,210,124	1,330,169	1,178,241	1,394,430	1,495,298
Maryland	151,105	186,563	210,670	260,688	297,149	296,971
West Virginia	132,907	192,699	187,858	169,802	166,597	182,937
North Carolina	....	....	....			
Colorado	6,582	88,701	96,364	118,146	147,216	201,580
Missouri	5,000	30,238				
Kentucky and Tennessee	....	....	22,756	13,430	....	9,746
Wisconsin	15,699	14,620				
Michigan	3,473	2,939	14,519	21,785	39,941	82,328
Minnesota	....	....				
New Jersey	....	....	13,984	40,300	28,492	66,681
New York	....	....	....			
Total	5,795,584	7,337,384	8,202,778	7,943,452	9,596,793	10,393,168

Of the total production of Bessemer pig iron in Pennsylvania in 1902 the Lehigh Valley made 115,615 tons; the Schuylkill Valley, 54,220 tons; the Upper Susquehanna Valley, 3,147 tons; the Lower Susquehanna Valley and the Juniata Valley, 404,656 tons; Allegheny County, 3,123,632 tons; the Shenango Valley, 891,776 tons; and the remainder of the State, 536,976 tons; total, 5,130,022 tons.

In Ohio in 1902 the Mahoning Valley produced 1,093,242 tons of Bessemer pig iron; the Hanging Rock bituminous district, 112,603 tons; the lake counties, 819,107 tons; and the remainder of the State, 902,653 tons; total, 2,927,605 tons.

PRODUCTION OF BASIC PIG IRON.

The production of basic pig iron in 1896 was 336,403 tons; in 1897 it was 556,391 tons; in 1898 it was 785,444 tons; in 1899 it was 985,033 tons; in 1900 it was 1,072,376 tons; in 1901 it was 1,448,850 tons; and in 1902 it was 2,038,590 tons. The production by States since 1898 has been as follows:

Production of basic pig iron, by States, 1898–1902.

State.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
New York, New Jersey	645	....	4,929	34,320	90,736
Pennsylvania:					
Allegheny County	378,156	470,848	446,543	568,516	932,532
Other counties	204,547	267,760	344,065	442,744	596,216
Maryland, Virginia, Tennessee, Alabama	154,829	166,093	179,717	301,444	295,191
Ohio, Illinois, Wisconsin, Missouri	47,267	80,332	97,122	101,826	123,915
Total	785,444	985,033	1,072,376	1,448,850	2,038,590

Maryland, Tennessee, Illinois, and Wisconsin did not make basic pig iron in 1901 or 1902, as in previous years. The production of basic pig iron made rapid progress in 1901 and 1902.

PRODUCTION OF SPIEGELEISEN AND FERROMANGANESE.

The production of spiegeleisen and ferromanganese in 1902, included in the total production of pig iron, was 212,981 tons, against 291,461 tons in 1901 and 255,977 tons in 1900. The spiegeleisen and ferromanganese produced in 1902 were made in New Jersey, Pennsylvania, Alabama, Illinois, and Colorado. Included in the total production for 1902 is a small quantity of ferrophosphorus, made in Alabama

PRODUCTION OF PIG IRON IN PENNSYLVANIA, BY DISTRICTS.

The production of pig iron in Pennsylvania by districts in 1902 was as follows: Lehigh Valley, 517,950 long tons; Schuylkill Valley, 520,597 tons; Upper Susquehanna Valley, 3,147 tons; Lower Susquehanna Valley, 527,794 tons; Juniata Valley, 198,571 tons; Shenango Valley, 1,254,933 tons; Allegheny County, 4,260,769 tons; western Pennsylvania, except Allegheny County and the Shenango Valley, 829,809 tons; charcoal (whole State), 4,230 tons; total, 8,117,800 tons. In 1902 only three charcoal furnaces in Pennsylvania were in operation, namely, Glen Iron, at Glen Iron, Union County; Eagle, at Roland, Center County, and Greenwood, at Greenwood Furnace post-office, Huntingdon County.

In 1901 Pennsylvania made 46.2 per cent of the country's total production of pig iron, and in 1902 it made 45.5 per cent.

In 1902 the Shenango Valley increased its production 275,058 tons over 1901; Allegheny County increased its production 570,758 tons, almost identically the same increase that it made in 1901 over 1900, which was 571,250 tons; western Pennsylvania, outside of Allegheny County and the Shenango Valley, gained 41,950 tons; the Lehigh Valley gained 26,676 tons; the Schuylkill Valley gained 16,528 tons; the Upper Susquehanna Valley lost 77,095 tons; the Lower Susquehanna Valley lost 125,683 tons; the Juniata Valley gained 46,882 tons; charcoal lost 531 tons.

Allegheny County produced more than one-half the pig iron made in Pennsylvania in 1897 and 1898 and more than one-fourth of the country's production in each year, but in 1899 it made slightly less than one-half the production of Pennsylvania in that year, and considerably less than one-fourth the country's production. In 1900 it again made less than one-half the production of Pennsylvania and less than one-fourth the country's total production. In 1901 and again in 1902 Allegheny County made more than one-half the production of Pennsylvania, but less than one-fourth the country's total production.

PRODUCTION OF PIG IRON IN OHIO, BY DISTRICTS.

The production of pig iron in Ohio in 1902, by districts, was as follows: Mahoning Valley, including the Leetonia furnaces, 1,438,087 long tons; Hocking Valley, 36,194 tons; Lake counties, 860,371 tons; miscellaneous bituminous, 969,372 tons; Hanging Rock bituminous, 316,566 tons; Hanging Rock charcoal, 10,798 tons; total, 3,631,388 tons.

The increase in production in the Mahoning Valley, including the Leetonia furnaces, in 1902 over 1901 was 33,230 tons; in the Lake counties the increase was 76,881 tons; in the miscellaneous bituminous district the increase was 175,662 tons; in the Hanging Rock bituminous district the increase was 17,265 tons; in the Hanging Rock charcoal district the increase was 731 tons, and in the Hocking Valley there was an increase of 1,194 tons.

PRODUCTION OF PIG IRON IN THE SHENANGO AND MAHONING VALLEYS.

The production of pig iron in the Mahoning Valley in Ohio, including the Leetonia furnaces, and in the Shenango Valley in Pennsylvania in 1898 was almost exactly the same, the former producing 769,334 tons and the latter 769,677 tons. In 1899 the Mahoning Valley made 932,165 tons and the Shenango Valley made 937,215 tons. In 1900 the Mahoning Valley went away ahead of its rival, making 1,002,362 tons, against 800,214 tons in the Shenango Valley. In 1901 the Mahoning Valley further increased its lead, producing 1,404,857 tons, against 979,875 tons in the Shenango Valley. In 1902 the Mahoning Valley, as already stated, increased its production over 1901 only 33,230 tons, while the Shenango Valley increased its production 275,058 tons, showing a comparative gain of 241,828 tons in favor of the Shenango Valley in 1902.

STOCKS OF UNSOLD PIG IRON.

The statistics of stocks of unsold pig iron do not include pig iron made by the owners of rolling mills or steel works for their own use, but only pig iron made for sale which has not been sold. The stocks of pig iron which were unsold in the hands of manufacturers or which were under their control at the close of 1902, and were not intended for their own consumption, amounted to 49,951 tons, against 70,647 tons at the close of 1901 and 442,370 tons at the close of 1900. The American Pig Iron Storage Warrant Company held no pig iron whatever in any of its yards on December 31, 1902. This is the first time since its organization in 1889 that the company has not held at least a small quantity of pig iron in its yards at the close of a calendar year. At the end of 1901 it had 3,000 tons, and at the end of 1900 it had 16,400 tons.

ANNUAL CONSUMPTION OF PIG IRON.

The consumption of pig iron in the last five years is approximately shown in the following table, the comparatively small quantity of foreign pig iron held in bonded warehouses not being considered. Warrant stocks are included in unsold stocks:

Annual consumption of pig iron in the United States, 1898–1902.

Pig iron.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Domestic production	11,773,934	13,620,703	13,789,242	15,878,354	17,821,307
Imported	25,152	40,393	52,565	62,930	625,383
Stocks unsold Jan. 1	874,978	415,333	68,309	446,020	70,647
Total supply	12,674,064	14,076,429	13,910,116	16,387,304	18,517,337
Deduct stocks Dec. 31	415,333	68,309	446,020	73,647	49,951
Also exports	253,057	228,678	286,687	81,211	27,487
Approximate consumption	12,005,674	13,779,442	13,177,409	16,232,446	18,439,899

It will be observed that while the increased production of pig iron in 1902 over 1901 was 1,942,953 tons, the increased consumption was 2,207,453 tons. The increased consumption in 1901 over 1900 was 3,055,037 tons, but the consumption in 1900 was actually less than in 1899.

NUMBER OF FURNACES IN BLAST.

The whole number of furnaces which were in blast at the close of 1902 was 307, against 266 at the close of 1901 and 232 at the close of 1900. The following classified table shows the number of furnaces in blast at the close of each year since 1897:

Number of furnaces in blast at close of each year, 1897–1902.

Fuel used.	1897.	1898.	1899.	1900.	1901.	1902.
Bituminous coal and coke	146	152	191	155	188	222
Anthracite and anthracite and coke	29	30	68	45	54	52
Charcoal and charcoal and coke	16	20	30	32	24	33
Total	191	202	289	232	266	307

The number of furnaces out of blast at the close of 1902 was 105. Many of these furnaces were only temporarily banked because of the inability of their owners to obtain a supply of fuel. At the close of 1901 there were 140 furnaces out of blast.

LIMESTONE CONSUMED IN MAKING PIG IRON.

The limestone consumed for fluxing purposes by the blast furnaces of the United States in the production of 17,821,307 tons of pig iron in 1902 amounted to 9,490,090 tons. The average consumption of limestone per ton of all kinds of pig iron produced was 1,192.8 pounds. The consumption by the anthracite and bituminous furnaces was 1,207.7 pounds per ton of pig iron made, and by the charcoal and mixed charcoal and coke furnaces it was 527.9 pounds. Oyster shells are regularly used by Muirkirk (charcoal) furnace, in Maryland, for fluxing purposes to the entire exclusion of limestone.

PRODUCTION OF BESSEMER STEEL INGOTS AND STEEL RAILS.

Below are presented complete statistics, received directly from the manufacturers, of the production of Bessemer steel in the United States in 1902, also of Bessemer steel rails by the producers of Bessemer steel ingots. Neither the production of Bessemer ingots nor the production of Bessemer rails kept pace in 1902 with the marvelous growth in that year of the iron and steel industries taken as a whole, which was owing entirely to the fact that the Lackawanna Iron and

Steel Company dismantled its Bessemer plants and its rail mills, as well as its remaining blast furnace, at Scranton, early in the year, preparatory to the erection at Buffalo by the Lackawanna Steel Company of new and more extensive works, which are not yet entirely completed. The north works of the company at Scranton made their last rails on January 16, 1902, and the south works made their last rails on February 26, 1902.

Ingots and castings.—The total production of Bessemer steel ingots and castings in 1902 was 9,138,363 long tons, against 8,713,302 tons in 1901, an increase of 425,061 tons, or 4.8 per cent. The increase in 1901 over 1900 amounted to 2,028,532 tons, or over 30 per cent. The production of 1902 was the largest in our history. The following table gives the production of Bessemer steel ingots and castings in the last six years. Of the production last year 12,548 tons were steel castings, against a production of 6,764 tons in 1901.

Production of Bessemer steel ingots and castings in the United States, 1897–1902.

Year.	Bessemer ingots.	Year.	Bessemer ingots.
	Long tons.		*Long tons.*
1897	5,475,315	1900	6,684,770
1898	6,609,017	1901	8,713,302
1899	7,586,354	1902	9,138,363

The production of Bessemer ingots and castings in the United States during the last five years was as follows:

Production of Bessemer steel ingots and castings, by States, 1898–1902.

State.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pennsylvania	3,402,254	3,968,779	3,488,731	4,293,439	4,209,326
Ohio	1,489,115	1,679,237	1,388,124	2,154,846	2,528,802
Illinois	1,105,040	1,211,246	1,115,571	1,324,217	1,443,614
Other States	612,608	727,092	692,344	940,800	956,621
Total	6,609,017	7,586,354	6,684,770	8,713,302	9,138,363

There were no Clapp-Griffiths works in operation in 1902 and only two Robert-Bessemer plants were active. Five Tropenas plants were at work, as compared with seven in 1901. In addition one Bookwalter converter was running. All these works that were active were engaged in the production of steel castings only.

Rails.—The production of all kinds of Bessemer steel rails by the producers of Bessemer steel ingots in 1902 was 2,876,293 long tons, against a similar production in 1901 of 2,836,273 tons, in 1900 of 2,361,921 tons, and in 1899 of 2,240,767 tons. The maximum production of Bessemer steel rails by the producers of Bessemer steel ingots was reached in 1902, but the increase in that year over 1901 amounted to only 40,020 tons, or 1.4 per cent. As compared with 1887, fifteen years ago, the increase in 1902 in the production of Bessemer rails amounted to only 831,474 tons, or 40 per cent, while during the same period the increase in the production of Bessemer ingots amounted to 6,370,438 tons, or almost 217 per cent. The following table shows the production by States of Bessemer steel rails by the producers of Bessemer steel ingots in the last six years. The figures do not include a small quantity of rails made each year from purchased blooms or from rerolled steel rails, statistics for both of which products for 1902 are not yet available.

Production of Bessemer steel rails, by States, 1897–1902.

State.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pennsylvania	1,024,386	1,052,771	1,224,807	1,195,255	1,406,008	1,148,425
Other States	590,013	902,656	1,015,960	1,166,666	1,430,265	1,727,868
Total	1,614,399	1,955,427	2,240,767	2,361,921	2,836,273	2,876,293

In 1897, at the request of the manufacturers, the statistics of the production of rails weighing 45 pounds and less than 85 pounds to the yard were separated from those of rails weighing less than 45 pounds and over 85 pounds to the yard. This separation is continued for 1902. The small quantity of Bessemer rails made from purchased ingots or from rerolled rails is not included in the following table.

Production of Bessemer steel rails, by weight per yard, by States, in 1902.

State.	Under 45 pounds.	45 pounds and less than 85.	85 pounds and over.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Pennsylvania	53,964	766,567	327,894	1,148,425
Other States	173,104	1,237,496	317,268	1,727,868
Total for 1902	227,068	2,004,063	645,162	2,876,293
Total for 1901	140,214	2,202,237	493,822	2,836,273
Total for 1900	154,796	1,605,067	602,058	2,361,921

It will be noticed that there was a considerable decline in 1901 in the production of Bessemer steel rails weighing 85 pounds and over as compared with 1900, but that in 1902 there was an increase over 1900 and a very large increase over 1901. The production of rails weighing between 45 and 85 pounds shows a slight decrease in 1902 as compared with 1901.

The total production of rails in 1902 will include rails made from open-hearth steel, rails rolled from purchased Bessemer blooms, rerolled rails, and iron rails. The total production from all these sources in 1901 amounted to 38,366 tons.

With the exception of the Lackawanna plant at Scranton, all our Bessemer rail mills were operated nearly to their full capacity in 1902, the demand for steel rails being greater than the supply all through the year. Some interruption to the utmost possible activity of the Bessemer rail mills in 1902 was also caused by the inability of the railroads to deliver raw materials to the blast furnaces promptly.

Notwithstanding the large production of rails last year there were imported 63,522 tons of iron and steel rails, but to balance this importation there were exported 67,666 tons of iron and steel rails. In 1901 318,956 tons of rails were exported and only 1,905 tons imported. Virtually all the rails imported and exported are steel rails.

PRODUCTION OF OPEN-HEARTH STEEL IN 1902.

The total production of open-hearth steel ingots and castings in the United States in 1902 was 5,687,729 long tons, against 4,656,309 tons in 1901, an increase of 1,031,420 tons, or over 22 per cent. As compared with 1898, five years ago, when the production of open-hearth steel amounted to 2,230,292 tons, there was an increase in 1902 of 3,457,437 tons, or over 155 per cent. The following table gives the production of open-hearth steel ingots and castings, by States, since 1899:

Production of open-hearth steel ingots and castings, by States, 1899–1902.

State.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
New England	57,124	74,522	170,876	179,923
New York and New Jersey	61,461	67,361	82,985	92,763
Pennsylvania	2,393,811	2,699,502	3,594,763	4,375,364
Ohio	117,458	130,191	184,943	278,854
Illinois	246,183	285,551	398,522	435,461
Other States	71,279	141,008	224,220	325,364
Total	2,947,316	3,398,135	4,656,309	5,687,729

The open-hearth steel made in 1902 was produced by 98 works in 16 States—Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Tennessee, Alabama, Ohio, Indiana, Illinois, Michigan, Wisconsin, and Missouri. Ninety works in 14 States made open-hearth steel in 1901. The States which have open-hearth furnaces, but which did not produce steel by this process in 1902, were Kentucky and Minnesota. The erection of a large open-hearth steel plant was commenced in Colorado in 1902, but open-hearth steel had not been made down to the close of the year. This State will, however, probably make open-hearth steel during the year 1903. Maryland and Michigan again made open-hearth steel in 1902.

In 1901 3,618,993 tons of open-hearth steel were made by the basic process and 1,037,316 tons were made by the acid process, while in 1902 the production by the basic process amounted to 4,496,533 tons and by the acid process to 1,191,196 tons. In the following table the production by States of both acid and basic steel in 1902 is given:

Production of acid and basic steel in 1902, by States.

States.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
	Long tons.	*Long tons.*	*Long tons.*
New England	110,961	68,962	179,923
New York and New Jersey	54,296	38,467	92,763
Pennsylvania	3,459,702	915,662	4,375,364
Ohio	195,700	83,154	278,854
Illinois	384,951	50,510	435,461
Other States	290,923	34,441	325,364
Total	4,496,533	1,191,196	5,687,729

The increase in the production of acid steel in 1902 as compared with 1901 was 153,880 tons, or almost 15 per cent, while the increase in the production of basic steel was 877,540 tons, or over 24 per cent.

The total production of open-hearth steel castings in 1902, included above, amounted to 367,879 long tons, of which 112,404 tons were made by the basic process and 255,475 tons were made by the acid process. In 1901 the production of open-hearth steel castings amounted to 301,622 tons, of which 94,941 tons were made by the basic process and 206,681 tons by the acid process. The following table gives the production of open-hearth steel castings by the acid and basic processes in 1902, by States, in long tons:

Production of open-hearth steel castings by the acid and basic processes in 1902, by States.

States.	Acid castings.	Basic castings.	Total.
	Long tons.	*Long tons.*	*Long tons.*
New England, New York, and New Jersey	33,158	3,883	37,041
Pennsylvania	141,385	11,014	152,399
Ohio, Illinois, and other States	80,932	97,507	178,439
Total	255,475	112,404	367,879

IRON AND STEEL SHIPBUILDING.

In the fiscal year ending June 30, 1900, there were built in the United States 90 steel vessels, and in the fiscal year 1901 there were built 119 steel vessels and 1 iron vessel. The gross tonnage of the vessels built in the fiscal year 1900 was 196,851 tons, and the gross tonnage of the vessels built in the fiscal year 1901 was 262,699 tons. In the fiscal year 1902 there were built 106 steel vessels and 1 iron vessel, with a gross tonnage of 280,362 tons. The iron vessel was built at Wilmington and was of 193 tons' capacity. Of the 107 vessels built in the last fiscal year referred to, 49 were built at ports on the Great Lakes, their tonnage amounting to 161,930 gross tons out of a total tonnage of 280,362 tons. Vessels for the U. S. Navy are not included in the figures given, which have been furnished by the Hon. Eugene T. Chamberlain, Commissioner of Navigation, of the Treasury Department.

The Commissioner also furnishes the following details of steel vessels built in the United States in the first nine months of the present fiscal year, ending March 31, 1903: Number of sailing vessels built, 3, with a total tonnage of 7,731 tons; number of steam vessels built, 62, with a total tonnage of 140,319 tons; total number of steel vessels built in the nine months, 65; total tonnage, 148,050 tons. These figures and those given above show a very great increase in the last few years in the building of steel vessels in this country, not including, as already mentioned, the large number of vessels built and building for the U. S. Navy. On January 1, 1903, there were 72 yards in this country which were equipped for building all kinds of iron and steel vessels, and in addition 4 shipbuilding yards were being built.

PRODUCTION OF PIG IRON IN CANADA.

The statistics of the production of pig iron in Canada in 1902 have been received from the manufacturers by the American Iron and Steel Association. They show an increase of 74,581 long tons, or over 30 per cent, as compared with the production in 1901.

The total production in 1902 amounted to 319,557 long tons, against 244,976 tons in 1901 and 86,090 tons in 1900. In the first half of 1902 the production was 157,804 tons and in the second half it was 161,753 tons, a gain of only 3,949 tons. Of the total product in 1902, 302,712 tons were made with coke and 16,845 tons with charcoal. A little over one-third of the total product was basic pig iron, namely, 107,315 tons. The Bessemer pig iron made amounted to about 9,000 tons. Spiegeleisen and ferromanganese have not been made since 1899.

The following table gives the total production of all kinds of pig iron in Canada from 1894 to 1902, the statistics for each year having been received directly from the manufacturers. Prior to 1894 the statistics of pig iron production in Canada were not collected by the American Iron and Steel Association:

Total production of all kinds of pig iron in Canada, 1894–1902.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1894	44,791	1897	53,796	1900	86,090
1895	37,829	1898	68,755	1901	244,976
1896	60,030	1899	94,077	1902	319,557

On December 31, 1902, the unsold stocks of pig iron in Canada amounted to about 20,000 long tons, as compared with 59,472 tons at the close of 1901 and 12,465 tons at the close of 1900. Of the unsold pig iron on hand on December 31, over 19,000 tons were coke pig iron.

On December 31, 1902, Canada had 14 completed blast furnaces, of which 7 were in blast and 7 were idle. Of this total, 9 were equipped to use coke for fuel, 4 to use charcoal, and 1 to use mixed charcoal and coke. In addition, 4 coke and 2 charcoal furnaces were being built or were partly erected on December 31, but work on some of these furnaces was suspended.

The Algoma Steel Company, Limited, of Sault Ste. Marie, Ontario, one of the constituent companies of the Consolidated Lake Superior Company, commenced the erection of 2 charcoal and 2 coke furnaces at Sault Ste. Marie in 1901. The charcoal furnaces were to be 70 by 14 feet and the coke furnaces 90 by 21 feet. Subsequently work on the coke furnaces was suspended, and one of the building charcoal furnaces was converted into a coke furnace, the size being changed from 70 by 14 feet to 80 by 15½ feet. The company now expects to have its charcoal furnace ready for blast in June and its coke furnace in July.

The Cramp Steel Company, Limited, has put in the foundations for a blast furnace at Collingwood, Simcoe County, Ontario. The company expects to have the furnace ready for operation in the fall of 1903. Coke will be used. Its daily capacity will be about 250 long tons.

The Nova Scotia Steel and Coal Company, Limited, of New Glasgow, Nova Scotia, broke ground in June, 1902, for a new furnace at Sydney Mines, Cape Breton, Nova Scotia. The furnace will be 85 by 17 feet, and will have a daily capacity of about 200 tons of basic and foundry pig iron. Coke will be used, and red and brown hematite ore will be obtained from Nova Scotia and Newfoundland. It is expected that the furnace will be completed in September, 1903. The company now has a furnace at Ferrona, with an annual capacity of 33,000 long tons.

The Londonderry Iron and Mining Company, Limited, of Londonderry, Nova Scotia, is rebuilding Furnace A, at Acadia Iron Mines, and expects to blow it in in May, 1903. The furnace will be 75 by 17 feet, and will have an annual capacity of 48,000 tons of foundry iron. The company does not contemplate blowing in Furnace B in the near future, but may rebuild it later on.

PRODUCTION OF STEEL IN CANADA.

The total production of steel ingots and castings in Canada in 1902 was 182,037 long tons, against 26,084 tons in 1901, an increase of

155,953 tons. Bessemer and open-hearth steel ingots and castings were made in each year. Almost all of the open-hearth steel reported in 1902 was made by the basic process.

The following table gives the production of all kinds of steel ingots and castings in Canada from 1894 to 1902, in long tons.

Production of all kinds of steel ingots and castings in Canada, 1894–1902.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1894	25,685	1897	18,400	1900	23,577
1895	17,000	1898	21,540	1901	26,084
1896	16,000	1899	22,000	1902	182,037

The large increase in the production of steel in Canada in 1902 over 1901 was caused by the starting up of the new open-hearth steel plant of the Dominion Iron and Steel Company, Limited, at Sydney, Cape Breton, Nova Scotia, which first produced steel on December 31, 1901, and of the new Bessemer plant of the Algoma Steel Company, Limited, at Sault Ste. Marie, Ontario, at which steel was first made on February 18, 1902. The latter company has two 6-long-ton Bessemer converters, which were operated for a few months in 1902, producing in all 44,537 long tons of ingots. The company has also a rail mill which first made Bessemer steel rails on May 5, 1902, and which also ran for a few months in that year, producing 32,878 long tons. In addition this company also produced 1,236 long tons of other rolled products in 1902. The Dominion Iron and Steel Company produced 99,425 long tons of basic open-hearth steel ingots and castings and 86,424 tons of blooms, billets, and slabs. It did not make steel rails.

STATISTICS OF IRON AND STEEL, IRON ORE, AND COAL, TO 1901, INCLUSIVE.

By James M. Swank,

General Manager of the American Iron and Steel Association.

In the following tables, beginning in most cases as far back as authentic statistics are available, are presented complete statistics of the production of iron and steel, iron ore, and coal in the United States, Great Britain, Germany, France, and Belgium to the close of 1901, and also the production of iron ore in Algeria. There are added also the United States statistics of the production of coke and of the shipments of Connellsville and Pocahontas Flat Top coke to the close of 1901; also statistics of the shipments of Lake Superior iron ore and of Cuban iron ore to the same date; also complete statistics of the imports of iron ore into the United States to the close of 1901.

The tables have been compiled to show the progress that has been made by the countries mentioned in the manufacture of iron and steel and coke and in the mining of iron ore and coal in the first year of the twentieth century. Iron ore and coal and coke are raw materials in the manufacture of iron and steel. In one instance statistics for 1902 are included.

UNITED STATES.

PRODUCTION OF COAL.

The following table gives the production of all kinds of coal in the United States, in long tons, in the census years 1870 and 1880, ending on the 31st day of May of each year; in the census year 1889, ending on the 31st day of December of that year; and in the calendar years from 1881 to 1888, and from 1890 to 1901. Authentic statistics for earlier years are not available. Credit is due to the Census Bureau for the statistics for census years, and to the Division of Mining and Mineral Resources of the United States Geological Survey for the statistics for other years.

Production of coal in the United States, 1870–1901.

Year.	Pennsylvania anthracite.	Bituminous and all other.	Total.
	Long tons.	*Long tons.*	*Long tons.*
1870	13,973,460	15,369,120	29,342,580
1880	25,572,160	38,250,670	63,822,830
1881	28,500,016	48,365,341	76,865,357
1882	31,358,264	60,861,190	92,219,454
1883	34,336,469	68,531,500	102,867,969
1884	33,175,756	73,730,539	106,906,295
1885	34,228,548	64,840,668	99,069,216
1886	34,853,077	66,646,947	101,500,024
1887	37,578,747	79,073,227	116,651,974
1888	41,624,611	91,107,002	132,731,613
1889	40,665,152	85,432,717	126,097,869
1890	41,489,858	99,377,073	140,866,931
1891	45,236,992	105,268,962	150,505,954
1892	46,850,450	113,264,792	160,115,242
1893	48,185,306	114,629,671	162,814,977
1894	46,358,144	106,089,647	152,447,791
1895	51,785,122	120,641,244	172,426,366
1896	48,523,287	122,893,103	171,416,390
1897	46,974,714	131,794,630	178,769,344
1898	47,663,075	148,742,878	196,405,953
1899	53,944,647	172,608,917	226,553,564
1900	51,221,353	189,566,885	240,788,238
1901	60,242,560	201,631,115	261,873,675

The maximum production of both anthracite and bituminous coal was attained in 1901.

PRODUCTION OF COKE.

The following table, compiled from the reports of the United States Geological Survey, gives the total production of coke in the United States from 1880 to 1901, in short tons of 2,000 pounds.

Production of coke in the United States, 1880–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1880	3,338,300	1888	8,540,030	1896	11,788,773
1881	4,113,760	1889	10,258,022	1897	13,288,984
1882	4,793,321	1890	11,508,021	1898	16,047,209
1883	5,464,721	1891	10,352,688	1899	19,668,569
1884	4,873,805	1892	12,010,829	1900	20,533,348
1885	5,106,696	1893	9,477,580	1901	21,795,883
1886	6,845,369	1894	9,203,632		
1887	7,611,705	1895	13,333,714		

The maximum production of coke in the United States was reached in 1901.

SHIPMENTS OF CONNELLSVILLE COKE.

The following table, compiled from statistics furnished by Mr. H. P. Snyder, editor of the Connellsville Courier, gives the shipments of coke from the Connellsville region in Pennsylvania from 1880 to 1901, in short tons of 2,000 pounds. Statistics for earlier years are not available.

Shipments of Connellsville coke, 1880–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1880	2,205,946	1888	4,955,553	1896	5,411,602
1881	2,639,002	1889	5,930,428	1897	6,915,052
1882	3,043,394	1890	6,464,156	1898	8,460,112
1883	3,552,402	1891	4,760,665	1899	10,129,764
1884	3,192,105	1892	6,329,452	1900	10,166,234
1885	3,096,012	1893	4,805,623	1901	12,609,949
1886	4,180,521	1894	5,454,451		
1887	4,146,989	1895	8,244,438		

The maximum shipments of coke from the Connellsville region were reached in 1901.

SHIPMENTS OF POCAHONTAS FLAT TOP COKE.

The following table gives the shipments of Pocahontas Flat Top coke from 1883 to 1901, in short tons of 2,000 pounds:

Shipments of Pocahontas Flat Top coke, 1883–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1883	23,762	1890	499,148	1897	855,756
1884	56,360	1891	466,016	1898	1,276,172
1885	48,571	1892	499,777	1899	1,317,246
1886	59,021	1893	539,548	1900	1,341,444
1887	151,171	1894	865,684	1901	1,279,949
1888	202,808	1895	707,697		
1889	310,504	1896	999,567		

The maximum shipments of Pocahontas Flat Top coke were reached in 1900.

PRODUCTION OF IRON ORE.

Previous to 1870 no iron ore statistics for the United States are complete. The figures for 1870 and 1880 are for census years ending on May 31 of those years. For 1889 (census year) and subsequent years they are for calendar years. Since 1889 the statistics given have been compiled by the United States Geological Survey.

Production of iron ore in the United States, 1870–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1870	3,031,891	1892	16,296,666	1897	17,518,046
1880	7,120,362	1893	11,587,629	1898	19,433,716
1889	14,518,041	1894	11,879,679	1899	24,683,173
1890	16,036,043	1895	15,957,614	1900	27,553,161
1891	14,591,178	1896	16,005,449	1901	28,887,479

The maximum production of iron ore in the United States was reached in 1901.

PRODUCTION OF CORNWALL IRON ORE.

The following table gives the production of iron ore by the Cornwall mines, in Pennsylvania, from 1864 to 1901. The production from 1740 to February, 1864, amounted to 2,524,908 tons. The figures for 1864 are for eleven months only:

Production of Cornwall iron ore, 1864–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1864	165,915	1877	171,589	1890	686,302
1865	114,803	1878	179,299	1891	663,755
1866	216,660	1879	268,488	1892	634,714
1867	202,755	1880	231,173	1893	439,705
1868	165,843	1881	249,050	1894	371,710
1869	173,429	1882	309,681	1895	614,598
1870	174,408	1883	363,143	1896	463,059
1871	176,055	1884	412,320	1897	419,878
1872	193,317	1885	508,864	1898	584,342
1873	166,782	1886	688,054	1899	763,152
1874	112,429	1887	667,210	1900	558,713
1875	98,925	1888	722,917	1901	747,012
1876	137,902	1889	769,020		

The maximum production of iron ore by the Cornwall mines was reached in 1889.

SHIPMENTS OF LAKE SUPERIOR IRON ORE.

Three States—Michigan, Wisconsin, and Minnesota—now comprise the Lake Superior iron-ore region, which was originally confined to Michigan alone. Minnesota now leads her sister States in production. The following table gives the shipments of iron ore from the Lake

Superior region from 1854 to 1901. The word "shipments" is not synonymous with "production" in this table:

Shipments of iron ore from the Lake Superior region, 1854–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1854	3,000	1870	830,940	1886	3,568,022
1855	1,449	1871	779,607	1887	4,730,577
1856	36,343	1872	900,901	1888	5,063,693
1857	25,646	1873	1,162,458	1889	7,292,754
1858	15,876	1874	919,557	1890	9,012,379
1859	68,832	1875	891,257	1891	7,062,233
1860	114,401	1876	992,764	1892	9,069,556
1861	49,909	1877	1,015,087	1893	6,060,492
1862	124,169	1878	1,111,110	1894	7,748,932
1863	203,055	1879	1,375,691	1895	10,438,268
1864	243,127	1880	1,908,745	1896	9,916,035
1865	236,208	1881	2,306,505	1897	12,469,638
1866	278,796	1882	2,965,412	1898	14,024,673
1867	473,567	1883	2,353,288	1899	18,251,804
1868	491,449	1884	2,518,692	1900	19,059,393
1869	617,444	1885	2,466,372	1901	20,589,237

The maximum shipments of iron ore from the Lake Superior region were reached in 1901, but shipments were greatly increased in 1902.

IMPORTS OF IRON ORE.

The following table gives the total imports of iron ore into the United States in the fiscal years from June 30, 1871, to June 30, 1879, and the imports in the calendar years from January 1, 1879, to December 31, 1901. In 1879 this country for the first time imported iron ore largely from Europe. Prior to that year such iron ore as was imported came chiefly from Canada, more than one-half of the total imports coming from that country in the calendar years 1873, 1874, and 1875.

Imports of iron ore into the United States, 1872–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1872	23,733	1882	589,655	1893	526,951
1873	45,981	1883	490,875	1894	168,541
1874	57,987	1884	487,820	1895	524,153
1875	56,655	1885	390,786	1896	682,806
1876	17,284	1886	1,039,433	1897	489,970
1877	30,669	1887	1,194,301	1898	187,093
1878	28,212	1888	587,470	1899	674,082
1879 [a]	150,197	1889	853,573	1900	897,831
1879 [b]	284,141	1890	1,246,830	1901	966,950
1880	493,408	1891	912,856		
1881	782,887	1892	806,585		

[a] Fiscal years end. [b] Calendar years begin.

The maximum imports of iron ore into the United States were reached in 1890.

SHIPMENTS OF IRON ORE FROM CUBA.

The first shipment of iron ore from the province of Santiago, Cuba, to the United States was made by the Juragua Iron Company in August, 1884. In October, 1892, the Sigua Iron Company first commenced to ship iron ore to the United States, and in 1895 the Spanish-American Iron Company first commenced shipping iron ore to the United States. The Cuban Steel Ore Company for the first time commenced to ship iron ore in 1901. For the following complete details of the shipments of iron ore from Cuba we are indebted to Mr. Josiah Monroe, the secretary of the Juragua Iron Company. The figures given include a few lost cargoes, approximating 16,000 tons. They embrace all shipments since 1884.

Shipments of iron ore from Cuba, 1884–1901.

Year.	Juragua Iron Co.		Sigua Iron Co.[a] to the United States.	Spanish-American Iron Co.		Total.
	To the United States.	To other countries.		To the United States.	To other countries.	
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1884	25,295					25,295
1885	80,716					80,716
1886	112,074					112,074
1887	94,240					94,240
1888	206,061					206,061
1889	260,291					260,291
1890	363,842					363,842
1891	264,262					264,262
1892	335,236		6,418			341,654
1893	337,155		14,020			351,175
1894	156,826					156,826
1895	307,503			74,991		382,494
1896	298,885			114,110		412,995
1897	242,324	5,932		154,492	51,537	454,285
1898	83,696			84,643		168,339
1899	161,783			215,406		377,189
1900	154,871			292,001		446,872
1901	199,764			322,142	12,691	[b]552,248
Total	3,684,824	5,932	20,438	1,257,785	64,228	5,050,858

	Long tons.
Total shipments to the United States	4,980,698
Total shipments to other countries	70,160

[a] This company met with financial disaster, and the mines that it operated in 1892 and 1893 are now idle.

[b] Including 17,651 tons shipped to the United States in 1901 by the Cuban Steel Ore Company, which has quit business.

PRODUCTION OF PIG IRON.

The total production of pig iron in the United States in the last ninety-two years is shown in the following table. Prior to 1854 the statistics given were compiled by various Government and other statistical agencies. For 1854 and all succeeding years the statistics were gathered by the American Iron and Steel Association. The statistics for 1810, 1840, and 1850 are census figures. The figures for 1820 and 1830 are estimates made by early statisticians. Census statistics for these years are wanting.

Production of pig iron in the United States, 1810–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1810	53,908	1860	821,223	1881	4,144,254
1820	20,000	1861	653,164	1882	4,623,323
1828	130,000	1862	703,270	1883	4,595,510
1829	142,000	1863	846,075	1884	4,097,868
1830	165,000	1864	1,014,282	1885	4,044,526
1831	191,000	1865	831,770	1886	5,683,329
1832	200,000	1866	1,205,663	1887	6,417,148
1840	286,903	1867	1,305,023	1888	6,489,738
1842	215,000	1868	1,431,250	1889	7,603,642
1846	765,000	1869	1,711,287	1890	9,202,703
1847	800,000	1870	1,665,179	1891	8,279,870
1848	800,000	1871	1,706,793	1892	9,157,000
1849	650,000	1872	2,548,713	1893	7,124,502
1850	563,755	1873	2,560,963	1894	6,657,388
1852	500,000	1874	2,401,262	1895	9,446,308
1854	657,337	1875	2,023,733	1896	8,623,127
1855	700,159	1876	1,868,961	1897	9,652,680
1856	788,515	1877	2,066,594	1898	11,773,934
1857	712,640	1878	2,301,215	1899	13,620,703
1858	629,548	1879	2,741,853	1900	13,789,242
1859	750,560	1880	3,835,191	1901	15,878,354

AVERAGE YEARLY PRICES OF PIG IRON.

The following table shows the average yearly prices of pig iron in the United States from 1842 to 1902, inclusive:

Average yearly prices of pig iron in the United States, 1842–1902.

Year.	No. 1 foundry pig iron at Philadelphia.	Gray forge pig iron at Philadelphia.	Gray forge pig iron, lake ore, at Pittsburg.	Bessemer pig iron at Pittsburg.	Year.	No. 1 foundry pig iron at Philadelphia.	Gray forge pig iron at Philadelphia.	Gray forge pig iron, lake ore, at Pittsburg.	Bessemer pig iron at Pittsburg.
1842	$25.60	....	....	....	1873	$42.75	....	$35.80	....
1844	25.75	....	....	....	1874	30.25	....	27.16	....
1845	29.25	....	....	....	1875	25.50	....	23.67	....
1846	27.88	....	....	....	1876	22.25	....	21.74	....
1847	30.25	....	....	....	1877	18.88	....	20.60	....
1848	26.50	....	....	....	1878	17.63	....	18.09	....
1849	22.75	....	....	....	1879	21.50	....	22.15	....
1850	20.88	....	....	....	1880	28.50	....	27.98	....
1851	21.38	....	....	....	1881	25.12	....	22.94	....
1852	22.63	....	....	....	1882	25.75	$22.60	23.84	....
1853	36.12	....	....	....	1883	22.38	19.33	19.04	....
1854	36.88	....	....	....	1884	19.88	17.71	17.17	....
1855	27.75	....	....	....	1885	18.00	15.58	15.27	....
1856	27.12	....	....	....	1886	18.71	16.40	16.58	$18.96
1857	26.38	....	....	....	1887	20.92	17.79	19.02	21.37
1858	22.25	....	....	....	1888	18.88	16.21	15.99	17.38
1859	23.38	....	....	....	1889	17.75	15.48	15.37	18.00
1860	22.75	....	....	....	1890	18.40	15.82	15.78	18.85
1861	20.25	....	....	....	1891	17.52	14.52	14.06	15.95
1862	23.88	....	....	....	1892	15.75	13.54	12.81	14.37
1863	35.25	....	....	....	1893	14.52	12.73	11.77	12.87
1864	59.25	....	....	....	1894	12.66	10.73	9.75	11.38
1865	46.12	....	....	....	1895	13.10	11.49	10.94	12.72
1866	46.88	....	....	....	1896	12.95	11.09	10.39	12.14
1867	44.12	....	....	....	1897	12.10	10.48	9.03	10.13
1868	39.25	....	....	....	1898	11.66	10.23	9.18	10.33
1869	40.63	....	....	....	1899	19.36	16.60	16.72	19.03
1870	33.25	....	....	....	1900	19.98	16.49	16.90	19.49
1871	35.12	....	....	....	1901	15.87	14.08	14.20	15.93
1872	48.88	....	....	....	1902	22.19	19.20	19.49	20.67

PRODUCTION OF BESSEMER STEEL.

The following table gives the production of Bessemer steel in the United States, in long tons, from 1867 to 1901, inclusive:

Production of Bessemer steel in the United States, 1867–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1867	2,679	1879	829,439	1891	3,247,417
1868	7,589	1880	1,074,262	1892	4,168,435
1869	10,714	1881	1,374,247	1893	3,215,686
1870	37,500	1882	1,514,687	1894	3,571,313
1871	40,179	1883	1,477,345	1895	4,909,128
1872	107,239	1884	1,375,531	1896	3,919,906
1873	152,368	1885	1,519,430	1897	5,475,315
1874	171,369	1886	2,269,190	1898	6,609,017
1875	335,283	1887	2,936,033	1899	7,586,354
1876	469,639	1888	2,511,161	1900	6,684,770
1877	500,524	1889	2,930,204	1901	8,713,302
1878	653,773	1890	3,688,871		

PRODUCTION OF OPEN-HEARTH STEEL.

The following table gives the production of open-hearth steel in the United States, in long tons, from 1869 to 1901, inclusive:

Production of open-hearth steel in the United States, 1869–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1869	893	1880	100,851	1891	579,753
1870	1,339	1881	131,202	1892	669,889
1871	1,785	1882	143,341	1893	737,890
1872	2,679	1883	119,356	1894	784,936
1873	3,125	1884	117,515	1895	1,137,182
1874	6,250	1885	133,376	1896	1,298,700
1875	8,080	1886	218,973	1897	1,608,671
1876	19,187	1887	322,069	1898	2,230,292
1877	22,349	1888	314,318	1899	2,947,316
1878	32,255	1889	374,543	1900	3,398,135
1879	50,259	1890	513,232	1901	4,656,309

TOTAL STEEL PRODUCTION.

The production of steel in the United States in the census year 1810 is returned at 917 long tons. We have no further steel statistics until the census year 1860, when 11,838 long tons are reported to have been made. No additional statistics are of record until 1863, when the production fell to 8,075 tons. From 1867 until 1901 the production of all kinds of crude steel, including steel castings, is shown in the following table:

Total steel production in the United States, 1867–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1867	19,643	1879	935,273	1891	3,904,240
1868	26,786	1880	1,247,335	1892	4,927,581
1869	31,250	1881	1,588,314	1893	4,019,995
1870	68,750	1882	1,736,692	1894	4,412,032
1871	73,214	1883	1,673,535	1895	6,114,834
1872	142,954	1884	1,550,879	1896	5,281,689
1873	198,796	1885	1,711,920	1897	7,156,957
1874	215,727	1886	2,562,503	1898	8,932,857
1875	389,799	1887	3,339,071	1899	10,639,857
1876	533,191	1888	2,899,440	1900	10,188,329
1877	569,618	1889	3,385,732	1901	13,473,595
1878	731,977	1890	4,277,071		

PRODUCTION AND PRICES OF BESSEMER STEEL RAILS.

The following table gives the annual production in long tons of Bessemer steel rails in the United States from 1869 to 1901, together with their average annual price at works in Pennsylvania and the rates of duty imposed on foreign steel rails. The prices given are all in currency. The premium on gold is not considered.

Production and prices of Bessemer steel rails in the United States, 1869–1901.

Year.	Quantity.	Price.	Duty.
	Long tons.		
1869	8,616	$132.25	45 per cent ad valorem to Jan. 1, 1871.
1870	30,357	106.75	
1871	34,152	102.50	$28 per ton from Jan. 1, 1871, to Aug. 1, 1872; $25.20 from Aug. 1, 1872, to Mar. 3, 1875; $28 from Mar. 3, 1875, to July 1, 1883.
1872	83,991	112.00	
1873	115,192	120.50	
1874	129,414	94.25	
1875	259,699	68.75	
1876	368,269	59.25	
1877	385,865	45.50	
1878	491,427	42.25	
1879	610,682	48.25	
1880	852,196	67.50	
1881	1,187,770	61.13	
1882	1,284,067	48.50	
1883	1,148,709	37.75	$17 per ton from July 1, 1883, to Oct. 6, 1890.
1884	996,983	30.75	
1885	959,471	28.50	
1886	1,574,703	34.50	
1887	2,101,904	37.08	
1888	1,386,277	29.83	
1889	1,510,057	29.25	
1890	1,867,837	31.75	$13.44 per ton from Oct. 6, 1890, to Aug. 28, 1894.
1891	1,293,053	29.92	
1892	1,537,588	30.00	
1893	1,129,400	28.12	
1894	1,016,013	24.00	$7.84 per ton from Aug. 28, 1894.
1895	1,299,628	24.33	
1896	1,116,958	28.00	
1897	1,644,520	18.75	
1898	1,976,702	17.62	
1899	2,270,585	28.12	
1900	2,383,654	32.29	
1901	2,870,816	27.33	

GREAT BRITAIN.

PRODUCTION OF PIG IRON.

The following table gives the official Government statistics of the production of pig iron in the United Kingdom from 1740 to 1901. As there has been no iron industry in Ireland since about 1740 the figures given relate solely to the production of pig iron by England, Scotland, and Wales:

Production of pig iron in Great Britain, 1740–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1740	17,350	1856	3,586,377	1879	5,995,337
1788	68,300	1857	3,659,447	1880	7,749,233
1796	125,079	1858	3,456,064	1881	8,144,449
1806	243,851	1859	3,712,904	1882	8,586,680
1818	325,000	1860	3,826,752	1883	8,529,300
1820	400,000	1861	3,712,390	1884	7,811,727
1823	455,166	1862	3,943,469	1885	7,415,469
1825	581,367	1863	4,510,040	1886	7,009,754
1827	690,000	1864	4,767,951	1887	7,559,518
1828	703,184	1865	4,825,254	1888	7,998,969
1830	677,417	1866	4,523,897	1889	8,322,824
1833	700,000	1867	4,761,023	1890	7,904,214
1836	1,000,000	1868	4,970,206	1891	7,406,064
1839	1,248,781	1869	5,445,757	1892	6,709,255
1840	1,396,400	1870	5,963,515	1893	6,976,990
1842	1,099,138	1871	6,627,179	1894	7,427,342
1843	1,215,350	1872	6,741,929	1895	7,703,459
1844	1,999,608	1873	6,566,451	1896	8,659,681
1845	1,512,500	1874	5,991,408	1897	8,796,465
1847	1,999,508	1875	6,365,462	1898	8,609,719
1852	2,701,000	1876	6,555,997	1899	9,421,435
1854	3,069,838	1877	6,608,664	1900	8,959,691
1855	3,218,154	1878	6,381,051	1901	7,928,647

Great Britain's maximum production of pig iron was reached in 1899.

PRODUCTION OF COAL.

Great Britain has not been dependent upon any other country for any part of her supply of mineral fuel; she is, indeed, an exporter of coal in large quantities. The following table, compiled from the reports of His Majesty's inspectors of mines, gives the official statistics of the production of coal in Great Britain from 1854 to 1901:

Production of coal in Great Britain, 1854–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1854	64,661,401	1870	110,431,192	1886	157,518,482
1855	64,453,070	1871	117,352,028	1887	162,119,812
1856	66,645,450	1872	123,497,316	1888	169,935,219
1857	65,394,707	1873	128,680,131	1889	176,916,724
1858	65,008,649	1874	126,590,108	1890	181,614,288
1859	71,979,765	1875	133,306,485	1891	185,479,126
1860	80,042,698	1876	134,125,166	1892	181,786,871
1861	83,635,214	1877	134,179,968	1893	164,325,795
1862	81,638,338	1878	132,612,063	1894	188,277,525
1863	86,292,215	1879	133,720,393	1895	189,661,362
1864	92,787,873	1880	146,969,409	1896	195,361,260
1865	98,150,587	1881	154,184,300	1897	202,129,931
1866	101,630,544	1882	156,499,977	1898	202,054,516
1867	104,500,480	1883	163,737,327	1899	220,094,781
1868	103,141,157	1884	160,757,779	1900	225,181,300
1869	107,427,557	1885	159,351,418	1901	219,046,945

The maximum production of coal in Great Britain was reached in 1900.

PRODUCTION OF IRON ORE.

The following table of the production of iron ore in the United Kingdom from 1855 to 1901 has been compiled from Mr. Richard Meade's Coal and Iron Industries of the United Kingdon (London, 1882) and from the Mineral Statistics of His Majesty's inspectors of mines:

Production of iron ore in Great Britain, 1855–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1855	9,553,741	1871	16,334,888	1887	13,098,041
1856	10,483,309	1872	15,584,357	1888	14,590,713
1857	9,573,281	1873	15,577,499	1889	14,546,105
1858	8,040,959	1874	14,844,936	1890	13,780,767
1859	7,880,316	1875	15,821,060	1891	12,777,689
1860	8,024,205	1876	16,841,584	1892	11,312,675
1861	7,215,518	1877	16,692,802	1893	11,203,476
1862	7,562,240	1878	15,726,370	1894	12,367,308
1863	9,088,960	1879	14,379,735	1895	12,615,414
1864	10,064,890	1880	18,026,050	1896	13,700,764
1865	9,910,045	1881	17,446,065	1897	13,787,878
1866	9,955,012	1882	18,031,957	1898	14,176,938
1867	10,021,058	1883	17,383,046	1899	14,461,330
1868	10,169,231	1884	16,137,887	1900	14,028,208
1869	11,508,525	1885	15,417,982	1901	12,275,198
1870	14,370,655	1886	14,110,013		

The maximum production of iron ore in Great Britain was reached in 1882. Great Britain is a large importer of iron ore, chiefly from Spain.

PRODUCTION OF BESSEMER STEEL INGOTS.

The statistics of the production of Bessemer and open-hearth steel ingots in Great Britain have been collected by Mr. J. S. Jeans, secretary of the British Iron Trade Association. The production of Bessemer steel ingots from 1868 to 1901 has been as follows, in long tons. There are no trustworthy statistics for earlier years.

Production of Bessemer steel ingots in Great Britain, 1868–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1868	110,000	1880	1,044,382	1892	1,500,810
1869	160,000	1881	1,441,719	1893	1,493,454
1870	215,000	1882	1,673,649	1894	1,535,384
1871	329,000	1883	1,553,380	1895	1,535,225
1872	410,000	1884	1,299,676	1896	1,815,842
1873	496,000	1885	1,304,127	1897	1,884,155
1874	540,000	1886	1,570,520	1898	1,759,386
1875	620,000	1887	2,089,403	1899	1,825,074
1876	700,000	1888	2,032,794	1900	1,745,004
1877	750,000	1889	2,140,791	1901	1,606,253
1878	807,527	1890	2,014,843		
1879	834,511	1891	1,642,005		

PRODUCTION OF OPEN-HEARTH STEEL INGOTS.

The production of open-hearth steel ingots in Great Britain from 1873 to 1901 has been as follows. Authentic statistics for earlier years are wanting. In 1894 the production of open-hearth steel first exceeded that of Bessemer steel:

Production of open-hearth steel ingots in Great Britain, 1873–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1873	77,500	1883	455,500	1893	1,456,309
1874	90,500	1884	475,250	1894	1,575,318
1875	88,000	1885	583,918	1895	1,754,737
1876	128,000	1886	694,150	1896	2,317,555
1877	137,000	1887	981,104	1897	2,601,806
1878	175,500	1888	1,292,742	1898	2,806,600
1879	175,000	1889	1,429,169	1899	3,030,251
1880	251,000	1890	1,564,200	1900	3,156,050
1881	338,000	1891	1,514,538	1901	3,297,791
1882	436,000	1892	1,418,830		

TOTAL PRODUCTION OF STEEL.

The following table, compiled from statistics published by the British Iron Trade Association, gives the production of all kinds of crude steel in Great Britain from 1873 to 1901. We have added to the production of Bessemer and open-hearth ingots an estimated production of crucible ingots and other steel. Steel castings are not included.

Total production of steel in Great Britain, 1873–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1873	653,500	1883	2,088,880	1893	3,049,763
1874	710,500	1884	1,854,926	1894	3,210,702
1875	788,000	1885	1,968,045	1895	3,389,962
1876	908,000	1886	2,344,670	1896	4,233,397
1877	967,000	1887	3,150,507	1897	4,585,961
1878	1,063,027	1888	3,405,536	1898	4,665,986
1879	1,089,511	1889	3,669,960	1899	4,955,325
1880	1,375,382	1890	3,679,043	1900	5,001,054
1881	1,859,719	1891	3,256,543	1901	5,000,000
1882	2,189,649	1892	3,019,640		

Great Britain's maximum production of all kinds of steel was attained in 1900.

GERMANY.

PRODUCTION OF IRON ORE.

In his admirable and unequaled volume on coal and iron in all countries, prepared for the Paris Universal Exposition of 1878, Johann Pechar gives the production of iron ore in Germany and the Grand

Duchy of Luxemburg at various periods prior to 1869 as follows: 1848, 693,725 metric tons; 1853, 903,236 tons; 1857, 1,962,054 tons; 1862, 2,216,023 tons; 1866, 2,996,148 tons; 1867, 3,264,464 tons; 1868, 3,634,302 tons. The production of iron ore in Germany and Luxemburg from 1869 to 1901 is given by Dr. H. Rentzsch as follows, in metric tons. Germany imports iron ore from neighboring countries.

Production of iron ore in Germany and Luxemburg, 1869–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1869	4,083,807	1880	7,238,640	1891	10,657,521
1870	3,839,222	1881	7,573,772	1892	11,539,133
1871	4,368,025	1882	8,263,254	1893	11,457,533
1872	5,895,674	1883	8,756,617	1894	12,392,065
1873	6,177,576	1884	9,005,796	1895	12,349,600
1874	5,137,468	1885	9,157,869	1896	14,162,335
1875	4,730,352	1886	8,485,758	1897	15,465,979
1876	4,711,982	1887	9,351,106	1898	15,901,263
1877	4,980,048	1888	10,664,307	1899	17,989,635
1878	5,462,055	1889	11,002,187	1900	18,964,294
1879	5,859,439	1890	11,406,132	1901	16,570,258

The maximum production of iron ore in Germany and Luxemburg was reached in 1900.

PRODUCTION OF PIG IRON.

The production of pig iron in Germany and Luxemburg in 1844 is said by Dr. Wedding to have amounted to only 171,000 metric tons, and Herr Pechar says that in 1848 it amounted to 205,342 tons. It was not until 1866 that the production reached 1,000,000 tons, in which year it is said by Dr. Wedding to have amounted to 1,046,954 tons. Since 1869 it has been as follows, in metric tons, according to Dr. Rentzsch, of Dresden-Blasewitz, the statistician of the Verein Deutscher Eisen und Stahl Industrieller, who has verified the figures in the table.

Production of pig iron in Germany and Luxemburg, 1869–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1869	1,409,429	1880	2,729,038	1891	4,641,217
1870	1,391,124	1881	2,914,009	1892	4,937,461
1871	1,563,682	1882	3,380,806	1893	4,986,003
1872	1,988,395	1883	3,469,719	1894	5,380,039
1873	2,240,575	1884	3,600,612	1895	5,464,501
1874	1,906,263	1885	3,687,434	1896	6,372,575
1875	2,029,389	1886	3,528,657	1897	6,881,466
1876	1,846,345	1887	4,023,953	1898	7,312,766
1877	1,781,989	1888	4,337,121	1899	8,143,132
1878	2,147,641	1889	4,524,558	1900	8,520,541
1879	2,226,587	1890	4,658,450	1901	7,860,893

Germany's maximum production of pig iron was reached in 1900.

Adding the production of pig iron by Great Britain in 1901 to that of Germany and Luxemburg, and reducing metric tons in the above table to long tons, gives us a total production of pig iron by both countries in 1901 of 15,665,310 long tons, or 213,044 tons less than the production of 15,878,354 tons of pig iron by the United States in that year.

PRODUCTION OF COAL AND LIGNITE.

The following table, for the details of which we are indebted for the earlier years to Dr. Hermann Wedding and for later years to Dr. H. Rentzsch, gives the aggregate production of coal and lignite in Germany and Luxemburg from 1848 to 1901 in metric tons. About one-fourth of the annual production of coal in Germany and Luxemburg is brown coal, or lignite.

Production of coal and lignite in Germany and Luxemburg, 1848–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1848	5,800,985	1872	42,324,467	1887	76,232,618
1853	10,714,556	1873	46,145,194	1888	81,960,083
1857	14,867,121	1874	46,658,145	1889	84,973,230
1860	16,730,492	1875	47,804,054	1890	89,290,834
1861	18,755,361	1876	49,550,461	1891	94,252,278
1862	20,660,677	1877	48,229,882	1892	92,544,030
1863	22,366,203	1878	50,519,899	1893	95,426,153
1864	25,612,899	1879	53,470,716	1894	98,805,702
1865	28,552,762	1880	59,118,035	1895	103,957,639
1866	28,162,805	1881	61,540,485	1896	112,471,106
1867	30,802,889	1882	65,378,211	1897	120,474,485
1868	32,879,123	1883	70,442,648	1898	127,958,550
1869	34,343,913	1884	72,113,820	1899	135,844,419
1870	34,003,004	1885	73,675,515	1900	149,788,256
1871	37,856,110	1886	73,682,584	1901	152,628,931

Of the total production of coal and lignite in Germany and Luxemburg in 1900 there were 40,498,019 tons of brown coal, or lignite, and of the total production in 1901 there were 44,211,902 tons of brown coal. The maximum production of coal and lignite in Germany and Luxemburg was reached in 1901.

PRODUCTION OF FINISHED STEEL.

The following table gives the production of all kinds of finished steel in Germany and Luxemburg from 1866 to 1901 in metric tons. We are indebted to Dr. Rentzsch for a verification of this table. Statistics of Bessemer and open-hearth steel ingots for early years are not available. Steel castings are included in the table.

Production of finished steel in Germany and Luxemburg, 1866–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1866	83,737	1878	483,503	1890	1,613,783
1867	88,589	1879	478,344	1891	1,841,063
1868	92,696	1880	624,418	1892	1,976,735
1869	109,753	1881	840,224	1893	2,231,873
1870	125,814	1882	1,003,406	1894	2,608,713
1871	143,305	1883	859,814	1895	2,831,318
1872	285,582	1884	862,529	1896	3,462,736
1873	310,425	1885	893,742	1897	3,863,469
1874	361,947	1886	954,586	1898	4,352,831
1875	347,337	1887	1,163,884	1899	4,820,275
1876	377,910	1888	1,298,574	1900	4,825,587
1877	402,643	1889	1,425,439	1901	4,552,952

Germany's maximum production of all kinds of finished steel was attained in 1900.

The production of Bessemer and open-hearth steel ingots and castings in Germany and Luxemburg in 1901 was 6,394,222 metric tons. Assuming that the production of crucible steel in Great Britain in 1901 amounted to 95,956 long tons, that country's total production of crude steel in that year would be exactly 5,000,000 tons. Adding Great Britain's production to that of Germany and Luxemburg gives us for both countries a total production in 1901 of 11,293,170 long tons, or 2,180,425 tons less than the production of 13,473,595 tons by the United States in 1901.

FRANCE.

PRODUCTION OF IRON ORE.

The statistical tables for this country which we shall present have been compiled in part from statistics furnished by M. Pinget, of Paris, secretary of the Comité des Forges de France, and in part from official Government statistics. The production of iron ore in France from 1860 to 1901 (not including Algeria, which appears hereafter) has been as follows, in metric tons:

Production of iron ore in France, 1860-1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1860	3,604,638	1877	2,426,278	1890	3,471,718
1865	3,658,464	1878	2,469,953	1891	3,579,286
1866	3,790,168	1879	2,271,173	1892	3,706,748
1867	3,279,395	1880	2,874,263	1893	3,517,438
1868	3,005,094	1881	3,032,070	1894	3,772,101
1869	3,461,672	1882	3,467,251	1895	3,679,767
1870	2,899,593	1883	3,297,853	1896	4,062,390
1871	2,099,706	1884	2,976,948	1897	4,582,236
1872	3,081,026	1885	2,318,104	1898	4,731,394
1873	3,051,124	1886	2,285,648	1899	4,985,702
1874	2,516,548	1887	2,579,465	1900	5,447,694
1875	2,505,870	1888	2,841,757	1901	4,790,732
1876	2,393,340	1889	3,070,389		

The maximum production of iron ore in France was reached in 1900.

PRODUCTION OF FINISHED STEEL.

M. Pinget states that complete statistics of the production of Bessemer, open-hearth, and other steel in the form of ingots are not of record for the early years of this table, and that only the statistics of finished steel, including castings, are obtainable for those years. The following table gives the production of all kinds of finished steel in France from 1860 to 1901, in metric tons, including direct steel castings:

Production of finished steel in France, 1860-1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1860	29,848	1874	208,787	1888	517,294
1861	37,777	1875	256,393	1889	529,302
1862	47,096	1876	241,842	1890	581,998
1863	37,483	1877	269,181	1891	638,530
1864	41,559	1878	312,921	1892	682,527
1865	40,574	1879	333,265	1893	664,032
1866	37,764	1880	388,894	1894	674,190
1867	46,477	1881	422,416	1895	714,523
1868	80,564	1882	458,238	1896	916,817
1869	110,224	1883	521,820	1897	994,891
1870	94,387	1884	502,908	1898	1,174,075
1871	86,126	1885	553,839	1899	1,239,660
1872	141,705	1886	454,000	1900	1,226,537
1873	150,529	1887	493,294	1901	1,175,454

The maximum production of finished steel in France was reached in 1899.

PRODUCTION OF BESSEMER AND OPEN-HEARTH STEEL INGOTS.

The production of Bessemer and open-hearth steel ingots and castings in France from 1888 to 1901 is given in the following table, in metric tons. This table has been revised by M. Pinget. About 20,000 tons of steel castings are made annually.

Production of Bessemer and open-hearth steel ingots in France, 1888–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1888	591,807	1893	789,852	1898	1,433,717
1889	626,232	1894	818,200	1899	1,499,026
1890	683,358	1895	875,974	1900	1,565,164
1891	744,484	1896	1,180,743	1901	1,425,351
1892	825,486	1897	1,325,213		

PRODUCTION OF COAL AND LIGNITE.

The production of coal and lignite in France from 1787 to 1901 has been as follows, in metric tons, about 1 ton in 50 being lignite. France is a large importer of coal from Great Britain and other countries. It also imports coke.

Production of coal and lignite in France, 1787–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1787	215,000	1872	15,802,515	1887	21,287,589
1802	844,180	1873	17,479,341	1888	22,602,894
1812	835,523	1874	16,907,913	1889	24,303,509
1820	1,093,658	1875	16,956,840	1890	26,083,118
1830	1,862,665	1876	17,101,448	1891	26,024,893
1840	3,003,382	1877	16,804,529	1892	26,178,701
1850	4,433,567	1878	16,960,916	1893	25,650,981
1860	8,303,682	1879	17,110,979	1894	27,416,905
1865	11,600,404	1880	19,361,564	1895	28,019,893
1866	12,260,085	1881	19,765,983	1896	29,189,900
1867	12,738,686	1882	20,603,704	1897	30,797,629
1868	13,253,876	1883	21,333,884	1898	32,356,104
1869	13,464,205	1884	20,023,514	1899	32,862,712
1870	13,330,308	1885	19,510,530	1900	33,404,298
1871	13,258,921	1886	19,909,894	1901	32,325,302

The maximum production of coal and lignite in France was reached in 1900.

PRODUCTION OF PIG IRON IN FRANCE.

The production of pig iron in France from 1819 to 1901 has been as follows, in metric tons:

Production of pig iron in France, 1819–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1819	112,500	1870	1,178,114	1886	1,516,574
1830	266,361	1871	859,641	1887	1,567,622
1840	347,774	1872	1,217,838	1888	1,683,349
1850	405,653	1873	1,381,626	1889	1,733,964
1855	849,296	1874	1,415,897	1890	1,962,196
1859	864,399	1875	1,448,272	1891	1,897,387
1860	898,353	1876	1,435,212	1892	2,057,258
1861	966,895	1877	1,506,827	1893	2,003,096
1862	1,090,838	1878	1,521,274	1894	2,069,714
1863	1,156,875	1879	1,400,286	1895	2,003,868
1864	1,212,751	1880	1,725,293	1896	2,339,537
1865	1,203,711	1881	1,886,350	1897	2,484,191
1866	1,260,348	1882	2,039,067	1898	2,525,075
1867	1,229,044	1883	2,069,430	1899	2,578,401
1868	1,235,308	1884	1,871,537	1900	2,714,298
1869	1,380,965	1885	1,630,648	1901	2,388,823

PRODUCTION OF IRON ORE IN ALGERIA.

The production of iron ore in Algeria, which is now regarded as a part of the French Republic, was as follows from 1873 to 1901, in metric tons. All the iron ore mined in Algeria is exported. The figures given below are not included in the production of iron ore in France, already given:

Production of iron ore in Algeria, 1873–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1873	444,718	1883	556,980	1893	393,921
1874	534,524	1884	492,936	1894	343,830
1875	557,285	1885	419,174	1895	318,416
1876	511,569	1886	432,761	1896	374,476
1877	454,236	1887	437,643	1897	441,467
1878	375,838	1888	383,958	1898	473,569
1879	417,853	1889	351,800	1899	550,941
1880	614,146	1890	474,632	1900	601,788
1881	656,646	1891	404,964	1901	514,473
1882	567,119	1892	452,603		

BELGIUM.

PRODUCTION OF IRON ORE.

The statistics of the mining and metallurgical industries of Belgium which we shall present are official Government statistics. This country is a large importer of iron ore, but it is a large producer and exporter of coal. The imports of iron ore into Belgium in recent years have amounted annually to about 2,500,000 tons. Its exports of coal and coke aggregate about 6,000,000 tons annually. The production of iron ore from 1840 to 1901 has been as follows, in metric tons:

Production of iron ore in Belgium, 1840–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1840	191,812	1874	527,050	1888	185,542
1845	394,544	1875	365,044	1889	181,526
1850	299,272	1876	269,206	1890	172,291
1855	852,134	1877	234,127	1891	202,204
1860	809,176	1878	207,157	1892	209,943
1865	1,018,231	1879	195,212	1893	238,783
1866	886,641	1880	253,499	1894	311,222
1867	602,829	1881	223,412	1895	312,637
1868	519,740	1882	208,867	1896	307,031
1869	628,046	1883	215,670	1897	240,774
1870	654,332	1884	176,005	1898	217,370
1871	697,272	1885	187,118	1899	201,445
1872	749,781	1886	152,508	1900	247,890
1873	503,565	1887	172,436	1901	218,780

The maximum production of iron ore in Belgium was reached in 1865.

PRODUCTION OF PIG IRON.

The production of pig iron in Belgium from 1845 to 1901 has been as follows, in metric tons:

Production of pig iron in Belgium, 1845–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1845	134,563	1872	655,565	1887	755,781
1850	144,452	1873	607,373	1888	826,850
1855	294,270	1874	532,790	1889	832,226
1860	319,943	1875	541,805	1890	787,836
1861	311,838	1876	490,508	1891	684,126
1862	356,550	1877	470,488	1892	753,268
1863	392,078	1878	518,646	1893	745,264
1864	449,875	1879	389,330	1894	818,597
1865	470,767	1880	608,084	1895	829,234
1866	482,404	1881	624,736	1896	948,023
1867	423,069	1882	726,946	1897	1,035,037
1868	435,754	1883	783,433	1898	979,755
1869	534,319	1884	750,812	1899	1,024,576
1870	563,468	1885	712,876	1900	1,018,561
1871	609,230	1886	701,677	1901	764,180

PRODUCTION OF STEEL INGOTS.

The production of steel ingots in Belgium from 1865 to 1901 has been as follows, in metric tons:

Production of steel ingots in Belgium, 1865–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1865	650	1886	155,169	1895	407,634
1870	4,321	1887	216,186	1896	598,974
1875	54,420	1888	231,847	1897	616,604
1880	132,052	1889	254,397	1898	653,130
1881	141,640	1890	221,296	1899	731,249
1882	182,627	1891	221,913	1900	655,199
1883	179,489	1892	260,037	1901	515,780
1884	185,916	1893	273,113		
1885	155,012	1894	405,661		

PRODUCTION OF FINISHED STEEL.

The following table gives the production of finished steel in Belgium, including steel rails, in metric tons:

Production of finished steel in Belgium, 1865–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1865	545	1878	102,259	1891	206,305
1866	930	1879	88,952	1892	208,281
1867	1,420	1880	102,772	1893	224,922
1868	1,857	1881	119,237	1894	341,318
1869	2,826	1882	151,291	1895	367,947
1870	4,062	1883	156,301	1896	519,311
1871	6,622	1884	153,999	1897	527,617
1872	12,389	1885	125,461	1898	567,728
1873	18,533	1886	137,771	1899	633,950
1874	30,932	1887	191,445	1900	568,539
1875	45,536	1888	185,417	1901	489,640
1876	64,543	1889	214,561		
1877	90,646	1890	201,817		

PRODUCTION OF COAL.

The following table gives the production of coal in Belgium from 1830 to 1901, in metric tons. The production of lignite is not included:

Production of coal in Belgium, 1830–1901.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*		*Metric tons.*
1830	2,568,054	1873	15,778,401	1888	19,218,481
1835	2,638,731	1874	14,669,029	1889	19,869,980
1840	3,929,962	1875	15,011,331	1890	20,365,960
1845	4,919,156	1876	14,329,578	1891	19,675,644
1850	5,820,588	1877	13,669,077	1892	19,583,173
1855	8,409,330	1878	14,899,175	1893	19,410,519
1860	9,610,895	1879	15,447,292	1894	20,534,501
1865	11,840,703	1880	16,886,698	1895	20,450,604
1866	12,774,662	1881	16,873,951	1896	21,252,370
1867	12,755,822	1882	17,590,989	1897	21,492,446
1868	12,298,589	1883	18,177,754	1898	22,088,335
1869	12,943,994	1884	18,051,499	1899	22,072,068
1870	13,697,118	1885	17,437,603	1900	23,462,817
1871	13,733,176	1886	17,285,543	1901	22,213,410
1872	15,658,948	1887	18,378,624		

GOLD AND SILVER.

By George E. Roberts,
Director of the Mint.

PRODUCTION.

The statistics of the production of gold and silver are furnished, as heretofore, by the Director of the Mint, to whom the statistics collected from the gold and silver mines have also been submitted.

During the calendar year 1902 the United States produced 3,870,000 fine ounces of gold, valued at $80,000,000, an increase of $1,333,300, or 1.69 per cent as compared with the yield of 1901.

Eight of the nineteen States and Territories yielding gold showed an increased production, Alaska leading with $1,460,100, an increase most marked in the quartz mines. Colorado showed an increase of $775,200. It may be stated that the general values of the ores mined throughout the State were lower than formerly, yet the tonnage has, in almost every instance, been greater. South Dakota also made a gain of $485,900; South Carolina, $75,200; North Carolina, $35,200; Wyoming, $26,100; Arizona, $29,300, and Maryland, $2,520.

The greatest decrease, amounting to $394,300, was in Idaho; this was due to the lack of water and to the shortness of the season. Montana also showed a decrease of $370,500, due to the steady decline which has taken place for years in the productivity of the placers. Other decreases were: New Mexico, $157,300; California, $99,300; Utah, $95,700; Nevada, $68,500.

The silver yield for 1902 amounted to 55,500,000 ounces, of the commercial value of $29,415,000, an increase of 286,000 ounces, or 0.51 per cent. The greatest gain, 1,933,700 ounces, was in Nevada, due chiefly to developments in the rich Tonopah district in Nye County. Idaho, Washington, South Dakota, Arizona, and Montana also made substantial gains. The production of Colorado, owing to the decline in the grade of ores extracted, fell off 2,761,800 fine ounces; the yield of New Mexico diminished 106,200 ounces; Oregon, 66,800; Texas, 26,200; California, 24,800, and Wyoming, 16,400.

The total value of the precious metals produced by the United States in 1902 (silver at commercial value), amounted to $109,415,000, which was $2,380,100, or 2.17 per cent less than the yield for 1901.

The following table shows the production of gold and silver in the United States from 1792 to 1902, inclusive:

Production of gold and silver in the United States from 1792.

[The estimates for 1792 to 1873 are by Dr. R. W. Raymond, United States mining commissioner, and since by the Director of the Mint.]

Year.	Total.	Gold.	Silver (coining value).
April 2, 1792, to July 31, 1834	$14,000,000	$14,000,000	Small.
July 31, 1834, to Dec. 31, 1844	7,750,000	7,500,000	$250,000
1845	1,058,327	1,008,327	50,000
1846	1,189,357	1,139,357	50,000
1847	939,085	889,085	50,000
1848	10,050,000	10,000,000	50,000
1849	40,050,000	40,000,000	50,000
1850	50,050,000	50,000,000	50,000
1851	55,050,000	55,000,000	50,000
1852	60,050,000	60,000,000	50,000
1853	65,050,000	65,000,000	50,000
1854	60,050,000	60,000,000	50,000
1855	55,050,000	55,000,000	50,000
1856	55,050,000	55,000,000	50,000
1857	55,050,000	55,000,000	50,000
1858	50,500,000	50,000,000	500,000
1859	50,100,000	50,000,000	100,000
1860	46,150,000	46,000,000	150,000
1861	45,000,000	43,000,000	2,000,000
1862	43,700,000	39,200,000	4,500,000
1863	48,500,000	40,000,000	8,500,000
1864	57,100,000	46,100,000	11,000,000
1865	64,475,000	53,225,000	11,250,000
1866	63,500,000	53,500,000	10,000,000
1867	65,225,000	51,725,000	13,500,000
1868	60,000,000	48,000,000	12,000,000
1869	61,500,000	49,500,000	12,000,000
1870	66,000,000	50,000,000	16,000,000
1871	66,500,000	43,500,000	23,000,000
1872	64,750,000	36,000,000	28,750,000
1873	71,750,000	36,000,000	35,750,000
1874	70,800,000	33,500,000	37,300,000
1875	65,100,000	33,400,000	31,700,000
1876	78,700,000	39,900,000	38,800,000
1877	86,700,000	46,900,000	39,800,000
1878	96,400,000	51,200,000	45,200,000
1879	79,700,000	38,900,000	40,800,000
1880	75,200,000	36,000,000	39,200,000
1881	77,700,000	34,700,000	43,000,000
1882	79,300,000	32,500,000	46,800,000
1883	76,200,000	30,000,000	46,200,000
1884	79,600,000	30,800,000	48,800,000
1885	83,400,000	31,800,000	51,600,000
1886	86,000,000	35,000,000	51,000,000
1887	86,350,000	33,000,000	53,350,000
1888	92,370,000	33,175,000	59,195,000
1889:			
Mint	97,446,000	32,800,000	64,646,000
Census	99,282,866	32,886,180	66,396,686

Production of gold and silver in the United States from 1792—Continued.

Year.	Total.	Gold.	Silver (coining value).
1890	$103,309,645	$32,845,000	$70,464,645
1891	108,591,565	33,175,000	75,416,565
1892	115,009,150	33,000,000	82,099,150
1893	113,525,757	35,950,000	77,575,757
1894	103,500,000	39,500,000	64,000,000
1895	118,661,000	46,610,000	72,051,000
1896	129,157,236	53,088,000	76,069,236
1897	127,000,172	57,363,000	69,637,172
1898	134,847,485	64,463,000	70,384,485
1899	141,860,026	71,053,400	70,806,626
1900	153,704,495	79,171,000	74,533,495
1901	150,054,500	78,666,700	71,387,800
1902	151,758,000	80,000,000	71,757,575

The following table shows the production of gold in the United States in 1901 and 1902 and the increase or decrease in 1902, by States and Territories:

Production of gold in the several States and Territories in 1901 and 1902 and the increase or decrease of the production of each in the latter year.

State or Territory.	Value.			
	1901.	1902.	Increase.	Decrease.
Alabama	$3,100	$2,500	....	$600
Alaska	6,885,700	8,345,800	$1,460,100	....
Arizona	4,083,000	4,112,300	29,300	....
California	16,891,400	16,792,100	....	99,300
Colorado	27,693,500	28,468,700	775,200	....
Georgia	124,500	97,800	....	26,700
Idaho	1,869,300	1,475,000	....	394,300
Maryland	....	2,500	2,500	....
Michigan	30,800	....	....	30,800
Montana	4,744,100	4,373,600	....	370,500
Nevada	2,963,800	2,895,300	....	68,500
New Mexico	688,400	531,100	....	157,300
North Carolina	55,500	90,700	35,200	....
Oregon	1,818,100	1,816,700	....	1,400
South Carolina	46,700	121,900	75,200	....
South Dakota	6,479,500	6,965,400	485,900	....
Texas	600	....	....	600
Utah	3,690,200	3,594,500	....	95,700
Virginia	5,300	3,100	....	2,200
Washington	580,500	272,200	....	308,300
Wyoming	12,700	38,800	26,100	....
Total	78,666,700	80,000,000	2,889,500	1,556,200
Net increase	....	....	1,333,300	....

The following table shows the production of silver in the United States in 1901 and 1902 and the increase or decrease in 1902, by States and Territories:

Production of silver in the several States and Territories in 1901 and 1902, and the increase or decrease of the production of each in the latter year.

State or Territory.	Weight.			
	1901.	1902.	Increase.	Decrease.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
Alabama	100	100		
Alaska	47,900	92,000	44,100	
Arizona	2,812,400	3,043,100	230,700	
California	925,600	900,800		24,800
Colorado	18,437,800	15,676,000		2,761,800
Georgia	400	400		
Idaho	5,542,900	5,854,800	311,900	
Michigan	81,000	110,800	29,800	
Montana	13,131,700	13,243,800	112,100	
Nevada	1,812,500	3,746,200	1,933,700	
New Mexico	563,400	457,200		106,200
North Carolina	20,300	20,900	600	
Oregon	160,100	93,300		66,800
South Carolina	200	300	100	
South Dakota	78,000	340,200	262,200	
Tennessee		12,300	12,300	
Texas	472,400	446,200		26,200
Utah	10,760,800	10,831,700	70,900	
Virginia	700	5,900	5,200	
Washington	344,400	619,000	274,600	
Wyoming	21,400	5,000		16,400
Total	55,214,000	[a]55,500,000	3,288,200	3,002,200
Net increase			286,000	

[a] Commercial value, $29,415,000; coining value, $71,757,575.

The following table shows the approximate distribution of the production, by States and Territories, of gold and silver in the United States in 1902:

Approximate distribution of the production of gold and silver in the United States for the calendar year 1902, by producing States and Territories.

[As estimated by the Director of the Mint.]

State or Territory.	Gold.		Silver.			Total value (silver at commercial value).
	Fine ounces.	Value.	Fine ounces.	Coining value.	Commercial value.	
Alabama	119	$2,500	100	$129	$53	$2,553
Alaska	403,730	8,345,800	92,000	118,950	48,760	8,394,560
Arizona	198,933	4,112,300	3,043,100	3,934,513	1,612,843	5,725,143
California	812,319	16,792,100	900,800	1,164,671	477,424	17,269,524
Colorado	1,377,175	28,468,700	15,676,000	20,267,960	8,308,280	36,776,980
Georgia	4,730	97,800	400	517	212	98,012
Idaho	71,352	1,475,000	5,854,800	7,569,842	3,103,044	4,578,044
Maryland	121	2,500				2,500
Michigan			110,800	143,257	58,724	58,724

Approximate distribution of the production of gold and silver, etc.—Continued.

State or Territory.	Gold.		Silver.			Total value (silver at commercial value).
	Fine ounces.	Value.	Fine ounces.	Coining value.	Commercial value.	
Montana	211,571	$4,373,600	13,243,800	$17,123,297	$7,019,214	$11,392,814
Nevada	140,059	2,895,300	3,746,200	4,843,572	1,985,486	4,880,786
New Mexico	25,693	531,100	457,200	591,127	242,316	773,416
North Carolina	4,390	90,700	20,900	27,022	11,077	101,777
Oregon	87,881	1,816,700	93,300	120,630	49,449	1,866,149
South Carolina	5,896	121,900	300	388	159	122,059
South Dakota	336,952	6,965,400	340,200	439,855	180,306	7,145,706
Tennessee	....	....	12,300	15,903	6,519	6,519
Texas	....	....	446,200	576,905	236,486	236,486
Utah	173,886	3,594,500	10,831,700	14,004,622	5,740,801	9,335,301
Virginia	148	3,100	5,900	7,628	3,127	6,227
Washington	13,166	272,200	619,000	800,323	328,070	600,270
Wyoming	1,879	38,800	5,000	6,464	2,650	41,450
Total	3,870,000	80,000,000	55,500,000	71,757,575	29,415,000	109,415,000

The following table shows the distribution of the production of gold and silver in 1902 according to sources of production:

Distribution of the production of gold and silver in the United States for the calendar year 1902 as to sources of production.

[As reported by mint officers and agents.]

State or Territory.	Gold.		Silver.		
	Quartz.	Placer.	Quartz.	Lead ores.	Copper ores.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
Alabama	117	25	95	....	....
Alaska	124,156	276,554	89,388	....	....
Arizona	199,140	2,100	1,837,000	203,000	1,130,000
California	612,559	205,478	168,582	285,917	22,257
Colorado	1,348,046	31,441	3,476,192	a 12,324,766	....
Georgia	4,130	1,035	581	....	....
Idaho	38,500	34,547	713,786	5,228,928	....
Maryland	94	37	3	....	....
Michigan	....	....	....	....	110,844
Montana	191,229	21,626	4,160,284	410,738	9,058,715
Nevada	144,211	757	3,516,259	482,124	....
New Mexico	12,297	6,312	178,390	47,929	54,171
North Carolina	3,727	803	....	....	23,368
Oregon	77,086	11,798	107,463	2,000	....
South Carolina	7,257	226	580	....	....
South Dakota	345,715	....	351,000	....	....
Tennessee	....	7	1	....	....
Texas	....	....	446,166	....	....
Utah	192,157	....	1,568,227	8,700,218	2,409,592
Virginia	181	27	....	....	1,344
Washington	15,115	3,000	369,450	350,000	2,000
Wyoming	....	2,188	5,200	....	....
Total	3,315,717	597,964	16,988,647	28,035,620	12,812,291

a Lead and copper ores.

The following table shows the production of gold in the famous Cripple Creek district of Colorado for the eleven years from 1892 to 1902, inclusive:

Production of gold in Cripple Creek district, Colorado, 1892–1902.

1892	$583,010
1893	2,010,367
1894	2,908,702
1895	6,879,137
1896	7,512,911
1897	10,139,708
1898	13,507,244
1899	15,658,254
1900	18,073,539
1901	17,261,579
1902	16,912,783
Total	111,447,234

The following table shows the production of gold in the United States in 1900 and 1901, and the increase or decrease in 1901, by States and Territories:

Production of gold in the United States in 1900 and 1901, and the increase or decrease in 1901, by States and Territories.

State or Territory.	1900.	1901.	Increase.	Decrease.
Alaska	$8,171,000	$6,885,700		$1,285,300
Arizona	4,193,400	4,083,000		110,400
California	15,816,200	16,891,400	$1,075,200	
Colorado	28,829,400	27,693,500		1,135,900
Georgia	116,700	124,500	7,800	
Idaho	1,724,700	1,869,300	144,600	
Michigan	29,000	30,800	1,800	
Montana	4,698,000	4,744,100	46,100	
Nevada	2,006,200	2,963,800	957,600	
New Mexico	832,900	688,400		144,500
North Carolina	28,500	55,500	27,000	
Oregon	1,694,700	1,818,100	123,400	
South Carolina	121,000	46,700		74,300
South Dakota	6,177,600	6,479,500	301,900	
Texas	1,100	600		500
Utah	3,972,200	3,690,200		282,000
Washington	718,200	580,500		137,700
Wyoming	34,200	12,700		21,500
Alabama, Maryland, Missouri, Tennessee, Virginia	6,000	8,400	2,400	
Total	79,171,000	78,666,700	2,687,800	3,192,100
Net decrease				504,300

The following table shows the production of silver in the United States in 1900 and 1901, and the increase or decrease in 1901, by States and Territories:

Production of silver in the United States in 1900 and 1901, and the increase or decrease in 1901, by States and Territories.

State or Territory.	Weight.			
	1900.	1901.	Increase.	Decrease.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
Alabama	100	100		
Alaska	73,300	47,900		25,400
Arizona	2,995,500	2,812,400		183,100
California	941,400	925,600		15,800
Colorado	20,483,900	18,437,800		2,046,100
Georgia	400	400		
Idaho	6,429,100	5,542,900		886,200
Michigan	102,000	81,000		21,000
Montana	14,195,400	13,131,700		1,063,700
Nevada	1,358,700	1,812,500	453,800	
New Mexico	434,300	563,400	129,100	
North Carolina	11,200	20,300	9,100	
Oregon	115,400	160,100	44,700	
South Carolina	400	200		200
South Dakota	536,200	78,000		458,200
Texas	477,400	472,400		5,000
Utah	9,267,600	10,760,800	1,493,200	
Virginia		700	700	
Washington	224,500	344,400	119,900	
Wyoming	200	21,400	21,200	
Total	57,647,000	[a] 55,214,000	2,271,700	4,704,700
Net decrease				2,433,000

[a] Commercial value, $33,128,400; coining value, $71,387,800.

The following table shows the distribution of the production of gold and silver in the United States in 1900, by producing States and Territories:

Approximate distribution of the production of gold and silver in the United States for the calendar year 1900, by producing States and Territories.

[As estimated by the Director of the Mint.]

State or Territory.	Gold.		Silver.			Total value (silver at commercial value).
	Quantity.	Value.	Quantity.	Coining value.	Commercial value.	
	Fine ounces.		*Fine ounces.*			
Alabama	92	$1,900	100	$129	$62	$1,962
Alaska	395,271	8,171,000	73,300	94,772	45,446	8,216,446
Arizona	202,856	4,193,400	2,995,500	3,872,970	1,857,210	6,050,610
California	765,109	15,816,200	941,400	1,217,165	583,668	16,399,868
Colorado	1,394,622	28,829,400	20,483,900	26,484,234	12,700,018	41,529,418
Georgia	5,644	116,700	400	517	248	116,948
Idaho	83,433	1,724,700	6,429,100	8,312,372	3,986,042	5,710,742
Maryland	5	100				100
Michigan	1,403	29,000	102,000	131,879	63,240	92,240
Missouri	33	700				700

Approximate distribution of the production of gold and silver, etc.—Continued.

State or Territory.	Gold.		Silver.			Total value (silver at commercial value.
	Quantity.	Value.	Quantity.	Coining value.	Commercial value.	
	Fine ounces.		*Fine ounces.*			
Montana	227,266	$4,698,000	14,195,400	$18,353,648	$8,801,148	$13,499,148
Nevada	97,050	2,006,200	1,358,700	1,756,703	842,394	2,848,594
New Mexico	40,292	832,900	434,300	561,519	269,266	1,102,166
North Carolina	1,379	28,500	11,200	14,481	6,944	35,444
Oregon	81,980	1,694,700	115,400	149,204	71,548	1,766,248
South Carolina	5,854	121,000	400	517	248	121,248
South Dakota	298,842	6,177,600	536,200	693,269	332,444	6,510,044
Tennessee	5	100	....	....	....	100
Texas	53	1,100	477,400	617,244	295,988	297,088
Utah	192,155	3,972,200	9,267,600	11,982,351	5,745,912	9,718,112
Virginia	155	3,200	....	....	....	3,200
Washington	34,743	718,200	224,500	290,263	139,190	857,390
Wyoming	1,655	34,200	200	258	124	34,324
Total	3,829,897	79,171,000	57,647,000	74,533,495	35,741,140	114,912,140

The following table shows the distribution of the production of gold and silver in the United States in 1901, by producing States and Territories:

Approximate distribution of the production of gold and silver in the United States for the calendar year 1901, by producing States and Territories.

[As estimated by the Director of the Mint.]

State or Territory.	Gold.		Silver.			Total value (silver at commercial value).
	Quantity.	Value.	Quantity.	Coining value.	Commercial value.	
	Fine ounces.		*Fine ounces.*			
Alabama	150	$3,100	100	$129	$60	$3,160
Alaska	333,096	6,885,700	47,900	61,931	28,740	6,914,440
Arizona	197,515	4,083,000	2,812,400	3,636,234	1,687,440	5,770,440
California	817,121	16,891,400	925,600	1,196,736	555,360	17,446,760
Colorado	1,339,673	27,693,500	18,437,800	23,838,772	11,062,680	38,756,180
Georgia	6,023	124,500	400	517	240	124,740
Idaho	90,427	1,869,300	5,542,900	7,166,578	3,325,740	5,195,040
Michigan	1,490	30,800	81,000	104,727	48,600	79,400
Montana	229,495	4,744,100	13,131,700	16,978,360	7,879,020	12,623,120
Nevada	143,374	2,963,800	1,812,500	2,343,435	1,087,500	4,051,300
New Mexico	33,302	688,400	563,400	728,436	338,040	1,026,440
North Carolina	2,685	55,500	20,300	26,246	12,180	67,680
Oregon	87,950	1,818,100	160,100	206,998	96,060	1,914,160
South Carolina	2,259	46,700	200	259	120	46,820
South Dakota	313,446	6,479,500	78,000	100,849	46,800	6,526,300
Texas	29	600	472,400	610,780	283,440	284,040
Utah	178,513	3,690,200	10,760,800	13,912,954	6,456,480	10,146,680
Virginia	256	5,300	700	905	420	5,720
Washington	28,082	580,500	344,400	445,285	206,640	787,140
Wyoming	614	12,700	21,400	27,669	12,840	25,540
Total	3,805,500	78,666,700	55,214,000	71,387,800	33,128,400	111,795,100

The following table shows the distribution of the production of gold and silver in 1901 according to sources of production:

Distribution of the production of gold and silver in the United States for the calendar year 1901, as to sources of production.

[As reported by officers and agents of the Mint.]

State or Territory.	Gold.		Silver.		
	Quartz.	Placer.	Quartz.	Lead ores.	Copper ores.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
Alabama	116	67	41		
Alaska	94,957	240,389	51,433		
Arizona	197,900	5,081	1,795,000	205,000	1,200,000
California	630,713	191,132	195,369	47,122	708,340
Colorado	1,313,687	29,025	4,639,267	[a] 13,917,801	
Georgia	6,266	873	673		
Idaho	56,289	36,461	1,080,352	4,511,382	
Maryland	7				
Michigan	1,490				81,031
Montana	207,045	25,286	3,646,623	397,029	10,136,893
Nevada	148,321	1,621	1,619,443	402,188	
New Mexico	31,768	2,889	201,785	130,626	435,419
North Carolina	2,026	896		99	26,216
Oregon	19,969	68,790	160,503	3,370	
South Carolina	5,775	383	307		
South Dakota	314,855		84,461		
Tennessee	12			5	
Texas	30		472,423		
Utah	184,803		1,761,234	7,357,482	2,201,144
Virginia	185	128	617		427
Washington	27,034	4,953	329,677	46,240	1,464
Wyoming		2,000	25,000		
Total	3,243,248	609,974	16,064,208	27,018,344	14,790,934

[a] Lead and copper ores.

MANGANESE ORES.

By John Birkinbine.

PRODUCTION.

SUMMARY OF PRODUCTION AND VALUE.

The quantity of manganese ore produced in the United States in the year 1902 was 16,477 long tons, valued at $177,911. This is an increase of 4,482 long tons and $61,189 over the 1901 production of 11,995 long tons, valued at $116,722, and is the largest amount mined since the year 1891.

The following table presents by States the production, total valuation, and average value per ton at the mine of the manganese ores produced in the United States for the years from 1896 to 1902, inclusive:

Production and value of manganese ores in the United States, 1896–1902.

State.	1896.			1897.			1898.		
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.
	Long tons.			*Long tons.*			*Long tons.*		
Alabama							22	a $143	a $6.50
Arkansas	3,421	$36,686	$10.72	3,240	$33,708	$10.40	2,662	26,035	9.78
California	284	3,415	12.02	484	2,788	5.76	541	3,222	5.96
Georgia	4,085	27,032	6.62	3,332	22,084	6.63	6,689	41,571	6.21
Michigan				37	370	10.00			
North Carolina	2	17	8.50						
Pennsylvania	265	1,988	7.50	354	2,832	8.00			
Tennessee				11	93	8.45	381	2,276	5.97
Virginia	2,018	21,485	10.65	3,650	33,630	9.21	5,662	55,938	9.88
West Virginia	13	104	8.00						
Total	10,088	90,727	8.99	11,108	95,505	8.60	15,957	129,185	8.10

a Estimated.

Production and value of manganese ores in the United States, 1896–1902—Continued.

State.	1899.			1900.		
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.
	Long tons.			*Long tons.*		
Arkansas	356	$3,781	$10.62	145	$1,530	$10.55
California	115	855	7.43	131	1,310	10.00
Georgia	3,089	23,377	7.57	3,447	26,816	7.78
Missouri	16	160	10.00			
Montana				137	514	3.75
North Carolina	90	765	8.50			
Pennsylvania	12	58	4.83			
Tennessee	19	133	7.00	30	195	6.50
Virginia	6,228	53,069	8.52	7,881	69,924	8.87
West Virginia	10	80	8.00			
Total	9,935	82,278	8.28	11,771	100,289	8.52

State.	1901.			1902.		
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.
	Long tons.			*Long tons.*		
Alabama	17	$111	$6.50			
Arkansas	91	657	7.22	82	$422	$5.15
California	610	3,610	5.92	846	10,175	12.03
Georgia	4,074	24,674	6.06	3,500	20,830	5.95
Missouri	28	280	10.00			
Montana				9,000	117,000	13.00
South Carolina				8	40	5.00
Tennessee	400	3,287	8.22			
Utah	2,500	31,250	12.50			
Virginia	4,275	52,853	12.36	3,041	29,444	9.68
Total	11,995	116,722	9.73	16,477	177,911	10.80

Six States contributed to the 1902 total. Alabama, Missouri, Tennessee, and Utah, which supplied ore in 1901, reported no manganese ores mined in 1902, while South Carolina contributed a sample shipment of 8 tons. Montana is also added to the list of contributors, but none of this ore was shipped, it being stocked at the mine. This State, a new contributor, with a reported output of 9,000 tons, takes first rank. The other prominent contributing States, with the exception of California, show a reduction in the amount of ore produced; and had it not been for reported production in the State of Montana, the industry would have shown a considerable decline in 1902. Montana, Virginia, and Georgia contributed a total of 15,541 long tons, or 94 per cent of the total for the United States. Omitting the 9,000 tons reported for Montana as mined and not shipped, Georgia furnished 47 per cent and Virginia 41 per cent of the product of domestic manganese ore.

The following table shows the production and total valuation of manganese ores in the United States from 1880 to 1902, and also the quantities mined in the States of Virginia, Georgia, and Arkansas, which have heretofore been the largest contributors:

Production of manganese ores in the United States, 1880–1902.

[Maxima are given in italics.]

Year.	Virginia.	Georgia.	Arkansas.	Other States.	Total production.	Total value.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	
1880	3,661	1,800	....	300	5,761	$86,415
1881	3,295	1,200	100	300	4,895	73,425
1882	2,982	1,000	175	375	4,532	67,980
1883	5,355	....	400	400	6,155	92,325
1884	8,980	....	800	400	10,180	122,160
1885	18,745	2,580	1,483	450	23,258	190,281
1886	*20,567*	6,041	3,316	269	30,193	277,636
1887	19,835	*9,024*	5,651	14	*34,524*	*333,844*
1888	17,646	5,568	4,312	1,672	29,198	279,571
1889	14,616	5,208	2,528	1,845	24,197	240,559
1890	12,699	749	5,339	6,897	25,684	219,050
1891	16,248	3,575	1,650	1,943	23,416	239,129
1892	6,079	826	*6,708*	....	13,613	129,586
1893	4,092	724	2,020	882	7,718	66,614
1894	1,797	1,277	1,934	1,300	6,308	53,635
1895	1,715	3,856	2,991	985	9,547	71,769
1896	2,018	4,085	3,421	564	10,088	90,727
1897	3,650	3,332	3,240	886	11,108	95,505
1898	5,662	6,689	2,662	944	15,957	129,185
1899	6,228	3,089	356	262	9,935	82,278
1900	7,881	3,447	145	298	11,771	100,289
1901	4,275	4,074	91	3,555	11,995	116,722
1902	3,041	3,500	82	*9,854*	16,477	177,911
Total for 23 years	191,067	71,644	49,404	34,395	346,510	3,336,596

PRODUCTION OF MANGANIFEROUS IRON ORES.

As in previous annual statements, the amount of manganiferous iron ores produced in the United States is included in the report on iron ores, but it is also noted here as a matter of interest in connection with manganese ores.

In the Lake Superior iron district many of the iron ores carry small percentages of manganese, but in the greater number of such ores this does not exceed 1 per cent. Some of the manganiferous iron ores mined in Colorado, and also some of the Lake Superior ores, were used in the manufacture of spiegeleisen, but the larger portion of the Colorado production was utilized as a flux by the smelters.

The production, approximate percentages of manganese, and reported total and average values of manganiferous iron ores produced in the United States in 1902 are as follows:

Production, percentage of manganese, and total and average value of manganiferous iron ores in 1902.

Locality.	Quantity.	Percentage of manganese.	Reported total value at mines.	Average value per ton.
	Long tons.			
Colorado	13,275	18 to 32	$52,371	$3.95
Lake Superior region	884,939	1 to 10	1,946,255	2.20
Virginia	3,000	Not given.	3,000	1.00
Total	901,214	1 to 32	2,001,626	2.22

The annual production, valuation, and average value per ton of manganiferous iron ores mined from 1889 to 1902, inclusive, are presented in the following table:

Production of manganiferous iron ores in the United States, 1889–1902.

[Maxima in italics.]

Year.	Quantity.	Value.	Average value per ton.
	Long tons.		
1889	83,434	$271,680	$3.26
1890	61,863	231,655	*3.74*
1891	132,511	314,099	2.37
1892	153,373	354,664	2.31
1893	117,782	283,228	2.40
1894	205,488	408,597	1.99
1895	125,729	233,998	1.86
1896	338,712	726,413	2.14
1897	202,304	343,784	1.70
1898	287,810	429,302	1.49
1899	761,845	1,147,047	1.51
1900	377,577	1,037,314	2.75
1901	574,489	1,475,084	2.57
1902	*901,214*	*2,001,626*	2.22

PRODUCTION OF MANGANIFEROUS SILVER ORES.

In mining the precious metals a considerable amount of manganiferous iron ore is obtained which carries an insufficient percentage of the precious metal to make it valuable on that account, but it is used as a flux by the smelters. This is particularly true in the State of Colorado.

The ores which are obtained at Leadville, Colo., and vicinity are classed generally as carbonates, sulphides, oxides, and siliceous ores. The first refers to ores having as their chief value carbonates of lead and silver; the second, to iron or lead sulphide ores; the third, to an ore carrying either carbonate, oxide, or sulphide minerals, but in which silica is in excess of iron in the ore; and the fourth, to manganiferous iron oxide.

The three first-named classes are primarily dependent for their value upon the contents of metals other than iron and manganese. The fourth may or may not be dependent on these elements, but the ores are considered in this statement as argentiferous manganiferous iron ores unless their value for smelting purposes as represented by other metals is above what may be considered the normal mining and smelting charges, aggregating in the neighborhood of $12 per ton. Owing to the difficulty of segregation in every case, and to the fact that some mines produce several of the above varieties, the subdivision can not be exact. In other words, a considerable part of the production of the Leadville, Colo., district is properly classed as argentiferous manganese or iron ores, which would be supplied to smelters as a fluxing medium.

This ore was also included in the report on iron ores, the amount mined from 1889 to 1902, together with the total and average values, being as follows:

Production of manganiferous silver ores in the United States, 1889–1902.

[Maxima in italics.]

Year.	Quantity.	Value.	Average value per ton.
	Long tons.		
1889	64,987	$227,455	$3.50
1890	51,840	181,440	3.50
1891	79,511	397,555	5.00
1892	62,309	323,794	*5.20*
1893	[a] 55,962	258,695	4.75
1894	[b] 31,687	148,292	4.84
1895	54,163	229,651	4.24
1896	138,079	416,020	3.01
1897	149,502	424,151	2.84
1898	99,651	295,412	2.96
1899	79,855	266,343	3.34
1900	188,509	897,068	4.76
1901	*228,187*	865,959	3.79
1902	194,132	*908,098*	4.68

[a] Including 1,500 tons from Montana, for which no value is given.
[b] Including 1,049 tons from Montana, for which no value is given.

PRODUCTION OF MANGANIFEROUS ZINC ORES.

In northern New Jersey zinc ores are obtained which carry varying percentages of iron and manganese, and the clinker resulting from the treatment of the ores to obtain the zinc content is used in the production of spiegeleisen. The amount of this character of ore produced in the year 1902 was 65,246 long tons, valued nominally at $1 per ton. The production of this class of ore clinker in the United States from 1889 to 1902, inclusive, together with the total and average value per ton, is given below.

Production of manganiferous zinc ore residuum in the United States, 1889–1902.

[Maxima in italics.]

Year.	Quantity.	Value.	Average value per ton.
	Long tons.		
1889	43,648	$54,560	$1.25
1890	48,560	*60,700*	1.25
1891	38,228	57,432	*1.50*
1892	31,859	25,937	.81
1893	37,512	30,535	.81
1894	26,981	20,464	.76
1895	43,249	24,451	.57
1896	44,953	20,455	.46
1897	33,924	18,713	.55
1898	48,502	[a] 26,676	.55
1899	65,010	32,505	.50
1900	*87,110*	34,844	.40
1901	52,311	52,311	1.00
1902	65,246	65,246	1.00

[a] Estimated.

PRODUCTION OF MANGANESE AND MANGANIFEROUS ORES.

The following table shows the production of ores containing manganese in various percentages which were produced in the United States in the years 1901 and 1902, together with the total and average value per long ton:

Production of manganese and manganiferous ores in the United States in 1901 and 1902.

Kind of ore.	1901.			1902.		
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.
	Long tons.			*Long tons.*		
Manganese ores	11,995	$116,722	$9.73	16,477	$177,911	$10.80
Manganiferous iron ores	574,489	1,475,084	2.57	901,214	2,001,626	2.22
Manganiferous silver ores	228,187	865,959	3.79	194,132	908,098	4.68
Manganiferous zinc residuum [a]	52,311	52,311	1.00	65,246	65,246	1.00
Total	866,982	2,510,076	2.90	1,177,069	3,152,881	2.68

[a] As this is a by-product in the treatment of zinc ores, the value given to it is nominal.

PRODUCTION OF MANGANESE ORES BY STATES.

The contributions made to the total output of manganese ores by various States are summarized in the following statements:

ARKANSAS.

From 1885 to 1898, inclusive, Arkansas was an important contributor of manganese ore, but since the last date the amounts mined have been small, the total for 1902 being but 82 tons, valued at $422, all of which came from the Batesville district. This State has a number of manganese deposits, but, owing either to lack of transportation or high phosphorus content, few have been worked. The total amount of ore produced by the Batesville district from its opening, in 1850, to 1902 is 49,974 tons. The yearly productions are shown in the following table:

Production of manganese in the Batesville district of Arkansas from 1850 to 1902, inclusive.

[Maximum in italics.]

Year.	Authority	Quantity.
		Long tons.
1850 to 1867	Estimated	400
1868	.....do	10
1881	Railroad reports of shipments	100
1882	.....do	175
1883	.....do	400
1884	.....do	800
1885	Mineral Resources of the United States	1,483
1886	.....do	3,316
1887	.....do	5,651
1888	.....do	4,312
1889	Eleventh Census	2,528
1890	Mineral Resources of the United States	5,339
1891	.....do	1,650
1892	.....do	*6,708*
1893	.....do	2,180
1894	.....do	1,934
1895	.....do	2,991
1896	.....do	3,421
1897	.....do	3,240
1898	.....do	2,662
1899	.....do	356
1900	.....do	145
1901	.....do	91
1902	.....do	82
Total		49,974

CALIFORNIA.

Manganese ores have been exploited at various times in a number of localities in California, but during the year 1902 only deposits in Alameda, San Joaquin, Santa Clara, and Stanislaus counties were operated. The quantity obtained in 1902, 846 tons, valued at $10,175, is the maximum production for the State. The total quantity mined from 1874 to the close of 1902, 11,358 tons, and the annual outputs appear in the following table:

Total production of manganese ores in California, 1874-1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1874 to 1888	6,000	1896	284
1889	53	1897	484
1890	386	1898	541
1891	705	1899	115
1892	....	1900	131
1893	400	1901	610
1894	278	1902	846
1895	525	Total	11,358

COLORADO.

In this State considerable quantities of argentiferous and manganiferous iron ores are mined, which are used either in the production of spiegeleisen in the steel works or as a flux by the smelters. These ores, except those which are used in the production of spiegeleisen, are all accounted for in the iron ore report, but are mentioned here as they contain varying percentages of manganese.

Any ore worth as much as $12 or over per ton, although it may contain desirable percentages of iron and manganese, is not considered in this class, as the high valuation is due to the amount of precious metal contained in the ore.

The production of argentiferous and manganiferous iron ore in Colorado from 1889 to 1902, inclusive, is as follows:

Production of manganiferous ores in Colorado, 1889-1902.

Ore.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Manganiferous iron ores used for producing spiegeleisen	2,075	....	964	3,100	5,766	7,022	13,464
Manganiferous silver ores	64,987	51,840	79,511	62,309	54,462	30,187	53,506
Total	67,062	51,840	80,475	65,409	60,228	37,209	66,970

Ore.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Manganiferous iron ores used for producing spiegeleisen	9,072	16,519	18,848	29,355	43,303	62,385	13,275
Manganiferous silver ores	137,597	149,502	99,651	79,855	188,509	228,187	194,132
Total	146,669	166,021	118,499	109,210	231,812	290,572	207,407

GEORGIA.

In the year 1902 the production of manganese ore in this State amounted to 3,500 tons, valued at $20,830, a falling off of 574 tons from the 1901 production of 4,074 long tons. The total production to the close of the year 1902 is 91,594 long tons.

The following table shows the quantities mined each year from 1866 to 1902, inclusive:

Production of manganese ores in Georgia, 1866–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
From 1866 to 1873 (estimated)	5,550	1890	749
1874	2,400	1891	3,575
1875	2,400	1892	826
1876	2,400	1893	724
1877	2,400	1894	1,277
1878	2,400	1895	3,856
1879	2,400	1896	4,085
1880	1,800	1897	3,332
1881	1,200	1898	6,689
1882	1,000	1899	3,089
1883 and 1884	(a)	1900	3,447
1885	2,580	1901	4,074
1886	6,041	1902	3,500
1887	9,024	Total	91,594
1888	5,568		
1889	5,208		

a None reported.

There are two manganese-producing districts in this State, one in the vicinity of Cartersville, Bartow County, and the Cave Spring district in Floyd and Polk counties. Ores have also been reported in other sections of the State, but none have as yet developed commercial importance. The mines in the Cartersville district only were active in 1902.

MONTANA.

In previous years this State has been comparatively unimportant as far as the production of manganese is concerned, but 9,000 tons of ore were reported as mined in 1902 from two deposits, and stocked at the mines. Analysis of the ore is said to show 45 per cent and over of manganese.

If this ore is not high in phosphorus and silica it should command a ready market, provided the freight rates to steel works be not prohibitory, and it would also be valuable as a flux.

NEVADA.

Mr. Daniel Bonelli reports a number of manganese claims situated in the St. Thomas mining district, Lincoln County, Nev., lying at the foot of a range of basic eruptive masses, and forming one side of the Boulder Canyon, below Rioville. They are largely in beds, which he says are quite extensive, and contain all the ores of manganese from rhodocrosate to pyrolusite. The ore is claimed to yield from 18 to 48 per cent metallic manganese, but as there are no railroads in the vicinity, it is doubtful whether these deposits will be exploited in the immediate future.

SOUTH CAROLINA.

A small quantity of manganese ore, 8 tons, was shipped in 1902 as a sample from a deposit located near Greenwood, S. C.

VIRGINIA.

This State was formerly the most important contributor of manganese ore in the United States, the bulk of the mineral won coming from the Crimora mine, located near the railroad station of the same name. A company has taken hold of this old mine and is at present engaged in exploring it, in the hope of being able again to resume operations on a profitable scale. If this venture proves successful, it is probable that in the future this State will show an augmented out put. The amount mined in 1902, however, was but 3,041 long tons valued at $29,444, giving Virginia third position as a producer. It shows a falling off of 1,234 tons from the 1901 output of 4,275 tons.

The annual production in this State from 1880 to 1902 is given in the following table, the total output for twenty-three years being 191,067 long tons:

Production of manganese ores in Virginia, 1880–1902.

[Maximum in italics.]

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1880	3,661	1893	4,092
1881	3,295	1894	1,797
1882	2,982	1895	1,715
1883	5,355	1896	2,018
1884	8,980	1897	3,650
1885	18,745	1898	5,662
1886	*20,567*	1899	6,228
1887	19,835	1900	7,881
1888	17,646	1901	4,275
1889	14,616	1902	3,041
1890	12,699	Total	191,067
1891	16,248		
1892	6,079		

USES OF MANGANESE ORES IN THE STEEL INDUSTRY.

The manganese ore mined in the United States, and also that imported from foreign countries, is chiefly used in the production either of spiegeleisen or of ferro-manganese. The quantity of metallic manganese used in this form, or present in the metal prepared, varies, per ton of steel ingots, according to the practice of the works in different sections of the country, but an investigation shows that the following closely represent the average consumption for various classes of steel:

Open-hearth steel, 13.5 pounds of metallic manganese per long ton of ingots.

Soft Bessemer steel, 16.5 pounds of metallic manganese per long ton of ingots.

Bessemer rail steel, 29 pounds of metallic manganese per long ton of ingots.

These averages have been obtained from a number of plants, whose practice in open-hearth steel varies from the use of 9 pounds of metallic manganese per long ton of ingots to 37 pounds per ton, in the latter case the steel being used for special purposes. In soft Bessemer steel the variation is not so marked, running from 14 to 17 pounds. In Bessemer rail steel, however, the range is from 25 to 31 pounds of metallic manganese per ton of ingots, and in the manufacture of high carbon or high manganese rails even more than 31 pounds of metallic manganese per long ton of ingots are used.

IMPORTS.

The United States is a large consumer of manganese ores, and owing to the insufficient supply of satisfactory native ores large quantities are imported from various foreign countries, the quantity brought in during the year 1902 being 235,576 long tons, valued at $1,931,282, or $8.20 per ton. Brazil, with a total of 102,550 tons, was the principal contributor, retaining the first place, taken from Russia in 1901. The other important contributors were India, Cuba, Turkey, and Spain, in the order named, and smaller amounts were imported from Russia, Japan, Germany, and the United States of Colombia—the present Republic of Panama.

The table below shows the imports of manganese ores into the United States during the calendar years 1899 to 1902, inclusive, by countries, together with the valuations of the ores:

Imports of manganese ores into the United States during the calendar years 1899, 1900, 1901, and 1902, by countries.

Country.	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Brazil	28,115	$299,877	54,451	$590,825	48,029	$460,024	102,550	$1,006,969
Russia, Black Sea	73,397	598,644	132,121	812,592	32,600	224,798	3,338	24,581
British East Indies	17,950	54,471	10,650	30,787	11,000	40,148	64,170	352,487
Cuba	16,359	221,785	20,582	259,348	21,627	307,084	36,294	285,571
Chile	17,575	111,726	9,925	69,670	14,794	104,364	....	....
Colombia	8,900	82,489	7,902	86,678	2,600	34,800	700	3,385
Turkey in Asia	5,782	46,822	7,062	49,482	5,980	43,653	....	....
Turkey in Europe	8,310	61,241	6,186	43,593	11,879	87,380	12,609	88,979
Japan	4,492	31,657	5,338	44,707	5,985	52,443	2,481	37,064

Imports of manganese ores into the United States, etc.—Continued.

Country.	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
France	2,953	$21,080						
Germany	1,274	34,927	1,696	$43,025	4,184	$76,827	2,155	$68,241
United Kingdom	134	6,697	156	7,466	468	10,563	451	10,814
French West Indies			65	650				
Greece	3,030	10,526	50	897				
Quebec, Ontario, etc			39	1,100	468	3,669	140	820
Nova Scotia, New Brunswick, etc	78	2,586	19	1,114	29	1,110	59	2,311
Austria-Hungary			10	427				
Spain					6,050	38,947	10,464	48,098
Netherlands					29	763		
Belgium							165	1,962
Total	188,349	1,584,528	256,252	2,042,361	165,722	1,486,573	235,576	1,931,282

The importations in 1902, by customs districts, indicate that 85 per cent, or 200,434 tons, were received at the port of Baltimore and 12 per cent at Gulf ports, the remainder being scattered among a number of ports, situated principally on the Atlantic seaboard.

The following table presents the quantity and value of the manganese ore imported into the United States during the calendar years 1899 to 1902, inclusive, by customs districts:

Manganese ore imported into the United States during the calendar years 1899, 1900, 1901, and 1902, by customs districts.

Customs district.	1902.		1901.		1900.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Philadelphia, Pa	1,007	$30,927	24,396	$188,869	80,333	$726,545	90,583	$655,061
Baltimore, Md	200,434	1,583,303	120,579	1,004,750	161,932	1,134,823	80,006	739,547
New York, N. Y	4,287	77,978	8,103	110,979	13,883	176,944	14,762	152,959
Norfolk, Va							2,901	32,248
Pittsburg, Pa	10	850	40	2,994	25	1,573	44	2,473
Newport News, Va	53	1,616	26	862	15	568	26	1,351
Chicago, Ill	116	4,874	48	2,392			16	595
Boston, Mass	32	1,450	25	691	1	24	5	116
Passamaquoddy, Me					2	30	4	82
Pensacola, Fla	5,339	46,281	8,935	127,159				
Mobile, Ala	24,158	183,157	3,100	44,100				
Huron, Mich	30	240	396	3,170				
Champlain, N. Y	30	240	72	499				
All others	80	366	2	108	61	1,849	2	96
Total	235,576	1,931,282	165,722	1,486,573	256,252	2,042,361	188,349	1,584,528

The relative quantities of domestic manganese ore produced and of foreign manganese ore imported indicate that the importations have, as a rule, showed an almost constant increase from 1889, with the exception of six years, and that the domestic production has fallen off.

The average for the last fourteen years is 14,130 long tons of manganese ore produced in the United States, valued at $129,497, while the amount of imported ore for the same period shows an annual average of 102,639 long tons, valued at $930,602.

The following table illustrates the relative quantities and values of domestic and imported manganese ores from 1889 to 1902, inclusive:

Relative quantities and values of domestic and imported manganese ores, 1889–1902.

Year.	Domestic production.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1889	24,197	$240,559	4,286	$78,391
1890	25,684	219,050	34,154	516,900
1891	23,416	239,129	28,825	380,618
1892	13,613	129,586	58,572	840,811
1893	7,718	66,614	68,113	880,238
1894	6,308	53,635	44,655	432,561
1895	9,547	71,769	86,111	747,910
1896	10,088	90,727	31,489	250,468
1897	11,108	95,505	119,961	1,023,824
1898	15,957	129,185	114,885	831,967
1899	9,935	82,278	188,349	1,584,528
1900	11,771	100,289	256,252	2,042,361
1901	11,995	116,722	165,722	1,486,573
1902	16,477	177,911	235,576	1,931,282
Total for 14 years	197,814	1,812,959	1,436,950	13,028,432
Average for 14 years	14,130	129,497	102,639	930,602

PRODUCTION OF MANGANESE ORE IN FOREIGN COUNTRIES.

As the importations of manganese ore are so prominently in excess of the domestic production, data concerning some of the sources of foreign manganese ores appear in the following pages. Because of the present close geographical and the future commercial relationship of the two countries to the United States, the manganese deposits of Cuba and Panama receive special attention.

CANADA.

Exploited manganese deposits in Canada are found in the Provinces of Nova Scotia and New Brunswick, but in the year 1902 only those in the former province were active. The production for that year, as reported by the Canadian Geological Survey, was 84 tons, valued at $2,774, but the exports during the same period were 172 tons, valued at $4,062. The Geological Survey of Canada explains that these figures would seem to show that there are other producers of manganese ore, but so far these have not been located. The amount of ore mined in Canada from 1886 to 1900, inclusive, together with the total and the average value per ton, also the exports by provinces from 1873 to 1902, inclusive, are given in the following tables:

Production of manganese ore in Canada, 1886–1900.

Year.	Quantity.	Value.	Value per ton.
	Short tons.		
1886	1,789	$41,499	$23.20
1887	1,245	43,658	35.07
1888	1,801	47,944	26.62
1889	1,455	32,737	22.50
1890	1,328	32,550	24.51
1891	255	6,694	26.25
1892	115	10,250	89.13
1893	213	14,578	68.44
1894	74	4,180	56.49
1895	125	8,464	67.71
1896 [a]	123½	3,975	32.19
1897 [a]	15¼	1,166	76.46
1898	50	1,600	32.00
1899 [b]	1,581	20,004	12.66
1900 [c]	30	1,800	60.00

[a] Exports.
[b] Nova Scotia mined 63 tons. New Brunswick's product was 1,518 tons.
[c] Nova Scotia mined 10 tons and New Brunswick 20 tons.

Exports of manganese ore from Canada, 1873–1902.

Year.	Nova Scotia.		New Brunswick.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1873			1,031	$20,192	1,031	$20,192
1874	6	$42	776	16,961	782	16,973
1875	9	200	194	5,314	203	5,514
1876	21	723	391	7,316	412	8,039
1877	106	3,699	785	12,210	891	15,909
1878	106	4,889	520	5,971	626	10,860
1879	154	7,420	1,732	20,016	1,886	27,436
1880	79	3,090	2,100	31,707	2,179	34,797
1881	200	18,022	1,504	22,532	1,704	40,554
1882	123	11,520	771	14,227	894	25,747
1883	313	8,635	1,013	16,708	1,326	25,343
1884	134	11,054	469	9,035	603	20,089
1885	77	5,054	1,607	29,695	1,684	34,649
1886	[a] 441	854	1,377	27,484	[a] 1,818	58,338
1887	578	14,240	837	20,562	1,415	34,802
1888	87	5,759	1,094	16,073	1,181	21,832
1889	59	3,024	1,377	26,326	1,436	29,350
1890	177	2,583	1,729	34,248	1,906	36,831
1891	22	563	233	6,131	255	6,694
1892	84	6,180	59	2,025	143	8,205
1893	123	12,409	10	112	133	12,521
1894	11	720	45	2,400	56	3,120
1895	108	6,348	$\frac{3}{10}$	3	108$\frac{3}{10}$	6,351
1896	123½	3,975			123½	3,975
1897	15¼	1,166			15¼	1,166
1898	11	325			11	325
1899	67	2,328	3	82	70	2,410
1900 [b]					34	1,720
1901					440	4,820
1902					172	4,062

[a] 250 tons should be more correctly classed under the heading of mineral pigments.
[b] Owing to changes in compiling customs returns, exports can no longer be given by provinces.

CUBA.

Two companies are actively engaged in mining manganese ores in Cuba, the Ponupo Mining and Transportation Company and the Standard Manganese Company, the total shipments from the port of Santiago de Cuba in 1902 amounting to 39,628 long tons.

The Ponupo manganese ore is obtained from mines located near La Maya, about 16 miles northeast of El Cristo, the ore shipped having about 47 per cent of metallic manganese. A description of this deposit appeared in the report for 1899.

The Standard Manganese Company's property, known as the Boston mine, is located about three miles southeast of the town of El Cristo. The mine is worked open-cut, across the crest of the hill, through mixed sandstone and manganese. The ore occurs in pockets, the bulk being in wash dirt; but by picking some good manganese ore is obtained which does not require washing. When ready for shipment the ore is reported to carry about 50 per cent metallic manganese and from 1 to 3 per cent of iron.

In a report on the mineral resources of Cuba, prepared by H. C. Brown under the direction of Dr. David T. Day, which appeared in the civil report of the military governor of Cuba, Volume V, Part II, is a detailed description of the manganese mines of Cuba.

EXPORTS OF CUBAN MANGANESE ORE.

The following table gives the Cuban exports from 1888 to 1902, inclusive, the shipments in 1902 being the maximum annual production:

Exports of manganese ore from Santiago district, Cuba, 1888–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1888	1,942	1896	None.
1889	704	1897	None.
1890	21,810	1898	950
1891	21,987	1899	13,686
1892	18,751	1900	22,600
1893	10,640	1901	25,183
1894	....	1902	39,628
1895	1,394		

PANAMA.

The following excerpts are from a paper by Mr. E. G. Williams on the "Manganese industry of the Department of Panama, Republic of Colombia."

Manganese ore has been found on the Isthmus of Panama throughout a region of nearly 300 square miles, over the greater part of which, however, it is found in small bodies without commercial value.

Only six mines, controlled by two companies, have actually shipped ore, although a large area has been taken up in mining claims.

The ore-bearing region extends along the coast of the Caribbean Sea, beginning on the west near Puerto Bello and continuing easterly about 35 miles toward Point San Blas. Ore has been discovered in the interior, at a maximum distance of about 10 miles from the coast.

The first shipments from the region were made in 1871, from the village of Viento Frio. This early mining was primitive, and consisted in breaking up surface bowlders near the sea and packing the ore to the coast upon men's backs. Probably 1,000 tons of ore were shipped in small vessels, mostly to England, between 1871 and 1875, when the loss of a schooner near Viento Frio caused the abandonment of the work.

The discovery in 1890, about 5 miles south of Viento Frio, of large bowlders of high-grade ore upon the surface, which had been unknown to the early miners, caused a revival of interest in manganese mining in the locality, and led to the formation of the Caribbean Manganese Company, which in 1894 and 1895 constructed from the shipping port of Nombre de Dios to the base of the range upon which its principal mine was located a 3-foot gauge railroad, 9 miles in length, with maximum grades of 5 per cent in favor of the traffic and maximum curves of 40°.

Except this company, the only shipper from the region has been the firm of Brandon, Arias & Fillippi. The Caribbean Manganese Company has shipped ore from four properties, the Viento Frio, the Carano, the Concepción, and the Soledad. The firm has shipped from the La Guaca and the Culebra mines. All the mines mentioned are near the railroad except the Culebra, which is on a small island about 12 miles east of Nombre de Dios. Some ore has been mined at Meamar, about midway between Nombre de Dios and Culebra, but none has been shipped.

The total production of the region to date has exceeded 60,000 tons.

All of the ore deposits are upon the Atlantic slope of the Cordilleras. The manganese deposits occur upon the comparatively low lands near the sea as well as upon the summits of the hills in the interior, and the Culebra mine is, as stated, upon an island, a remnant of the mountain spur which here approaches the sea.

The rocks immediately associated with the manganese deposits are all of sedimentary origin, probably originally shales, but so greatly decomposed as to leave their original character doubtful. In the vicinity of some of the ore deposits the rocks have been metamorphosed into a jasper, and thus preserved.

The surface clays are usually light yellow. Where associated with ore in place, however, the clay is generally bright red, but it is found in all shades from red to white, the colors resulting from the various stages of oxidation and hydration of the manganese and iron contained in the clay.

The ore occurs as oxides. The principal variety, furnishing the greater part of the commercial ore, is psilomelane. Pyrolusite and braunite also occur. The psilomelane and pyrolusite are intimately associated, one oxide blending into the other without visible lines of separation. In massive psilomelane small cavities may be filled with pyrolusite, and clusters of pyrolusite crystals have been found radiating from a base of psilomelane. The psilomelane is massive and very hard.

Samples of the purest ore of the Soledad mine analyzed by Prof. S. L. Penfield, of Yale University, gave the following result:

Analysis of manganese ore from Soledad mine, Panama.

Constituent.	Per cent.	Constituent.	Per cent.
Manganese protoxide (MnO)	78.25	Magnesia (MgO)	0.16
Available oxygen (O)	11.83	Potash (K_2O)	.10
Copper oxide (CuO)	.67	Soda (Na_2O)	.38
Quartz (SiO_2)	2.00	Water (H_2O)	1.70
Soluble silica (SiO_2)	2.67	Phosphoric acid (P_2O_5)	.03
Iron sesquioxide (Fe_2O_3)	.40	Total	99.72
Alumina (Al_2O_3)	.21	Metallic manganese	60.60
Lime (CaO)	1.32		

The Caribbean Manganese Company has reported that no manganese ore was mined during the year 1902, but the following table will show the shipments of manganese ore from Colombia, as reported to this office, from the year 1896 to 1902, inclusive:

Shipments of manganese ore from Panama, 1896–1902.

Calendar year.	Quantity.	Calendar year.	Quantity.
	Long tons.		*Long tons.*
1896	18,215	1900	8,610
1897	(*a*)	1901	684
1898	8,595	1902	None.
1899	8,955		

a Not reported.

BRAZIL.

Mr. Herbert Kilbourn Scott, mining engineer, who has made a special study of the manganese ores of Brazil, is authority for the following:

The manganese-ore industry in the State of Minas Geraes continued to expand during the year, the total quantity of mineral exported to consuming countries from this State during the year 1902 amounting to 141,859 tons, which was divided among the principal exporting firms approximately as follows:

Firm.	Location of mine.	Production.
		Long tons.
Usina Wigg	Miguel Burnier	48,000
Goncalves Ramos & Co	Piquiry	50,000
Société des Mines de Manganese de Ouro Preto	Sao Goncalo	44,000

The output of the Usina Wigg mine was shipped to England, that of the other firms going to United States consumers.

The Usina Wigg mine is now the only one of importance in active operation in the Miguel Burnier district. The mineral of this mine occurs in a bedded deposit about 2½ meters in thickness, and work has been continued on it throughout the year, the average production being at the rate of about 4,000 tons per month.

Owing to the high percentage of the moisture in the ore, due to its spongy character, American producers of ferro-manganese have not used this mineral lately, and the total output went to Europe. Attempts to dry or calcine the mineral with subsequent briquetting have not been successful by reason of the difficulty of making the briquettes sufficiently hard to withstand the repeated handling before they reach the blast furnaces.

At the Sao Goncalo and Piquiry mines in the Lafayette district the mineral occurs as huge lenticular masses and is worked open-cut, the output of the two mines amounting to about 8,000 tons per month. The mineral is of good quality, although more phosphoric than that of Miguel Burnier, and owing to its freedom from moisture and its lumpy character it is preferred by the United States ferro-manganese manufacturers.

Another large deposit of the same character as those of Sao Goncalo and Piquiry, situated in the same district, has lately been opened. It is known as the "Morro da Mina," and the natural conditions are so favorable for mining the ore, and the lenticular masses so large, that it has been possible within four months after operations were inaugurated to have a regular output of 500 tons per day. The first shipment of this mineral left for Europe in January of 1903, and it is said that the ore analyzed 49 per cent metallic manganese, 0.08 per cent phosphorus, 2 per cent silica, and 2 per cent moisture.

Several cargoes have been shipped during the year from the port of Bahia, nearly the whole of this mineral coming from the Onha mine, near Nazareth. The total amounted to 14,410 tons, but it is doubtful if there is any likelihood of increased exports from this district of Brazil in the future.

The total shipments of manganese ore from Brazil in 1902 were 156,269 long tons.

The manganese ore is transported from the mines in the State of Minas Geraes by the Central Railway of Brazil, the wide gauge of which is being extended to the station of Gagé, in order that the mineral from the Piquiry and Sao Goncalo mines can be transported without reshipment from the narrow-gauge road now running from the mines to the station of Lafayette. Owing to the increased output there may be a possible decrease in the value of the manganese ore, but if a market can be found for the Minas Geraes ores at present prices the production can be considerably increased over that of 1902.

EXPORTS OF BRAZILIAN MANGANESE ORE.

The importance of Brazil as a producer is exhibited by the following:

Exports of Brazilian manganese ore, 1896–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1896	11,710	1900	[a] 127,318
1897	11,370	1901	[b] 95,710
1898	27,110	1902	156,269
1899	62,170		

[a] Europe, 75,910; United States, 51,438. [b] Europe, 47,680; United States, 48,030.

CHILE.

Manganese ores are found in different portions of Chile, but the commercial mines are confined to the provinces of Atacama and Santiago. Other deposits have been exploited in the provinces of Aconcagua and Coquimbo, and still others are reported farther south. Practically all of the manganese ore produced is exported, the yearly quantities shipped from 1885 to 1901 being as follows:

Exports of Chilean manganese ores, 1885–1901.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1885	4,041	....	1894	47,238	$371,374
1886	23,928	....	1895	23,696	186,747
1887	47,521	....	1896	25,740	202,335
1888	18,713	....	1897	23,156	....
1889	28,683	....	1898	20,522	163,165
1890	47,986	....	1899	40,285	448,195
1891	34,462	....	1900	25,319	....
1892	50,871	$399,881	1901	31,477	....
1893	36,162	284,262			

GREAT BRITAIN.

In Great Britian a limited quantity of manganiferous iron ore is obtained, the production in 1902 being 1,278 tons, a decrease of 368 tons from the 1901 production of 1,646 tons.

The following table shows the quantity of manganiferous iron ore mined in the United Kingdom from 1884 to 1902, inclusive, together with the valuation of the same:

Production and value of manganiferous iron ores in the United Kingdom, 1884–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1884	909	$6,921	1894	1,809	$3,582
1885	1,688	11,669	1895	1,273	3,323
1886	12,763	52,722	1896	1,080	2,983
1887	13,777	53,772	1897	599	[a]1,650
1888	4,342	9,361	1898	231	974
1889	8,852	31,354	1899	415	1,212
1890	12,444	32,588	1900	1,362	3,285
1891	9,476	30,071	1901	1,646	....
1892	6,078	21,461	1902	1,278	....
1893	1,336	3,688			

[a] Estimated.

BELGIUM.

Manganiferous iron ore is mined in Belgium, the amount produced in the year 1900 being 10,820 metric tons, valued at $25,158.

The following table shows the quantity and value of manganiferous iron ores mined in Belgium from 1880 to 1900, inclusive:

Production of manganiferous iron ores in Belgium, 1880–1900.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Metric tons.			*Metric tons.*	
1880	700	$772	1891	18,498	$49,022
1881	770	772	1892	16,775	40,202
1882	345	338	1893	16,800	38,793
1883	820	791	1894	22,048	53,596
1884	750	724	1895	22,478	55,250
1885	....	....	1896	23,265	66,589
1886	750	1,737	1897	28,372	66,141
1887	12,750	30,079	1898	16,440	40,820
1888	27,787	62,725	1899	12,120	30,245
1889	20,905	47,864	1900	10,820	25,158
1890	14,255	33,968			

FRANCE.

Manganese ores are obtained in two departments south of L'Ariège and in the western and central sections of Saône and Loire, the Comité des forges de France giving the production in 1901 as 22,300 metric tons. The production for 1902 has not been collated and published at this writing.

The annual production and value of the manganese ores mined in France from 1886 to 1901, inclusive, is as follows:

Production and value of manganese ores in France, 1886–1901.

Year.	Quantity.	Value.	Value per ton.	Year.	Quantity.	Value.	Value per ton.
	Long tons.				*Long tons.*		
1886	7,555	$53,099	$7.03	1894	32,239	$192,264	$5.96
1887	11,932	50,501	4.23	1895	30,385	177,698	5.85
1888	10,873	60,757	5.59	1896	30,797	179,297	5.82
1889	9,842	59,000	5.99	1897	36,612	200,720	5.48
1890	15,731	89,517	5.69	1898	31,396	160,383	5.11
1891	15,101	90,316	5.98	1899	39,270	215,581	5.49
1892	31,894	205,074	6.43	1900	28,534	164,050	5.75
1893	37,406	290,073	7.75	1901	21,948		

GERMANY.

The greater portion of the manganese ore produced in Germany comes from the Kingdom of Prussia, and should be more properly classed as a manganiferous iron ore. A small amount of true manganese ore, however, is obtained from the other German provinces. The total amount of manganiferous iron ore mined in Prussia in 1902 was 48,882 metric tons, valued at 530,000 marks ($126,140), and the production in other portions of Germany amounted to 930 metric tons (915 long tons), valued at 49,000 marks ($11,662).

The production and value of manganese ore mined in Prussia from 1881 to 1902, and in all Germany from 1890 to 1902, were as follows, those for later years being furnished by Mr. E. Schrodter, secretary of the Verein Deutscher Eisenhütten Leute and editor of Stahl und Eisen:

Production and value of manganese ores in Prussia, 1881–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1881	10,911	$79,104	1892	30,892	$101,844
1882	4,597	33,745	1893	38,384	93,506
1883	4,502	28,423	1894	41,854	94,992
1884	7,629	43,118	1895	39,266	100,832
1885	14,464	81,302	1896	42,925	97,469
1886	24,649	177,066	1897	44,538	98,185
1887	35,957	228,439	1898	41,565	92,050
1888	26,877	147,250	1899	59,425	151,368
1889	43,311	216,381	1900	57,100	157,271
1890	39,497	174,428	1901	54,984	155,652
1891	36,278	174,624	1902	48,110	126,140

Production of manganese ores in Germany, 1890–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1890	41,180	1897	45,694
1891	39,698	1898	42,669
1892	32,341	1899	60,360
1893	40,057	1900	58,269
1894	43,012	1901	55,796
1895	40,674	1902	49,025
1896	44,350		

ITALY.

Italy contributed 2,477 metric tons of manganese ore in 1902, and in addition some manganiferous iron ore.

The following table gives the production and value of maganese and manganiferous iron ores in Italy from 1860 to 1902, inclusive.

Production and value of manganese and manganiferous iron ores in Italy, 1860–1902.

Year.	Manganese ores.		Manganiferous iron ores.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1860	642	$12,373	....	....
1861	515	9,174	....	....
1862	1,714	15,661	....	....
1863	714	6,674	....	....
1864	712	8,567	....	....
1865	571	6,716	....	....
1866	711	7,191	....	....
1867	677	8,079	....	....
1868	661	7,894	....	....
1869	758	10,403	....	....
1870	630	8,646	....	....
1871	779	9,793	....	....
1872	1,125	12,311	....	....
1873	3,103	46,548	....	....
1874	3,169	58,697	3,445	$6,755
1875	3,750	64,341	19,684	96,500
1876	6,800	61,074	22,878	93,315
1877	6,704	56,546	7,874	26,248
1878	6,550	46,567	6,368	15,297
1879	5,614	33,842	1,366	2,679
1880	6,373	40,682	20,148	63,214
1881	8,629	45,219	[a]29,526	[a]92,640
1882	6,868	67,201	[a]29,526	[a]92,640
1883	11,204	52,975	8,858	27,792
1884	871	7,570	....	....
1885	1,774	10,899	....	....
1886	5,473	30,943	....	....
1887	4,363	21,872	....	....
1888	3,573	15,054	....	....
1889	2,168	9,998	....	....
1890	2,113	10,050	....	....

Production and value of manganese and manganiferous iron ores in Italy, etc.—Cont'd.

Year.	Manganese ores.		Manganiferous iron ores.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1891	2,391	$12,467	....	....
1892	1,223	8,067	4,549	$8,028
1893	797	6,320	8,666	14,445
1894	748	4,536	5,718	8,971
1895	1,544	13,634	....	....
1896	1,860	19,734	9,842	19,300
1897	1,608	14,483	20,926	32,829
1898	2,955	18,052	10,974	25,823
1899	4,287	21,647	29,402	74,449
1900	5,919	29,910	26,377	64,655
1901	2,147	16,052	23,900	58,131
1902	2,438	....	22,745	....

a In original, 30,000 metric tons, valued at 480,000 lire, possibly an estimate.

SPAIN.

The greater portion of the manganese ores mined in Spain are of the carbonate and silicate varieties, being obtained in the province of Huelva. A small amount of oxide of manganese is also occasionally mined in the provinces of Obideo and Teruel. Mr. Carl Doetsch gives the total production of manganese in the province of Huelva, for the year ending December 31, 1902, as 62,944 metric tons.

The table given below shows the countries to which this ore was exported for the years from 1899 to 1902, inclusive.

Exports of Huelva manganese ores in 1899, 1900, 1901, and 1902.

Country.	Quantity.			
	1899.	1900.	1901.	1902.
	Metric tons.	*Metric tons*	*Metric tons.*	*Metric tons.*
Belgium and Luxemburg	127,743	126,482	85,951	57,927
England	4,842	1,213	918	12
France	4,449	2,221	2,361	1,823
Germany	1,385	....	2,442	3,182
Total	138,419	129,916	91,672	62,944

Production of manganese ores in Spain, 1890–1901.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1890	9,716	1896	90,546
1891	6,883	1897	101,937
1892	16,643	1898	136,182
1893	1,437	1899	136,533
1894	423	1900	127,864
1895	26,946	1901	*a* 90,224

a Province of Huelva only.

PORTUGAL.

Manganese ore is mined in Portugal, principally in the district of Beja, in the province of Alentejo, the quantity mined in 1901 being reported as 9,400 metric tons.

AUSTRIA-HUNGARY.

Mr. Hans Hofer states that the official figures of production of manganese ore in Austria in 1902 are 5,646 metric tons, valued at 97,607 crowns, or $19,814.

The following table shows the quantity of manganese ore mined yearly from 1876 to 1902, inclusive:

Production of manganese ore in Austria, 1876–1902.

Year.	Quantity.	Year.	Quantity.
	Centners.		*Centners.*
1876	67,817	1890	80,068
1877	78,999	1891	52,793
1878	41,836	1892	46,000
1879	34,337	1893	54,000
1880	88,744	1894	101,120
1881	91,097	1895	[a] 92,270
1882	84,183		*Metric tons.*
1883	93,821	1897	6,012
1884	79,423	1898	6,132
1885	61,577	1899	5,411
1886	92,464	1900	8,804
1887	93,108	1901	7,796
1888	65,541	1902	5,646
1889	39,261		

[a] Including Bosnia.

There were also obtained in the Kingdom of Hungary 7,347 metric tons, and Bosnia and Herzegovina were credited with 5,760 tons in 1902.

The annexed tables show the production of manganese ore in Hungary from 1897 to 1902, inclusive, and in Bosnia and Herzegovina from 1892 to 1902, inclusive:

Production of manganese ore in Hungary, 1897–1902.[a]

Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*
1897	3,976	1900	5,746
1898	8,055	1901	4,591
1899	5,073	1902	7,347

[a] Ungarisches Statistiches Jahrbuch.

Production of manganese ore in Bosnia and Herzegovina, 1892–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1892	7,819	1899	5,536
1895	8,016	1900	7,813
1896	6,713	1901	6,147
1897	a 5,260	1902	5,669
1898	a 5,235		

a Bosnisches Bureau Montan Abtheilung.

SWEDEN.

Sweden has been a constant producer of moderate quantities of maganese ore, the production in the year 1902, according to the official statistics, being 2,850 metric tons, equivalent to 2,805 long tons, valued at 54,959 kroners, or $14,729, which is $5.25 per ton.

The production and valuation, where known, of the maganese ores produced in Sweden from 1880 to 1902, inclusive, are given in the following table:

Production of manganese ore in Sweden, 1888–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1888	9,537	....	1896	2,023	$7,197
1889	8,509	....	1897	2,706	12,616
1890	10,529	....	1898	2,321	11,060
1891	8,936	....	1899	2,581	11,990
1892	7,708	....	1900	2,609	13,179
1893	6,949	....	1901	2,235	11,256
1894	3,306	....	1902	2,805	14,729
1895	3,068	....			

RUSSIAN EMPIRE.

The Russian Empire is the principal contributor of manganese ores, over one-half of the year's production being credited to that country. Although the greater part of this ore still comes from the Caucasus district, there has in late years been a considerable falling off in this product, due it is claimed to the lessened demand for foreign export, as a result of imperfect mining and sorting of the manganese ores. A number of small operators aim to mine in the aggregate a large amount of ore, but by indifference on the part of some to the proper preparation the general average of the ore won is reduced. High freight rates to the Russian shipping ports also have caused the Caucasian ore to be displaced in some of the foreign markets by that obtained from Brazil.

A number of investigations and reports on the subject of bettering the manganese conditions in this district have been prepared, the latest being a recommendation for the erection of blast furnaces at Poti and Batoum (near which the mineral is found) for the reduction of the ore to spiegeleisen and ferro-manganese. It was, however, demonstrated by the committee which investigated the subject that unless the Caucasus district received special advantages through export bounties and reduced transport rates Russian ferro-manganese could not successfully compete in foreign markets. The granting of these benefits to the Caucasian industry alone is opposed by the manganese producers of the Nicopal district, which, however, is a comparatively small producer of manganese ore. Requests for reduced transportation rates have been refused by the government, the opinion being that such a reduction would only benefit foreign buyers by causing a decline in the price of the mineral, this being stated to have been the result of the freight reduction made in 1899. It is stated that the stocks of manganese which have been accumulated at Tchiatour, Tchikour, Poti, and Batoum amount to about one year's shipments. In addition to the Caucasus district manganese ore is also mined in the southern portion of Russia, as well as in the Ural Mountains.

The following table gives the production and exportation of manganese ore in Russia from 1885 to 1899, inclusive, the statistics for the southern Russia and Ural districts being included; and the production for 1900 and 1901 is for the Caucasus alone.

Mr. W. R. Holloway, consul-general of the United States at St. Petersburg, states that in 1900 the production of manganese ore was 884,200 tons, the mineral being obtained from 372 mines.

Statistics of manganese ores in Russia (in poods).[a]

Year.	Production.				Exports.	
	Ural.	Southern Russia.	Caucasus.	Total.	Caucasus.[b]	Total.
1885	54,700		3,640,800	3,695,500	2,567,000	2,567,000
1886	50,000	250,000	4,242,100	4,542,100	3,403,000	3,403,000
1887	50,000	226,350	3,277,200	3,353,550	3,690,000	3,690,000
1888	82,700	89,600	1,822,800	1,995,100	3,055,000	3,055,000
1889	179,100	341,500	4,243,200	4,763,800	3,237,000	3,237,000
1890	143,500	528,100	10,468,100	11,139,700	8,235,000	8,235,000
1891	118,000	660,000	6,126,000	6,904,000	4,575,000	4,575,000
1892	56,000	1,795,000	10,560,000	12,411,000	7,876,000	7,876,000
1893	186,000	4,740,000	11,673,000	16,599,000	7,633,000	7,656,000
1894	108,000	3,562,000	11,193,000	14,863,000	8,961,000	8,965,000
1895	168,000	2,287,000	9,943,000	12,398,000	10,172,000	10,172,000
1896	255,000	2,782,000	9,662,000	12,699,000	8,808,000	8,842,000
1897	303,000	3,417,000	12,343,000	16,063,000	10,900,000	11,441,000
1898	396,000	3,640,000	16,066,000	20,102,000	14,610,000	14,950,000
1899	111,000	5,919,000	34,077,000	40,107,000	23,849,000	25,336,000
1900			40,363,486			
1901			22,569,035			

[a] One long ton equals 62 poods.

[b] Exports in Russia not included.

TURKEY.

Manganese ore exists in Macedonia and Asia Minor, but exact statistics are not obtainable. Mr. Hugh Whittall, of Constantinople, states that the ministry of mines reports the quantity of manganese ore mined and exported in 1901 as 46,000 metric tons, and in 1902 as 50,000 tons.

GREECE.

Greece mines manganese ore and also manganiferous iron ore, the quantity of the former in 1900 being given as 8,050 metric tons, valued at $45,170; and in 1901 the production was stated to be 14,166 metric tons, valued at $52,610.

INDIA.

The manganese industry in India is of comparatively recent origin, the first exportations of ore being reported in the year 1894, since which time there has been an almost constant growth, although in the year 1902 there was a slight falling off, the output in the year being but 157,780 long tons, as per the report of the under secretary of state for India. The greater portion of this ore is shipped to Great Britain, but a considerable quantity is also sent to the United States, the imports of the latter country in 1902 from India being given as 64,170 long tons, valued at $352,487.

Exports of manganese ore from British India by sea to other countries, 1894–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1894	11,410	1899 [a]	87,126
1895	15,816	1900 [a]	130,670
1896	56,869	1901 [a]	162,057
1897	73,680	1902 [a]	157,780
1898 [a]	60,449		

[a] Production.

JAPAN.

Manganese ores are obtained in Japan, but the mines are not extensive, and the annual production is, comparatively speaking, small.

The following table, taken from the Financial and Economical Annual of Japan, gives in the first column the production of manganese ores in that country from 1886 to 1901, inclusive; in the second column are the exports of this mineral according to the annual returns of the Empire of Japan (department of finance) from 1881 to 1902, inclusive, together with the value of the same from 1893 to 1902. As both sets of figures are claimed as official, no attempt at harmonizing is made.

Of the 4,489,392 kin[a] of manganese ore exported during the year 1902, 2,063,606 went to the United States, 1,464,172 to Hongkong,

[a] Kin taken at 1.31 pounds.

869,950 to Germany, 89,235 to Great Britain, and 2,429 to other countries.

Production and export of manganese ore, Japan, 1881–1902.

Year.	Production.	Exports.	Value of exports.
	Long tons.	*Long tons.*	
1881	....	2	....
1882	....	156	....
1883	....	151	....
1884	....	125	....
1885	....	123	....
1886	392	404	....
1887	302	312	....
1888	688	813	....
1889	916	945	....
1890	2,526	2,604	....
1891	3,142	3,178	....
1892	4,891	4,948	....
1893	15,655	18,510	$106,016
1894	13,007	17,465	99,007
1895	16,679	16,338	97,906
1896	17,482	20,785	136,668
1897	15,031	14,524	102,248
1898	11,207	9,905	77,853
1899	11,049	9,157	76,039
1900	15,430	12,576	111,750
1901	15,858	8,726	93,214
1902	....	2,625	....

JAVA.

Manganese ore is obtained in the regencies of Pengasih and Mangolaen, the latest reports showing that 1,388 tons were mined in 1899.

NEW ZEALAND.

A small amount of manganese ore is obtained from this island, the amount mined in 1901 being 208 long tons, valued at £614, or $2,988.

AUSTRALIA.

NEW SOUTH WALES.

The annual report of the New South Wales geological survey for 1902 states that no manganese ore was mined in that country in 1902, although the mineral exists there.

QUEENSLAND.

Queensland contributes a small quantity of manganese ore, the quantity obtained in 1901 being reported as 218 long tons, valued at £795, or $3,869.

The following table gives the production and value of manganese ores obtained in Queensland from 1881 to 1884 and from 1889 to 1901, inclusive.

Production and value of manganese ores in Queensland, 1881–1884 and 1889–1901.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1881	87	$1,263	1894	140	$1,936
1882	100	1,694	1895	355	5,387
1883	20	290	1896	300	4,380
1884	55	799	1897	300	5,475
1889	4	87	1898	67	1,221
1890	5	97	1899	735	13,775
1891	10	126	1900	75	998
1892	....	....	1901	218	3,869
1893	....	....			

SOUTH AUSTRALIA.

In the year 1901 the official reports show that 192 long tons of manganese ore were obtained in South Australia, which were valued at £230 or $1,119.

WORLD'S PRODUCTION OF MANGANESE ORES.

It is impossible to secure late contemporaneous data of the production of manganese ore in foreign countries, but in the table given below the latest reliable statistics which were obtainable have been incorporated, together with the year which the figures represent. These tons are either long or metric, except in Canada, where the short ton is used.

World's production of manganese ores.

Country.	Year.	Production.	Country.	Year.	Production.
North America:		*Tons.*	Europe—continued:		*Tons.*
United States	1902	16,477	Portugal	1901	9,400
Canada [a]	1902	172	Russia	1900	884,200
Cuba [a]	1902	39,628	Spain [a]	1902	62,944
South America:			Sweden	1902	2,850
Brazil [a]	1902	156,269	Turkey [a]	1902	50,000
Chile [a]	1901	31,477	Asia:		
Europe:			India	1902	157,780
Austria	1902	5,646	Japan	1901	15,858
Bosnia and Herzegovina	1902	5,760	Java [a]	1899	1,388
Hungary	1902	7,347	Oceania:		
France	1901	22,300	Queensland	1901	218
Germany	1902	49,812	New Zealand	1901	208
Greece	1901	14,166	South Australia	1901	192
Italy	1902	2,477			

[a] Exports.

COPPER.

By Charles Kirchhoff.

GENERAL TRADE CONDITIONS.

The copper mining industry of the United States suffered during 1902 from the reaction which followed the unsuccessful attempt during 1901 to maintain the value of the metal at an artificial level. The collapse which came toward the close of 1901 left many producers committed to sales covering a long period, at low prices, with the menace of heavy accumulations of metal constantly over the market. Yet production was heavier during 1902 than it had been in 1901, because some of the important mines were worked to full capacity and because some of the enlargements and improvements previously begun became effective during the year. Furthermore, a number of new mining enterprises first produced important quantities of metal. On the other hand, accidents and labor troubles cut down the output of some of the larger undertakings.

Unless unforseen events cause widespread or prolonged stoppage of operations at the mines, the production of copper in the United States will be considerably larger in 1903 than it has ever been. The Lake Superior district will yield considerably more copper; Arizona is expected to return a considerably larger product; Utah may reach a total of 35,000,000 pounds; and Wyoming, Nevada, Colorado, New Mexico, and the Southern States will report an increase.

The consumption of copper in the United States has been enormous in 1902, and it has been larger, too, in other leading industrial countries. It may be questioned, however, whether the rate of increase attained in 1902 will be maintained in 1903.

PRODUCTION.

The following table shows the production of copper in the United States since its rise to the dignity of an industry. For the earlier years the best available sources have been drawn upon for the estimates given. Since 1882 the figures are those collected by this office.

Production of copper in the United States, 1845–1902.

[Long tons.]

Year.	Total production.	Lake Superior.	Percentage of Lake Superior of total production.
1845	100	12	12
1846	150	26	17.3
1847	300	213	71
1848	500	461	92.2
1849	700	672	96
1850	650	572	88
1851	900	779	86.6
1852	1,100	792	72
1853	2,000	1,297	64.9
1854	2,250	1,819	80.8
1855	3,000	2,593	86.4
1856	4,000	3,666	91.7
1857	4,800	4,255	88.6
1858	5,500	4,088	74.3
1859	6,300	3,985	63.3
1860	7,200	5,388	74.8
1861	7,500	6,713	89.5
1862	9,000	6,065	67.4
1863	8,500	5,797	68.2
1864	8,000	5,576	69.7
1865	8,500	6,410	75.4
1866	8,900	6,138	69
1867	10,000	7,824	78.2
1868	11,600	9,346	80.6
1869	12,500	11,886	95.1
1870	12,600	10,992	87.2
1871	13,000	11,942	91.9
1872	12,500	10,961	87.7
1873	15,500	13,433	86.7
1874	17,500	15,327	87.6
1875	18,000	16,089	89.4
1876	19,000	17,085	89.9
1877	21,000	17,422	83
1878	21,500	17,719	82.4
1879	23,000	19,129	83.2
1880	27,000	22,204	82.2

Year.	Total production, United States.	Lake Superior.	Percentage of Lake Superior of total production.	Montana.	Percentage of Montana of total production.	Arizona.	Percentage of Arizona of total production.
1881	32,000	24,363	76.1	....	....	....	....
1882	40,467	25,439	62.9	....	....	....	....
1883	51,574	26,653	51.6	11,011	21.3	10,658	20.7
1884	64,708	30,961	47.8	19,256	29.8	11,935	18.4
1885	74,052	32,209	43.5	30,267	40.9	10,137	13.7
1886	70,430	36,124	51.3	25,362	36	6,990	9.9
1887	81,017	33,941	41.9	35,133	43.4	7,910	9.7
1888	101,054	38,604	38.2	43,704	43.2	14,195	14
1889	101,239	39,364	38.7	43,849	43.3	13,654	13.5

Production of copper in the United States, 1845–1902—Continued.

Year.	Total production, United States.	Lake Superior.	Percentage of Lake Superior of total product.	Montana.	Percentage of Montana of total product.	Arizona.	Percentage of Arizona of total product.
1890	115,966	45,273	38.9	50,437	43.5	15,534	13.4
1891	126,839	50,992	40.2	50,028	39.5	17,800	14
1892	154,018	54,999	35.7	72,860	47.3	17,160	11.1
1893	147,033	50,270	34.2	69,290	47.1	19,200	13.1
1894	158,120	51,031	32.3	81,729	51.6	19,873	12.6
1895	169,917	57,737	34	84,900	50	21,408	12.6
1896	205,384	64,073	31.2	99,071	48.2	32,560	15.8
1897	220,571	64,858	29.4	102,807	46.6	36,398	16.5
1898	235,050	66,291	28.2	92,041	39.2	49,624	21.1
1899	253,870	65,803	25.9	100,503	39.6	59,399	23.4
1900	270,588	64,938	24	120,865	44.7	52,820	19.5
1901	268,782	69,772	25.9	102,621	38.2	58,383	21.7
1902	294,423	76,165	25.9	128,975	43.8	53,547	18.2

Previous volumes of Mineral Resources contain a detailed statement of the copper production of the United States, territorially, from 1883, when the statistics were first collected by this office, to 1893. Since then the production has been as follows:

Total copper production in the United States, 1893–1902.

[Pounds.]

Source.	1893.	1894.	1895.	1896.	1897.
Lake Superior	112,605,078	114,308,870	129,330,749	143,524,069	145,282,059
Arizona	43,902,824	44,514,894	47,953,553	72,934,927	81,530,735
Montana	155,209,133	183,072,756	190,172,150	221,918,179	230,288,141
New Mexico	280,742	31,884	143,719	2,701,664	701,892
California	239,682	120,000	218,332	690,237	11,987,772
Utah	1,135,330	1,147,570	2,184,708	3,502,012	3,919,010
Colorado, including copper smelters [a]	7,695,826	6,481,413	6,079,243	6,022,176	11,873,033
Nevada	20,000	....	....	....	....
Idaho	36,367	....	1,425,914	....	183,277
South Dakota	....	....	....	....	2,440,338
Washington	39,785	....	....	....	....
Maine and New Hampshire; Vermont; Tennessee and Southern States; Middle States	732,793	2,374,514	3,105,036	4,704,993	4,472,017
Lead desilverizers, etc. [b]	7,456,838	2,136,473	....	4,063,173	1,400,000
Total domestic copper	329,354,398	354,188,374	380,613,404	460,061,430	494,078,274
From imported pyrites and ores and matte	10,431,574	10,678,434	[c] 5,300,000	[c] 5,900,000	[c] 12,000,000
Total (including copper from imported pyrites)	339,785,972	364,866,808	385,913,404	465,961,430	506,078,274

[a] Copper smelters in Colorado, purchasing argentiferous copper ores and mattes in the open market, sources not known. The quantity of Montana matte which goes to one of these works has been deducted.

[b] For 1896 the quantity stated covers only that part of the incidental copper product the source of which could not be ascertained.

[c] Estimated.

Total copper production in the United States, 1893–1902—Continued.

Source.	1898.	1899.	1900.	1901.	1902.
Lake Superior	158,491,703	147,400,338	145,461,498	156,289,481	170,609,228
Arizona	111,158,246	133,054,860	118,317,764	130,778,611	119,944,944
Montana	206,173,157	225,126,855	270,738,489	229,870,415	288,903,820
New Mexico	1,592,371	3,935,441	4,169,400	9,629,884	6,614,961
California	16,925,634	26,221,897	28,511,225	33,667,456	25,038,724
Utah	3,750,000	9,584,746	18,354,726	20,116,979	23,939,901
Colorado, including copper smelters[a]	16,274,561	11,643,608	7,826,949	9,801,783	8,422,030
Wyoming	233,044	3,104,827	4,203,776	2,698,712	889,228
Nevada	437,396	556,775	407,535	593,608	164,301
Idaho	1,266,920	110,000	290,162	480,511	227,500
South Dakota	1,261,393	17,020	15,147	753,510	445,663
Washington	....	....	....	....	209,297
Maine and New Hampshire; Vermont; Tennessee and Southern States; Middle States	5,395,226	4,410,554	4,820,495	6,860,039	13,599,047
Lead desilverizers, etc.[b]	3,553,336	3,500,000	3,000,000	531,530	500,000
Total domestic copper	526,512,987	568,666,921	606,117,166	602,072,519	659,508,644
From imported pyrites and ores and matte	[c]19,750,000	[c]23,800,000	[c]36,380,000	[c]64,000,000	[c]40,000,000
Total (including copper from imported pyrites)	546,262,987	592,466,921	642,497,166	666,072,519	699,508,644

[a] Copper smelters in Colorado, purchasing argentiferous copper ores and mattes in the open market, sources not known. The quantity of Montana matte which goes to one of these works has been deducted.

[b] For 1896 the quantity stated covers only that part of the incidental copper product the source of which could not be ascertained.

[c] Estimated.

Since July, 1892, Mr. John Stanton, of New York, has collected monthly, from sworn returns, the following figures showing the production of the leading mines of Lake Superior, Montana, and Arizona. The estimate of outside sources is drawn, particularly recently, from official returns of many of the principal outside mines, large and small:

American production of copper.

[Long tons.]

Year.	Reporting mines.	Outside sources.	Total.
Second 6 months of 1892	59,239	6,287	65,526
1893	129,760	12,730	142,490
1894	142,543	17,080	159,623
1895	155,497	15,700	171,197
1896	189,494	14,400	203,894
1897	204,206	11,900	216,106
1898	216,222	18,050	234,272
1899	230,806	31,400	262,206
1900	227,987	40,800	268,787
1901	223,355	41,900	265,255
1902	258,056	37,600	295,656

The monthly reports, in detail, for the years 1892, 1893, and 1894 are published in Mineral Resources for 1895; for the years 1895 and 1896 in Mineral Resources for 1896; and for 1897, 1898, and 1899 in Mineral Resources for 1899. For 1900, 1901, and 1902 the monthly production was as follows:

American production of copper, monthly, 1900, 1901, and 1902.

[Long tons.]

Month.	1900.			1901.			1902.		
	Reporting mines.	Outside sources.	Total.	Reporting mines.	Outside sources.	Total.	Reporting mines.	Outside sources.	Total.
January	17,613	3,400	21,013	19,279	3,400	22,679	15,155	3,800	18,955
February	17,497	3,400	20,897	17,700	3,400	21,100	16,931	3,400	20,331
March	19,883	3,400	23,283	19,984	3,400	23,384	20,335	3,700	24,035
April	20,667	3,400	24,067	18,038	3,400	21,438	20,824	3,800	24,624
May	19,282	3,400	22,682	18,892	3,500	22,392	21,763	4,000	25,763
June	19,235	3,400	22,635	18,901	3,500	22,401	22,740	4,000	26,740
July	19,612	3,400	23,012	18,585	3,400	21,985	22,749	4,000	26,749
August	17,667	3,400	21,067	19,267	3,400	22,667	23,196	[a] 2,100	25,296
September	17,986	3,400	21,386	18,080	3,500	21,580	23,688	2,100	25,788
October	19,945	3,400	23,345	20,498	3,600	24,098	24,152	2,100	26,252
November	19,876	3,400	23,276	18,128	3,600	21,728	22,997	2,300	25,297
December	18,724	3,400	22,124	16,003	3,800	19,803	23,526	2,300	25,826
Total	227,987	40,800	268,787	223,355	41,900	265,255	258,056	37,600	295,656

[a] The decrease in "outside sources" is caused by the largest of them becoming "reporting mines."

Early in 1903 large producing interests withdrew from the association, declining to furnish statistics in the future, so that the monthly compilations have ceased.

A considerable number of foreign mines, including those of the Peninsula, the Cape, Australasia, Germany, and Mexico, report monthly to a secretary in London since July, 1892. Since then the production of this group, which maintains friendly relations with the American Producers' Association, has been as follows:

Foreign reporting mines.

[Long tons.]

Year.	Quantity.	Year.	Quantity.
Second half of 1892	39,655	1898	84,554
1893	81,785	1899	89,240
1894	88,531	1900	89,431
1895	86,178	1901	100,241
1896	86,196	1902	108,875
1897	88,270		

According to the careful compilations of Mr. John Stanton the exports of fine copper during recent years have been as follows:

Exports of fine copper from the United States.

[Long tons.]

Year.	Quantity.	Year.	Quantity.
1893	80,392	1898	145,115
1894	77,527	1899	119,811
1895	64,722	1900	160,082
1896	125,605	1901	94,366
1897	129,210	1902	168,767

The details of this movement are dealt with elsewhere in this report.

LAKE SUPERIOR DISTRICT.

In previous volumes of the Mineral Resources the production of the individual mines has been tabulated from 1884 to 1891, both inclusive. Since that time some of the producers have reported to this office only with the understanding that the returns be regarded as confidential. The production of the majority of the mines is, however, given accurately in the published annual reports to stockholders. From these the following table has been compiled:

Production of some of the leading Lake Superior copper mines, 1896–1902.

[Pounds.]

Mine.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Tamarack	16,044,860	20,222,529	19,660,480	18,565,602	19,181,605	18,000,852	15,961,528
Quincy	16,863,477	16,924,618	16,354,061	14,301,182	14,116,551	20,540,720	18,988,691
Osceola	6,251,304						
Kearsarge	1,377,226	11,201,103	12,682,297	11,358,049	12,567,131	13,723,487	13,416,396
Tamarack, jr	2,135,000						
Franklin	2,746,076	2,908,284	2,623,702	1,230,000	3,663,710	3,757,419	5,259,140
Atlantic	4,895,985	5,109,663	4,377,399	4,675,882	4,930,149	4,666,889	4,949,366
Central	469,243	611,172	291,339				
Wolverine	2,220,933	2,316,296	4,588,114	4,756,646	4,778,829	4,946,126	6,473,181
Baltic			42,766	621,336	1,735,060	2,641,432	6,285,819
Champion							4,165,784
Trimountain							5,730,807
Isle Royal						2,171,955	3,569,748
Mohawk						677,145	908,479
Mass				42,800	122,239	873,297	2,345,805

The annual report of the Calumet and Hecla Mining Company for the fiscal year ending April 30, 1903, shows a production of 38,316 long tons of refined copper, as compared with 39,982 tons for the preceding fiscal year. The balance sheet for the last four years compares as follows for the fiscal year ending April 30:

Balance sheet of the Calumet and Hecla Company for fiscal years ending April 30, 1900, 1901, 1902, and 1903.

	1903.	1902.	1901.	1900.
ASSETS.				
Cash and copper	$6,118,435	$3,950,575	$3,487,855	$5,902,859
Notes and bills receivable	509,584	366,658	382,011	573,576
Insurance fund	606,859	149,936	....	504,583
Total	7,234,879	4,467,171	3,869,868	6,981,019
LIABILITIES.				
Drafts and bills payable	373,681	502,816	760,899	495,160
Machinery contracts	304,175	371,575	640,838	1,425,000
Set aside	....	....	300,000	800,000
Total	677,855	874,391	1,701,737	2,720,160
Balance	6,557,023	3,592,779	2,168,130	4,260,858

President Agassiz, in his annual report, states that the character of the new openings on the conglomerate belt tributary to the Red Jacket shaft has been unsatisfactory. The six additional heads of stamps in the extension of the Hecla mill are in commission, and the equipment is most satisfactory. The plan is to equip both the mills according to the new system, and it is expected that the remodeling will proceed at the rate of four stamps annually.

The report of the Quincy Mining Company shows that the production of the mine was 26,425,670 pounds of mineral, yielding 18,988,491 pounds of refined copper, for which there was realized the gross sum of $2,275,819.25. Since the running expenses at the mine were $1,477,813.16, the taxes in Michigan were $49,091.54, and the smelting, transportation, and other expenses were $185,887.31, there was left a mining profit of $563,027.24. Adding $18,091.27 realized from interest, and $13,005.62 from Hancock real estate account, and deducting $96,124.08, being construction cost less amount reserved from earnings of 1901, there is a net income for the year 1902 of $498,000.05. The Quincy mined 983,594 tons of rock, hoisted 984,594 tons, and treated in the stamp mills 953,019 tons, which yielded 21,504,860 pounds of mineral. The company is introducing extensively underground electric haulage, is substituting coarse crushing at the stamp mills, and is installing Chilean mills for treating the coarse sands from the roughing jigs.

The copper production of the Tamarack fell off from 18,000,852 pounds fine in 1901 to 15,961,528 pounds in 1902, which was largely due to the fact that the rock coming from the territory tributary to the new No. 5 shaft, which has a depth of 4,938 feet, was below the average. There were mined in 1902 837,568 tons of rock, as compared with 773,783 tons in 1901, and there were hoisted 763,209 tons, as compared with 668,622 tons. The cost of mining per ton of rock was $1.81 and $1.97, respectively, and the cost of mining per ton of rock stamped was $2.30 and $2.44 in 1902 and 1901, the quantity stamped being 658,720 tons in 1902 and 626,905 tons in 1901. The cost of stamping per ton stamped was 23.299 cents in 1902 and 24.953 cents in 1901. The costs compared as follows, per pound of refined copper:

Cost per pound of refined copper at Tamarack mine in 1901 and 1902.

	1901.	1902.
At mine ....cents..	8.48	9.51
Construction ....do....	1.56	.97
Smelting, freight, commissions, etc ....do....	1.63	1.42
Total........	11.67	11.90
Yield of fine copper per ton stamped........pounds..	28.7	24.2
Yield of mineral ....per cent..	60.01	61.99

The income of the company was $1,894,320.75 from 15,961,528 pounds of copper, sold at an average of 11.87 cents, and $47,586.51 from interest receipts. The running expenses at the mine were $1,518,044.60; the smelting charges, $128,098.92; transportation, $47,939.08; commissions and copper charges, $27,690.05; miscellaneous expenses at Boston, $22,826.32—a total of $1,744,598.97, leaving a mining profit of $197,308.29, from which must be deducted $154.877.74 for construction expenses.

Delays in the receipt of a new compressor plant, ordered in 1901, which retarded production and a threatened cave-in in No. 5 Osceola shaft, made it impossible to attain the increased output for the Osceola mine. The yield in 1902 was, however, 13,416,396 pounds fine copper, as compared with 13,723,487 pounds in 1901. The results in 1902 were as follows as compared with 1901: Rock mined, 968,835 tons and 958,272 tons; rock hoisted, 908,264 tons and 892,172 tons; rock stamped, 836,400 tons and 793,207 tons; pounds of mineral obtained, 18,430,012 and 18,807,616; yield of mineral, 72.797 per cent and 72.934 per cent. The cost, compared as follows:

Cost per pound of refined copper at Osceola mine in 1901 and 1902.

	1901.	1902.
	Cents.	*Cents.*
At mine........	10.94	9.91
Construction........	3.52	.64
Smelting, freight, selling, etc	1.45	1.22
Total........	15.91	11.77

The greater part of the rock is now being furnished by the Kearsarge shafts, while a part of the tonnage comes from the old Osceola mine. The Tamarack, jr., branch supplies little rock.

The total income of the Osceola in 1902 was $1,594,453.76, including the receipts from 13,416,396 pounds of copper sold at an average of 11.78 cents per pound. The expenses were $1,493,654.47, leaving a gross profit of $100,799.29. The construction account was $85,326.96. It is estimated that when the belated machinery is installed the Osceola will be capable of producing 25,000,000 pounds of copper annually.

The annual report of the Franklin Mining Company shows an increased output, there having been obtained in 1902 from stamping 315,687 tons of rock, 8,352,020 pounds of mineral, or 5,237,460 pounds of copper. In 1901 the production was 3,757,419 pounds. The total receipts for 1902 were $647,964, while the mining expenses were $521,432, and the smelting and transportation costs were $76,838. The cost of stamping was 28.81 cents per ton. The old Franklin mine continues to furnish nearly 10,000 tons of rock per month, and the Franklin junior conglomerate, which is low in grade, supplies the greater part of the product.

The yield of the rock of the Atlantic mine during the year 1902 was the lowest on record, having been only 0.5547 per cent, and since the average realized was only 11.88 cents per pound, the mine showed a deficiency. The receipts for copper were $588,200.73, and the expenses were $598,910.18, a deficit of $10,709.45. There was also expended on interest $5,059.79, for cost of exploration $13,175.90, and for improvements $20,441.26. During 1902 there were stamped 446,098 tons of rock, which yielded 6,847,270 pounds of mineral, and 4,949,366 pounds of fine copper. The costs were: 89.14 cents for mining, selecting, and breaking rock and all surface expenses; 5.97 cents for transportation to the mill; 25.03 cents for stamping and separating; 14.11 cents for freight, smelting, and marketing product—a total of mining expenses of $1.3425. During the early part of 1903 the Atlantic rock has shown considerable improvement.

During the fiscal year 1902–3 the Wolverine Mining Company hoisted 299,922 tons of rock and stamped 279,011 tons, yielding 11,330,370 pounds of mineral, which at 72.90 per cent gave 8,260,386 pounds of refined copper, sold at an average of 12.48 cents per pound. The cost of producing the copper, exclusive of construction, was 6.645 cents per pound; inclusive of construction it was 7.105 cents. The total receipts were $1,033,259 and the total expenses were $548,922, leaving a mining profit of $484,337. Construction costs were light, being only $38,014, which left a net profit of $446,323. The new stamp mill on Traverse Bay went partly in commission in August, 1902, and commenced to do full duty from the 1st of September. It is capable of treating fully 1,000 tons per day, so that the equipment is now equal to a yearly production of close to 10,000,000 pounds.

The Mass Mining Company produced, during 1902, 2,345,805 pounds of fine copper from 3,273,835 pounds of mineral, obtained from stamping 152,562 tons of rock out of 203,769 tons hoisted. The receipts from copper and from assessments aggregated $509,602, while the expenditures included $302,394 for development, mining, and mill expenses; $39,468 for buildings and equipment at the mine; $75,000 for buildings and machinery at the mill; and $38,581 for smelting, marketing copper, and other expenses.

The production of the Isle Royale Copper Company was 3,569,748 pounds fine in 1902, as compared with 2,171,955 pounds in 1901, the receipts being $425,125.23 from the copper, at an average of 11.91 cents per pound; $8,881.61 from 18,523 ounces of silver, and $66,768.64 from interest receipts and other income. The running expenses at the mine were $400,539.52; the smelting charges, $25,461.83; transportation, $6,403.63; commissions, $11,179.97, and miscellaneous expenses, $17,401.14—a total of $460,986.09, leaving a profit of $39,789.39. From this must be deducted $10,291.56 for construction and $8,657.88 for exploration. Two heads of stamps were operated during the first quarter of 1902, three heads to the end of July, and for the remainder of the year only one.

The Isle Royale and Portage lodes have proven to be bunchy.

The Champion Copper Company is a very important addition to the producing mines of Lake Superior. During 1902 the company had the use of a small head at the Atlantic mill, which crushed 66,257 tons, and also since August, 1902, a larger head at the Baltic mill. From the total of 120,485 tons of rock crushed by these the company obtained 5,575,440 pounds of mineral, or 4,165,784 pounds of ingot. This was sold at 11.823 cents per pound. The Champion Company completed in December, 1902, a four-stamp mill which is to have a crushing capacity of 2,000 tons of rock per day, which would be equivalent to a yearly production of 20,000,000 pounds of copper. The first head went into commission during December; the second in February, 1903, and the two others later. During 1903 two additional stamps are to be put in.

The Champion Copper Company was organized in November, 1899, the St. Mary's Mineral Land Company undertaking to provide one-half of the cost of development and equipment. It was organized with 100,000 shares, $10.25 per share being paid for the land, and $14.75 per share cash in assessments. The mine, however, proved to be larger than expected and the total cash expenditures with a four-head stamp mill completed, and with the mine sufficiently opened to deliver daily 2,000 tons of rock through four fully equipped shafts reached about $1,700,000 over and above the cost of the land.

One-half of the capital stock of the Champion Copper Company is held by the Copper Range Consolidated Company, who control all but 27 shares of the 100,000 shares of the Baltic Mining Company and the Copper Range Railroad. The Baltic hoisted, during 1902, 302,805 tons of rock, of which 275,175 tons were stamped, producing 8,903,096 pounds of mineral, or 6,285,819 pounds of copper, which sold at 11.872 cents per pound. The Baltic Company has a capacity of about 11,000,000 pounds of copper per annum when its mill is running on its own rock exclusively. During 1902 the running expenses at the mine were $475,289, and the smelting, freight, and marketing $88,224, leaving a mining profit of $182,762. The construction, taxes, and interest, however, aggregated $328,032. The extraordinary construction for the Baltic is now practically completed.

The Trimountain entered the ranks of lake copper producers in 1902 with a total output of 5,730,807 pounds of ingot. This will be largely increased during 1903. The stamp mill of the company, with its three stamps, will be in full commission, a part of the mill having been started in 1902. The Trimountain will also use two of the stamps of the Arcadian mill, so that it is likely, during the second half of 1903, to be producing at the rate of about 18,000,000 pounds per annum.

Owing to delays by the contractors of the mill, the first head of the Mohawk Mining Company did not go into commission until December, 1902, and the second head was not started until January, 1903. The third head is still under construction. During the first two months of 1903 there were stamped 40,473 tons of rock, which gave 993,064 pounds of fine copper, or an average yield of 24½ pounds per ton. This indicates a yearly production, when the whole plant is in full operation, of about 9,000,000 pounds. The total receipts were $444,666.22, including $31,384.67 by balance, $308,026 from assessments, $77,991.23 from sales of "mohawkite," and $26,425.91 from copper. The expenditures were $463,433.02, including $446,070.79 at the mine.

The Winona Copper Company has developed rather rapidly and is expected to produce some copper with a leased head of the Atlantic mill during 1903. The expenses at the mine during 1902 were $48,059 and other expenses were $7,003. The receipts from assessments were $90,744, and there was obtained from the sale of 101,188 pounds of copper the sum of $13,028.

The Michigan Copper Mining Company has continued development work on the Branch, Calico, and Minnesota veins, producing a small amount of copper from the last. An arrangement has been made by which rock will be crushed at the Mass mill. The receipts were $225,876.81, including $13,972.08 by balance and $190,471 from assessments, while the expenditures were $164,944.86, including $157,563.65 at the mine.

The Phoenix Consolidated Mining Company has continued explorations on the St. Clair and West veins, which justified the beginning of the erection of a one-head stamp mill. The receipts were $201,891.50, including $200,000 for assessments Nos. 1 and 2, while the expenses were $93,052.43 for underground work, $43,753.81 for surface expenses, $16,106.55 for construction, $36,932.06 for railroad, and $39,564.77 for the mill.

The Adventure Mining Company commenced stamping rock in its stamp mill in September, 1902, over six months later than was expected. The company sold in 1902 606,211 pounds of copper for $70,791, and received from assessments $200,000, from interest $6,741, and from sales of silver $1,181. The expenditures for machinery, supplies, labor, buildings, and permanent improvements aggregated $703,723, and for organization $15,082. It is expected that the Adventure mine will supply and the two stamp mills will crush 1,000 tons of rock per day, yielding about 1 per cent of ingot copper.

A number of South Range mines and the Stanton group have decided to build a refining plant on the shore of Portage Lake, 3 miles west of Houghton. The smelter, which will be erected by the Michigan Smelting Company, will have five reverberating furnaces and one cupola.

MONTANA.

The collection of statistics of the production of copper for Montana involves certain difficulties, because some of the smelting works, not having converting plants, or not operating them, ship the mattes produced to other works. There is therefore a danger of duplication which is avoided by the system of securing a statement from those works which treat custom mattes, giving the fine copper contents thereof. It is only natural, however, that the product of the initial plants and of the secondary works do not exactly agree, because the latter may fail to convert all the matte received or may draw on accumulated stocks of matte. In the former case the result may be too low; in the latter it may be excessive. In the long run, of course, the balance must be established, but there may be differences in individual years. It might be possible to arrive at exact figures for each individual year by taking into account the stocks at shipping and at receiving works, but it is believed that this introduces unnecessary complications.

The United Copper Company lost its concentrator by fire in August, 1902, and although a plant at Basin, Mont., was leased at once, the product was reduced for a time, in spite of the fact that the smelter was operated partially on first-class ore. It is expected that the output will be at the rate of 40,000,000 pounds per annum when the new concentrating plant is in commission. The production for the calendar year 1902 is given at 30,374,696 pounds of copper, 919,590 ounces of silver, and 11,269 ounces of gold, as compared with 30,318,328 pounds of copper, 1,083,474 ounces of silver, and 4,631 ounces of gold in 1901.

The properties developed in the Butte district by Franklin Farrel and his associates have been acquired by the Pittsburg and Montana Copper Mining Company, who are building a large smelting plant at Butte, which, it is expected, will begin production in 1903.

ARIZONA.

The copper production of Arizona was less in 1902 than it was in 1901, chiefly because some of the larger producers fell off considerably. The greater part of the decline was due to the restriction of output brought about at the United Verde mine at Jerome through a fire and through labor troubles. The Old Dominion and the Copper Queen, too, showed a falling off. On the other hand, the Arizona Copper Company increased over 10,000,000 pounds, the Detroit made a larger product, and there appeared as new contributors to the total the Shannon, the Calumet and Arizona, and the Val Verde.

The prospects are that the year 1903 will again witness a considerable increase, with at least a partial recovery by the United Verde, a full year's production on the part of the new mines of 1902, and with some additions by reason of the completion of plants still under construction.

There has been a great deal of activity in the Bisbee district in the opening up and development of new mines by strong interests from Lake Superior, Pittsburg, and New York. One of these companies, the Calumet and Arizona, reached the producing stage in 1902. Four others, controlled by substantially the same parties, are being vigorously pushed forward. The great mine of the district, the Copper Queen, did not, in 1902, reach the production of 1901. The work of building the new smelting plant at Douglas has been vigorously prosecuted during the year and will be completed during 1903.

A very important producer entered the ranks in 1902, the Calumet and Arizona Mining Company having started its smelting plant at Douglas on November 15, 1902. The production for the year was 2,066,647 pounds from one furnace. A second furnace and stand of converters will be started in 1903 and a third furnace will be added as a reserve. It is expected that when the plant is in full operation it will produce about 35,000,000 pounds of copper annually. The mines are at Bisbee, the ore going to Douglas, and the converter bars are refined by the Nichols Chemical Company, of New York, the copper being sold by Phelps, Dodge & Co. It is estimated that the mine is developed to furnish ore for a period of at least six years ahead.

In the Clifton district the Arizona Copper Company, limited, added over 10,000,000 pounds to its production in 1902 over 1901. During the half year ending September 30, 1902, the concentrating mills handled 195,849 tons of crude ore, which yielded 28,806 tons of concentrates. From the leaching of 35,721 tons of tailings 1,532,061 pounds of copper was obtained. These concentrates and richer ores, aggregating 54,486 tons and 1,653,209 pounds of copper derived from the leaching plant, were put through the smelting works and yielded 15,049,065 pounds of ingot copper for the six months. The average yield of all the copper ores treated was 3.37 per cent, and the yield from the concentrated ores was 2.76 per cent during the half year under consideration, as compared with 2.95 per cent during the preceding half year. During the year ending September 30, 1902, the accounts show net profits of £183,225 from the mines, and £113,662 from the railroad. The payments were £13,888 for mine administration, £8,306 for railroad administration, £2,506 for the Edinburgh office, and £25,718 for interest. There were placed to reserve £40,000, and there were paid on preference shares £24,531, which left a balance of £181,938. Out of this, dividends of 9s. 6d. per share were paid, absorbing £180,488. The general manager reports that the improvements on the railroad and on the metallurgical works are practically completed, so that the Arizona Copper Company is now in a position to produce annually a little over 30,000,000 pounds of refined copper.

The Shannon Copper Company, which was organized in 1899 to acquire properties then owned by C. M. Shannon, at Clifton, Arizona, began producing in 1902. The capital stock is $3,000,000 in 300,000 shares, of which 185,296 shares have been listed on the Boston Stock Exchange. There are also $600,000 of 7 per cent bonds on the property, 20 per cent of the net earnings per annum being provided as a sinking fund. The mining property of the company consists of 43 claims over 600 acres in area, one block of which is 4,300 feet in width, and is located at Metcalf, 7 miles south of Clifton, the terminus of the Arizona and New Mexico Railroad. It is adjacent to the producing properties of the Arizona Copper Company and near the Detroit Copper Company's mines. The development consists of about 5 miles of tunnels, cross-cuts, drifts, winzes, and upraises, the various workings being connected with an incline tram, which delivers ore by gravity to the railroad at Metcalf, where it is transported 7 miles to the smelter at Clifton. The reduction plant consists of two 250-ton water-jacketed blast furnaces, one of which was in operation during the latter part of 1902, and made over 2,000,000 pounds of fine copper. There is a 500-ton concentrator, built in two sections of 250 tons each, the first section of which was completed early in 1903. The second furnace was blown in in April, 1903, the capacity of the whole plant being about 1,000,000 pounds of copper per month.

In this district, Edward H. Strobel, as lessee of the New England Copper Company, of Arizona, is developing a property on a considerable scale. It has not yet, however, been decided to build a smelting plant.

The Producers' Mining and Smelting Company, of Chicago, whose mines are in southern Arizona, is erecting a smelter and is expected to become a producer of copper in September of 1903.

The report of the Old Dominion Copper Mining and Smelting Company shows a decline in the production from 10,004,787 pounds in 1901 to 7,992,550 pounds in 1902. During 1902 there were mined and smelted 68,840 tons of ore, which yielded 5.8 per cent. The product was 7,705,327 pounds of pig copper, averaging 95.95 per cent fine, and 850,078 pounds of matte at 70.52 per cent. The sales of product, including a considerable part of a large stock carried over, yielded $883,378, and the outlays for mining were $392,507; for smelting, $293,670; for handling, selling, and general expense, $130,559, and for construction and development, $47,175. The company is carrying out a comprehensive scheme of improvement, including the sinking of a new shaft and the construction of a new smelter and concentrating mill, so that a considerably larger product at a lower cost will be made. The aggregate freight rates on incoming and outgoing freight amounted to 3½ cents per pound of copper produced. Under contracts made this will be reduced by about 1½ cents per pound of copper. It is estimated that when the improvements have been completed the production will be at the rate of 20,000,000 pounds per annum, and that the cost will be reduced to about 8 cents per pound.

A small quantity of matte, containing about 50 per cent of copper and 30 ounces of silver, was produced by the Pride of the West Mining and Milling Company, but the property was closed down in the winter of 1902.

The Black Warrior Copper Company made a small quantity of copper, but it is expected that an output of some magnitude will be maintained during 1903.

The Imperial Copper Company, formerly the Silver Bell Copper Company, of Red Rock, Pinal County, is to start a new smelting plant to produce upward of 2,500,000 pounds fine copper per month. It is not expected, however, that the works will be in operation until the middle of 1904.

During the course of 1903 a new producer is to appear in the George A. Treadwell Mining Company, which controls property in the Verde and Big Bug districts, and proposes to use smelting furnaces in which oil is to be employed as a fuel.

The Valverde Copper Company, at Valverde, shipped a moderate amount of copper in the form of matte, no converting being done at the plant. It is considered probable that the production of 1902 will be doubled in 1903.

Among the mines equipped with smelting works which did not turn out any copper during 1902 were the Rosemont, the Helvetia, and the Azurite.

CALIFORNIA.

There was quite a sharp decline in 1902 in the output of copper in California, chiefly because the mines of Shasta County did not make their normal quantity. Mine operations by the principal company, the Mountain Copper Company, were interfered with by a fire, and later in the year a strike of the workmen caused a cessation of operations by both the Mountain and the Bully Hill companies, the yield of the former being reduced altogether about 10,000,000 pounds. The Mountain Copper Company produced 139,903 tons of ore, the Keswick smelter handling 149,787 tons and producing 7,854 tons of Bessemer bars. The refining plant in New Jersey made 8,739 tons of ingots. The profit on sales of copper was £117,846, and the rentals and miscellaneous profits amounted to £8,462.

UTAH.

Utah is forging to the front as one of the most important copper producing States, and it is notably in the Bingham camp that development has been most rapid. The largest producers are the Highland Boy Mining Company (controlled by the Utah Consolidated Company), the Bingham Mining Company, and the United States Mining Company, the last having begun production in 1902. In the spring of 1903, these were producing at the rate of 1,200,000 pounds, 700,000 pounds, and 800,000 pounds, respectively, or at the rate of over 35,000,000 pounds per annum. In the same district the Tintic Mining and Development Company is opening the Yampa mine and will build smelting furnaces during the present year. The Boston Consolidated Mining Company has also developed large bodies of ore at depth, but has not yet decided upon the erection of a smelting plant. The Columbia Copper Company, which has been successful with a small concentrating plant, will build a larger mill. The concentrates are sold to the smelters in the district.

The Bingham Company has control of the Bingham and Tintic mines and of the Dalton & Lark and Brooklyn mines, into which the Dalton & Lark tunnel, 7,000 feet long, is being driven in order to unwater them. The smelter possesses four furnaces. The company is also working under an option the Eagle and Blue Bell property at Tintic.

The United States Mining Company reached the stage of active production late in 1902. The company owns the Commercial mines at

Bingham, and draws its siliceous ores from the Centennial Eureka mine, and extensive development has been undertaken in the Old Telegraph and Jordan mines on the Old Jordan vein. The company has completed a well-equipped smelting plant with five furnaces, which it is expected will reach a production of 1,000,000 pounds per month. Since January 1, 1900, there has been expended $1,706,164, of which $892,987 was for the construction and operation of the smelter and its auxiliary works and $813,177 in the purchase of new properties, in the development and equipment of the mines, and in the payment of interest and general expenses. The total amount received at the date of the report of the voting trustees from the sale of bullion was $382,500, the amount still unpaid upon bullion already shipped being estimated at $69,319.

The Highland Boy Company, controlled by the Utah Consolidated Company, treated in 1902, 167,713 tons of ore, which yielded 11,840,431 pounds of copper, 160,915 ounces of silver, and 19,078 ounces of gold, as compared with a tonnage of 167,823 tons in 1901, yielding, respectively, 9,043,967 pounds of copper, 176,331 ounces of silver, and 13,983 ounces of gold. Having carried over from 1901, 2,163,683 pounds of copper and 62,909 ounces of silver, the company sold 14,004,114 pounds of copper, 223,824 ounces of silver, and 19,083 ounces of gold, the average prices realized being 11.91 cents per pound for copper and 52.62 cents per ounce for silver. The total earnings were $1,992,049, and the expenses were $1,142,049, the net earnings being $850,000. The costs included $242,621 for mining, $497,346 for smelting, $239,963 for freight and refining, $83,891 for ore and matte purchases, $42,249 for development, and $35,979 for general and miscellaneous expenses. After paying $534,000 in dividends and writing off $58,333, the company added $257,667 to a previous balance of $649,469, making a total surplus of $907,136.

Outside of the Bingham camp, several important new enterprises are being undertaken. Among these is the Newhouse mines and smelters, which company is to take over the Cactus properties of Mr. Samuel Newhouse, 7 miles from Frisco, in southern Utah. A main shaft is being driven and a tunnel 5,800 feet long has been begun. It is proposed to erect a concentrating plant capable of handling 1,500 tons of ore per day, and to build a large smelting works. It is estimated that the production of copper will be about 1,000,000 pounds per month.

The Majestic Copper Mining and Smelting Company, of which Mr. W. A. Farish is general manager, is opening a large property in Beaver County, and is building a smelting works which is expected to be in operation during 1903.

The Royal Gold and Copper Company has been organized to develop copper properties in Beaver, Iron, and Washington counties.

WYOMING.

The production of copper in 1902 was lower than in previous years because the principal mines were being developed prior to the enlargement of local works and a much smaller quantity of ore was shipped to distant smelters. The smelting operations at Encampment ceased on February 16, 1902, in order that enlargement of the works might be begun. The North American Copper Company has purchased the Ferris-Haggerty mines and the Boston-Wyoming Smelter, Power and Light Company. In the New Rambler district the Rambler Mining and Smelting Company at Holmes has operated a melting furnace intermittently.

The Tully Copper Mining Company proposes to install a plant in 1903.

NEW MEXICO.

The Santa Fe Gold and Copper Mining Company confined work to developing the principal ore body and to prospecting, no smelting operations being carried on. The Silver City works were idle also, so that the ores of the territory were chiefly treated at the El Paso plant of the American Smelting and Refining Company.

TENNESSEE.

During 1902 the work of modernizing the plant and equipment of the Tennessee Copper Company was brought to a close, and the company is now in a position to produce from 11,000,000 to 12,000,000 pounds of copper per annum. During 1902 there were mined from the Loudon mine, which produces the higher grade of ore, 81,741 tons of sulphide ore and 4,099 tons of siliceous ore. The equipment on the Burra Burra mine was completed, and 105,620 tons of sulphide ore were raised. The Polk County mine yielded 59,109 tons. Extensions of the roast yards were made and are being continued. For the first five months only one blast furnace was in operation, smelting 69,674 tons of ore. Then the second furnace was put into commission, and for the last seven months the two furnaces smelted 151,520 tons, making a total of 221,194 tons. In December, however, the two furnaces handled 26,804 tons of ore. Contracts have been let for a third furnace in order to prevent any delays through accidents. During 1902 a 25-ton refining furnace was built, so that during the latter half of the year a considerable part of the product was shipped as refined copper. The production was 8,103,534 pounds of fine copper, of which 4,349,487 pounds of pig copper were sold at an average price of 11.35 cents, or, deducting freight and charges, 10.71 cents per pound net. The fine copper from pig copper refined at the Raritan works, 866,079 pounds, was sold at 11.76 cents, netting 10.63 cents, and the copper refined at the Tennessee works, 1,401,293 pounds, sold at 11.73 cents, netting 11.12 cents.

The total receipts from copper sales were $760,450, and from rentals, etc., $2,647. The net profit, after deducting working expenses and $71,903 for interest and depreciation, was $231,109. There were also received $31,050 for iron-ore royalty, $17,358 for merchandise department, and $32,198 on toll account. The amount charged to construction was $47,505. During the year there were issued $5,000,000 5-per-cent bonds in order to pay floating debt and to furnish working capital.

Mr. J. Parke Channing, the consulting engineer, reports that the operating expenses were as follows per ton of ore:

Mining and development	$0.8411
Crushing and sorting	.0827
Roasting	.3399
Railroad	.1547
Engineering and laboratory	.0268
General expenses	.0866
Blast furnace	1.0469
Converting	.2172
Refining	.1007
Total cost per ton	2.8966

Mr. Channing expresses the belief that by a gradual extension of the roasting and smelting facilities the company will be enabled to produce from 18,000,000 to 20,000,000 pounds of copper per annum, and that this large production will reduce the cost of fine copper at least 0.5 cent per pound.

The Ducktown Sulphur and Copper Company, the second producers in Tennessee, showed an increase in output in 1902 of nearly 500,000 pounds over 1901.

ALASKA.

Only small quantities of copper ore have been shipped to Puget Sound smelters, but it is known that large deposits of copper ore exist whose development is being taken seriously in hand.

OREGON.

At Sumpter, Oregon, a plant is being constructed by the Oregon Smelting and Refining Company. It is a copper matte plant, having a capacity of 125 to 150 tons of ore per day. The copper is to be used chiefly as a carrier for the precious metals in the ore.

SOUTH DAKOTA.

The Horseshoe Mining Company, of Rapid City, which controls the National Smelting Company, Incorporated, smelts (in two matte furnaces, using hot blast heated by the escaping gases) ores which come from the Potsdam formation in the Ruby and Bald Mountain districts, Lawrence County. These highly siliceous silver-gold ores are mixed with Colorado and Montana sulphide ores, the product being a matte which averages 40 ounces of silver, 15 ounces of gold, and 8 per cent of copper.

IMPORTS.

In former volumes of Mineral Resources tables have been published showing the imports from 1867 to 1894, inclusive, of fine copper contained in ores. From 1895 to 1902 only the gross weight of the ore and of the regulus (matte) and of black copper are given. These are presented in the following table:

Copper ore and regulus and black copper imported and entered for consumption in the United States, 1895–1902.

Year ending December 31—	Ore.		Regulus and black copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1895	8,921,920	$213,689	3,104,640	$125,853	$339,542
1896	2,620,800	126,580	3,427,200	210,725	337,305
1897	43,919,680	683,497	2,974,720	226,704	910,201
1898	107,253,440	565,245	1,583,680	92,135	657,380
1899	120,934,616	1,141,180	7,763,885	784,232	1,925,412
1900	109,123,840	2,164,386	27,534,080	2,966,449	5,130,835
1901	131,790,400	3,084,306	75,913,600	11,310,357	14,394,663
1902	334,010,800	1,706,245	52,978,240	6,215,396	7,921,641

The sources of the imports of copper in the form of pigs, bars, old material, etc., are shown in the following table for the calendar years 1900, 1901, and 1902:

Imports of copper pigs, bars, ingots, plates, old and other unmanufactured, in the calendar years 1900, 1901, and 1902.

Country.	1900.		1901.		1902.
	Quantity.	Value.	Quantity.	Value.	Quantity.
	Pounds.		*Pounds.*		*Pounds.*
France	4,312,454	$658,180	1,022,178	$159,344	843,523
Germany	809,144	120,256	3,117,951	537.409	1,245,354
United Kingdom	36,809,986	6,341,696	43,838,699	7,539,801	27,762,838
Dominion of Canada:					
Quebec and Ontario	582,038	71,775	688,374	74,203	386,361
British Columbia	164,530	11,095	69,323	5,846	
West Indies:					
Cuba	1,510,017	174,858	1,013,460	125,255	801,016
British	466,064	42,458	328,206	37,252	190,972
Santo Domingo	38,090	3,163	42,826	4,367	
Mexico	20,168,888	2,664,249	23,024,376	3,245,564	68,565,175
Japan	2,478,967	305,933	224,850	33,185	....
British Australasia	....	....	....	....	....
All other countries	1,456,630	164,207	456,163	49,990	3,334,328
Total	68,796,808	10,557,870	73,826,406	11,812,216	103,129,568

A considerable part of the imports from the United Kingdom is blister copper originating in other countries, notably the Australian colonies, which comes to this country for refining. The Mexican copper is almost entirely in the form of converter bars, some American matte going to Mexican works for conversion to be returned to this country for refining.

Probably the imports of foreign mattes will soon cease, since Bessemer plants are being quite generally installed at the smelting works.

Copper imported and entered for consumption in the United States, 1890–1902.

Year ending December 31—	Bars, ingots, and pigs.		Old, fit only for remanufacture.		Old, taken from bottoms of American ships abroad.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
1890	5,189	$859	284,789	$26,473	....	....
1891	2,556	389	134,407	9,685	....	....
1892	22,097	2,588	71,485	6,114	....	....
1893	554,348	58,480	59,375	6,945	....	$6,326
1894	606,415	42,688	160,592	15,726	....	1,143
1895	7,979,322	726,347	1,336,901	109,340	....	....
1896	9,074,379	750,976	2,422,554	196,419	....	....
1897	12,646,552	1,142,526	1,780,390	158,829	....	....
1898	35,892,944	3,094,541	1,986,133	168,405	....	....
1899	64,282,583	9,350,582	6,678,145	758,010	....	....
1900	62,401,489	9,931,059	3,354,756	373,957	....	....
1901	71,001,713	11,478,422	2,818,757	325,859	....	....
1902	112,420,253	12,615,703	2,119,031	219,267	....	....

Year ending December 31—	Plates rolled, sheets, pipes, etc.		Sheathing metal, in part copper.		Manufactures not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1890	4,209	$917	37,458	$4,467	$24,752	$57,468
1891	122,219	23,291	228,486	29,112	12,926	75,403
1892	1,788	600	417,134	51,380	49,764	110,446
1893	7,056	1,065	1,670	167	16,166	89,149
1894	12,681	1,821	8,422	1,470	3,851	66,699
1895	27,156	2,586	5,698	389	13,166	851,828
1896	34,481	4,834	3,183	303	20,953	973,485
1897	3,116	430	15,282	1,929	30,729	1,334,443
1898	11,793	2,193	5,801	679	20,071	3,285,889
1899	827	331	13,763	6,310	13,629	10,128,862
1900	5,821	3,416	22,783	2,367	8,145	10,318,944
1901	19,248	6,761	5,237	807	8,610	11,820,459
1902	83,798	22,039	3,912	491	6,521	12,864,021

The imports of ore and of matte are shown in the following table for the calendar years 1900, 1901, and 1902.

Imports of copper ore and matte, by countries, in the calendar years 1900, 1901, and 1902.

Country.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Germany	138	$22,357	153	$45,219	169	$43,232
Dominion of Canada:						
Quebec and Ontario	733	61,415	579	65,142	154,737	2,318,616
British Columbia	10,298	1,969,245	20,093	2,902,588		
Newfoundland and Labrador	30,299	75,754	34,141	84,834		
Mexico	8,176	1,900,662	30,469	9,378,197	22,264	6,127,894
Chile	4,372	1,036,293	8,337	2,109,049	394	66,733
All other countries	1,096	129,284	2,275	107,616		
Total	55,112	5,195,010	96,047	14,692,645	177,564	8,556,475

It is exceedingly difficult to arrive at the copper contents of this material, since it varies from very low-grade ores to high-grade mattes. The greater part of the Canadian tonnage is ore, while the greater part of the Mexican material is matte.

EXPORTS.

The exports of copper in different forms have been printed in former volumes of Mineral Resources for the period beginning June 30, 1863. Below the figures are submitted from 1890:

Copper and copper ore of domestic production exported from the United States, 1890–1902.

[Cwts. are long hundredweights of 112 pounds.]

Year ending December 31—	Ore and matte.		Pigs, bars, sheets, and old.		Value of manufactured product.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwts.		*Pounds.*			
1890	431,411	$4,413,067	10,971,899	$1,365,379	$139,949	$5,918,395
1891	672,120	6,565,620	69,279,024	8,844,304	293,619	15,703,543
1892	943,040	6,479,758	30,515,736	3,438,048	245,064	10,162,870
1893	835,040	4,257,128	138,984,128	14,213,378	464,991	18,935,497
1894	87,040	440,129	162,393,000	15,324,925	378,040	16,143,094
1895	276,480	1,631,251	121,328,390	12,222,769	1,084,289	14,938,309
1896	414,265	2,393,914	259,223,924	27,822,280	819,017	31,035,211
1897	181,280	1,199,029	277,255,742	30,597,645	958,379	32,755,053
1898	186,860	755,443	291,955,905	33,598,869	1,190,939	35,545,251
1899	74,540	442,868	246,826,331	41,190,287	1,852,499	43,485,654
1900	200,140	1,332,829	337,973,751	55,285,047	2,257,563	58,875,439
1901	292,260	2,536,549	194,249,828	31,692,563	1,842,336	36,071,448
1902	201,992	1,326,131	354,668,849	43,392,800	2,092,798	46,811,729

The destination of the exports of copper for a series of years is shown by the following table, the data having been furnished by the Bureau of Statistics:

Exports of copper bars and ingots for 1897, 1898, 1899, 1900, 1901, and 1902, and countries to which exported.

[Pounds.]

Country.	1897.	1898	1899.
United Kingdom	63,774,004	88,443,870	50,675,849
Belgium	16,651,776	13,613,183	5,069,456
France	59,630,864	53,909,508	58,450,866
Germany	29,746,200	42,891,345	49,285,139
Netherlands	86,581,616	72,418,633	69,304,699
Italy	3,757,920	3,733,672	3,449,565
Russia	8,515,772	7,340,276	2,689,610
Austria	5,918,993	7,478,730	6,354,287
Mexico	2,678,597	253,975	285,222
British North America		1,523,505	985,525
West Indies		6,143	5,599
Other countries		343,065	270,514
Total	277,255,742	291,955,905	246,826,331

Country.	1900.	1901.	1902.
United Kingdom	63,522,445	36,819,100	88,972,029
Belgium	12,554,191	4,561,405	8,431,560
France	67,725,989	34,607,042	63,519,881
Germany	67,348,848	37,487,180	56,604,753
Netherlands	101,398,394	61,752,002	96,358,472
Italy	5,550,285	5,045,775	9,108,904
Russia	5,650,423	2,889,270	a 28,539,742
Austria	11,258,115	8,616,964	
Mexico	296,684	217,437	251,812
British North America	1,616,778	1,232,577	2,811,835
West Indies	1,317	3,032	97
Other countries	1,050,282	1,018,044	69,764
Total	337,973,751	194,249,828	354,668,849

a Other Europe, including Austria and Russia.

The recovery of the export trade, which followed the collapse of the effort to hold prices up to a high level, is well shown in these figures. Practically all of the metal which goes to the Netherlands is in transit to Germany, and a considerable part of the copper shipped to England finds lodgment ultimately in other countries.

Besides the exports of copper shown in the above table, largely of domestic origin, some foreign copper is reexported directly. The Bureau of Statistics reports that in 1899 2,550,149 pounds, in 1900 1,281,782 pounds, in 1901 12,888,083 pounds, and in 1902 11,629,877 pounds of foreign copper were exported.

The following table shows the ports from which copper was exported:

Domestic exports of ingots, bars, and old copper in 1897, 1898, 1899, 1900, 1901, and 1902, by ports.

[Pounds.]

District.	1897.	1898.	1899.
Baltimore, Md	88,389,939	87,027,133	90,786,853
Boston and Charlestown, Mass	928,584	439,368	1,568,197
Newark, N. J	....	673,180	....
Newport News, Va	5,899,609	2,638,868	4,085,580
Norfolk, Va	....	5,249,820	4,707,267
New York, N. Y	167,344,812	178,400,314	134,412,540
Philadelphia, Pa	227,023	68,624	2,733,692
New Orleans, La	13,882,408	15,508,831	7,459,623
Galveston, Tex	....	444,920	3,700
Detroit, Mich	164,317	728,689	320,121
Huron, Mich	229,226	118,827	107,562
Burlington, Vt	102,718	410,410	434,340
All others	87,106	246,921	206,856
Total	277,255,742	291,955,905	246,826,331

District.	1900.	1901.	1902.
Baltimore, Md	86,264,231	51,377,355	103,607,256
Boston and Charlestown, Mass	1,496,387	27,917	426,069
Newport News, Va	2,016,000	1,568,567	5,070,026
Norfolk, Va	....	....	598,339
New York, N. Y	230,178,643	133,540,150	236,622,515
Philadelphia, Pa	12,468,680	3,526,130	5,804,743
New Orleans, La	3,937,350	1,806	1,819
Detroit, Mich	469,819	387,923	812,828
Huron, Mich	149,525	92,062	208,849
Burlington, Vt	678,589	434,692	....
All others	314,527	293,226	1,516,405
Total	337,973,751	194,249,828	354,668,849

The exports of copper from New Orleans in 1897, 1898, and 1899 were Mexican bars, which were shipped through that port, and were merely in transit.

The available supply for the domestic markets may be computed as follows:

Supply of copper for the United States, 1893–1902.

[Pounds.]

Source.	1893.	1894.	1895.	1896.	1897.
Production of domestic copper.	329,354,398	354,188,374	380,613,404	460,061,430	494,078,274
Imports:					
Fine copper in ore, entered for consumption	7,256,015	4,804,614	[a]5,300,000	[a]5,900,000	[a]12,000,000
Fine copper in regulus, entered for consumption	3,175,559	5,873,820			
Bars and ingots	554,348	606,415	7,979,322	11,397,272	16,578,420
Old copper	59,375	160,592	1,336,901		
Total	340,399,695	365,633,815	395,229,627	477,358,702	522,656,694
Exports:					
Ingots and bars	138,984,128	162,393,000	121,328,390	259,223,924	[b]277,255,742 [c]406,598
Fine copper contents of matte	[a]50,000,000	5,750,000	15,200,000	22,881,936	[a]11,000,000
Total	188,984,128	168,143,000	136,528,390	282,105,860	288,662,340
Available supply	151,415,567	197,490,815	258,701,237	195,252,842	233,994,354

Source.	1898.	1899.	1900.	1901.	1902.
Production of domestic copper.	526,512,987	568,666,921	606,117,166	602,072,519	659,508,644
Imports:					
Fine copper in ore, entered for consumption	[a]19,750,000	[a]23,800,000	[a]36,380,000	[a]64,000,000	[d]40,000,000
Fine copper in regulus, entered for consumption					
Bars, ingots, and old copper.	54,166,467	71,922,340	68,796,808	73,826,406	103,129,568
Total	600,429,454	664,389,261	711,293,974	739,898,925	802,638,212
Exports:					
Ingots and bars—					
Domestic	291,955,905	246,826,331	338,121,071	194,249,828	354,668,849
Foreign	23,647,968	2,550,149	1,281,782	12,888,083	11,629,877
Fine copper contents of matte	[a]5,420,000	[a]3,500,000	[a]9,000,000	[a]15,000,000	[a]11,000,000
Total	321,023,873	252,876,480	348,402,853	222,137,911	377,298,726
Available supply	279,405,581	411,512,781	362,891,121	517,761,014	425,339,486

[a] Estimated.
[b] Domestic.
[c] Foreign.
[d] Deducting estimated contents of foreign matte exported.

STOCKS.

All the large producers of copper, with the exception of two leading producers of the Lake district, have submitted a statement of the stock of metal, the blanks calling for stock at works, in transit, or in agents' hands, exclusive of material in course of conversion at the works, but inclusive of converted bars, matte, etc., which must be shipped for further treatment. The stocks do not include the amounts on hand at the refining works nor those carried by merchants, bankers, or speculators, nor does the statement deal with the copper in stock at works of consumers.

In the aggregate the reporting mines, which represent a total production in 1902 of 456,779,663 pounds of copper out of a total of 659,508,644 pounds, had a stock of 155,665,652 pounds of copper on January 1, 1903, as compared with 282,014,297 pounds on January 1, 1902, a decline of over 126,000,000 pounds during 1902.

CONSUMPTION.

The data submitted, subject as they are in a number of respects to the limitations which the estimates impose, still justify some conclusions as to the consumption of copper in the United States, the estimate for the years 1900, 1901, and 1902 being as follows:

Estimated consumption of copper in the United States in 1900, 1901, and 1902.

[Pounds.]

	1900.	1901.	1902.
Available supply	362,891,121	517,761,014	425,339,486
Deduct increase in producers' stocks	6,000,000	135,000,000	
Add decrease in producers' stocks			126,348,645
Estimated consumption	356,891,121	382,761,014	551,688,131

PRICES.

The following table summarizes the highest and lowest prices obtained for Lake copper yearly in the New York markets from 1860 to 1895:

Highest and lowest prices of Lake Superior ingot copper, by years, 1860–1895.

[Cents per pound.]

Year.	Highest.	Lowest.	Year.	Highest.	Lowest.
1860	24	$19\frac{3}{4}$	1878	$17\frac{5}{8}$	$15\frac{1}{2}$
1861	27	$17\frac{1}{2}$	1879	$21\frac{3}{4}$	$15\frac{1}{2}$
1862	$32\frac{7}{8}$	$20\frac{3}{4}$	1880	25	$18\frac{1}{2}$
1863	$38\frac{1}{2}$	29	1881	$20\frac{3}{8}$	16
1864	55	39	1882	$20\frac{3}{8}$	$17\frac{7}{8}$
1865	$50\frac{1}{2}$	28	1883	$18\frac{1}{8}$	$14\frac{7}{8}$
1866	42	$26\frac{1}{2}$	1884	15	11
1867	$29\frac{1}{4}$	$21\frac{1}{2}$	1885	$11\frac{1}{2}$	$9\frac{4}{5}$
1868	$24\frac{1}{2}$	$21\frac{1}{2}$	1886	$12\frac{1}{8}$	10
1869	$26\frac{1}{2}$	$21\frac{7}{8}$	1887	$17\frac{3}{4}$	$9\frac{19}{20}$
1870	$23\frac{3}{8}$	19	1888	$17\frac{4}{10}$	$15\frac{17}{20}$
1871	27	$21\frac{1}{4}$	1889	$17\frac{1}{2}$	11
1872	44	$27\frac{1}{8}$	1890	$17\frac{1}{4}$	14
1873	35	21	1891	15	$10\frac{1}{4}$
1874	25	19	1892	$12\frac{3}{8}$	$10\frac{1}{2}$
1875	$23\frac{7}{8}$	$21\frac{1}{2}$	1893	$12\frac{1}{2}$	$9\frac{3}{5}$
1876	$23\frac{1}{4}$	$18\frac{3}{4}$	1894	$10\frac{1}{4}$	9
1877	$20\frac{1}{2}$	$17\frac{1}{2}$	1895	$12\frac{3}{4}$	$9\frac{1}{4}$

The following table shows the highest and lowest prices monthly during the last seven years:

Highest and lowest prices of Lake Superior ingot copper, by months, 1896–1902.

[Cents per pound.]

Year.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	10¼	9¾	11¼	10	11½	10⅞	11	10¾	11½	10⅞	11¾	11½
1897	12	11½	12	11⅞	11⅞	11½	11½	11	11⅛	10¾	11⅛	10⅞
1898	11	$10\frac{9}{10}$	11¾	11	12	11⅞	12⅛	11⅞	12⅛	12	11⅞	11¾
1899	17	13¼	18	17	18	17	19½	18	19¼	18½	18½	18
1900	16½	16¼	16½	16	17	16¼	17¼	17	17¼	16½	16½	16¼
1901	17	16¾	17	16⅞	17	16⅞	17	17	17	16⅞	17	16⅞
1902	13	10⅞	13¼	12	12½	12⅛	12¼	12	12¾	12	12¾	12¼

Year.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	11¾	11	11⅛	10⅞	10⅞	10⅜	10⅞	10½	11½	10⅞	11½	11¼
1897	11⅛	11	11¼	11	11⅜	11¼	11¼	11	11	10¾	11	10⅞
1898	11¾	11½	12⅛	11⅜	12¼	12⅛	12½	12¼	12¾	12½	12⅞	12⅝
1899	18½	18¼	18½	18¼	18½	18¼	18½	17	17¼	17	17	16½
1900	16½	16⅛	16¾	16½	16⅞	16¾	16⅞	16¾	17	16¾	17	16¾
1901	17	16⅜	16¾	16½	16¾	16½	16⅞	16½	16¾	16¼	16½	12⅞
1902	12⅛	12	12⅛	11⅝	12	11¾	12¼	11¾	12	11½	12⅛	11½

The following table shows the fluctuations in prices in the English market:

Average values of copper in England, 1890–1902.

Year.	Chile bars or G. O. B.			Ore, 25 per cent.		Year.	Chile bars or G. O. B.			Ore, 25 per cent.	
	Per long ton.			*Per unit.*			*Per long ton.*			*Per unit.*	
	£	*s.*	*d.*	*s.*	*d.*		£	*s.*	*d.*	*s.*	*d.*
1890	54	5	5	10	7	1897	49	2	6¾	9	5
1891	51	9	8½	9	7	1898	51	16	7¼	10	1½
1892	45	12	8¾	8	7	1899	73	13	8½	13	2
1893	43	15	6¾	8	5	1900	73	12	6¼	13	1
1894	40	7	4	7	6½	1901	66	19	8½	12	5
1895	42	19	7	8	4¼	1902	52	11	5½	8	10½
1896	46	18	1¾	9	1						

From the annual reports of some of the Lake Superior companies it is possible to obtain a close estimate of the average selling price of copper during 1902. The following table gives the results:

Average selling price of Lake copper during 1902.

Company.	Quantity sold.	Average price per pound.
	Pounds.	*Cents.*
Tamarack	15,961,528	11.87
Osceola	13,416,396	11.78
Atlantic	4,949,366	11.88
Isle Royale	3,569,748	11.91
Baltic	6,285,819	11.872
Average		11.86

In detail the fluctuations, monthly, of good merchant copper in the English market were as follows from 1896 to 1902, inclusive.

Fluctuations in good merchant copper in England, 1896–1902.

[Per long ton.]

Month.	1896.			1897.			1898.			1899.			1900.			1901.			1902.		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
January	41	13	$8\frac{1}{4}$	50	10	$8\frac{1}{4}$	48	19	2	62	18	$1\frac{1}{2}$	70	14	2	71	17	0	48	10	1
February	41	16	$11\frac{1}{4}$	51	6	6	49	12	$8\frac{1}{4}$	72	16	0	74	4	9	71	5	4	55	5	7
March	45	8	$0\frac{3}{4}$	50	4	$0\frac{1}{4}$	50	13	$2\frac{1}{2}$	69	1	$0\frac{1}{4}$	78	0	4	69	13	2	53	10	8
April	45	3	$2\frac{1}{4}$	48	16	9	51	14	$2\frac{1}{2}$	74	10	$0\frac{3}{4}$	78	7	1	69	14	10	52	18	7
May	46	6	6	48	10	$11\frac{1}{2}$	51	9	$9\frac{3}{4}$	77	5	11	74	1	8	69	15	7	54	3	10
June	48	18	0	49	1	$1\frac{1}{2}$	50	8	0	76	2	$0\frac{1}{2}$	71	14	3	68	18	9	54	0	0
July	49	3	$7\frac{3}{4}$	48	1	$0\frac{1}{4}$	50	3	1	76	19	$3\frac{1}{2}$	72	11	5	67	14	8	52	19	9
August	47	16	$9\frac{3}{4}$	48	12	$10\frac{1}{4}$	51	10	$7\frac{1}{2}$	76	4	$7\frac{1}{4}$	73	12	5	66	9	0	52	1	9
September	47	18	$7\frac{1}{2}$	49	8	5	52	2	$8\frac{3}{4}$	76	15	7	73	4	$11\frac{1}{2}$	66	2	0	52	16	4
October	47	11	7	48	10	3	53	8	2	75	3	$10\frac{1}{4}$	72	7	$7\frac{1}{4}$	64	4	7	52	6	9
November	49	3	11	48	0	$11\frac{1}{2}$	55	18	$8\frac{1}{4}$	74	8	$5\frac{1}{2}$	72	9	$3\frac{3}{4}$	65	12	2	51	3	2
December	48	16	$9\frac{3}{4}$	48	7	$0\frac{1}{4}$	55	18	$11\frac{1}{4}$	71	19	8	72	2	$3\frac{1}{2}$	52	9	3	51	1	0

THE COPPER MARKET IN 1902.

The year 1902 was ushered in with the greatly unsettled condition precipitated by the collapse of the markets in the last months of 1901, following the prolonged attempt to hold values of copper at an artificial level. The nominal basis for Lake copper was 12 to $12\frac{1}{8}$ cents early in January, with electrolytic at $11\frac{3}{4}$ cents; but before the middle of the month the metal declined to $11\frac{1}{4}$ cents for Lake, and later to $10\frac{7}{8}$ cents, and electrolytic to $10\frac{5}{8}$ cents. This brought out enormous buying, both by the home trade and for export, and the market rapidly strengthened. Powerful interests came to its support, and purchases were made up to 13 cents for Lake copper. This continued into February, but large offerings brought about a reaction to 12 cents, with sales of Lake as high as 12½ cents. Within these limits the market fluctuated during March, the demand being light. In April prices sagged slightly, and it was not until May that prices responded to a better inquiry, Lake selling as high as 12¾ cents. June, July, and August were dull, Lake copper receding to 11⅝ cents and electrolytic copper to 11⅜ cents. There was a brief spurt in September, during which prices recovered to 12 cents. But the market soon receded, until during the latter part of October, when large sales caused a hopeful tone to develop. The withdrawal of buyers, however, led to a weakening until prices were back to 11½ cents for Lake and 11¼ cents for electrolytic copper in November. The settlement of the anthracite coal strike, a better inquiry from Europe, and some fair sales for 1903 delivery brought values back, until the year closed with Lake copper at 11¾ to 12 cents and electrolytic copper at 11⅝ to 11⅞ cents.

THE ENGLISH COPPER TRADE.

Since England is one of the leading copper markets of the world, the following tables, showing the import and export movement, are of great interest:

British imports and exports of copper.

[Long tons.]

Year.	Imports of— Bars, cakes, and ingots.	Imports of— Copper in ores and furnace products.	Total imports.	Exports.	Apparent English consumption.
1890	[a]49,461	91,788	141,249	89,747	66,170
1891	44,213	94,403	138,616	76,056	59,223
1892	[b]35,015	99,356	134,371	82,542	[c]48,367
1893	41,829	88,003	129,832	70,986	66,817
1894	56,157	68,851	125,008	54,689	[d]50,330
1895	42,135	77,806	119,941	65,990	[d]50,692
1896	60,458	75,398	135,856	59,334	[d]76,036
1897	60,428	76,127	136,555	56,542	[d]69,787
1898	67,978	71,726	139,704	63,370	[d]69,284
1899	58,880	82,730	141,610	75,271	[d]60,877
1900	70,247	84,694	154,941	56,997	[d]81,896
1901	66,764	82,814	149,578	70,396	[d]70,178
1902	90,022	70,179	160,201	69,156	[d]80,223

[a] Including 3,501 tons of Chile bars transferred from France to England.

[b] Including 3,585 tons of Chile bars transferred from France to England.

[c] Add 4,001 tons for comparison with former years, the difference arising from the new method of making up stock.

[d] Deducting copper content of sulphate exported (13,078 tons in 1898, 10,045 tons in 1899, 10,728 tons in 1900, 9,004 tons in 1901, and 10,822 tons in 1902).

The following figures for the years from 1896 to 1902, both inclusive, taken from the board of trade returns, supplemented by Messrs. James Lewis & Son, of Liverpool, show in detail the form in which the copper is brought into Great Britain:

Imports of copper into Great Britain, 1896–1902.

[Long tons.]

Character.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Pure in pyrites	14,726	15,576	16,626	17,529	18,519	16,339	15,279
Pure in precipitate	23,160	25,932	21,558	24,387	23,462	22,037	17,874
Pure in ore	12,499	11,980	14,576	19,514	17,886	16,683	15,038
Pure in matte	25,013	22,639	18,966	21,300	24,827	27,755	21,988
Bars, cakes, etc	60,458	60,428	67,978	58,880	70,247	66,764	90,022
Total	135,856	136,555	139,704	141,610	154,941	149,578	160,201

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of copper product into Liverpool, Swansea, and London, which does not, however, include the imports of precipitate into certain outports like Newcastle and Cardiff, estimated in recent years at about 6,000 tons:

Imports of copper product into Liverpool, Swansea, and London, 1896–1902.

[Long tons.]

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Chile	15,923	14,982	17,734	19,752	19,875	24,624	23,789
United States	39,676	32,792	38,979	20,773	32,256	21,426	43,632
Spain and Portugal	6,298	7,697	7,293	7,084	9,721	7,780	7,860
Spain and Portugal (precipitate)	11,474	17,386	15,664	16,847	17,028	16,354	13,592
Spain and Portugal (pyrites)	14,726	15,576	16,626	17,529	18,519	16,339	15,279
Australasia	10,635	10,218	13,409	17,085	19,977	20,586	26,261
Cape of Good Hope	5,905	7,575	9,381	7,076	8,927	8,281	6,050
Venezuela	107	21	....	....	....	....	....
Japan	3,492	3,654	2,086	7,812	6,763	7,820	5,331
Italy	418	100	177	157	119	20	....
Norway	528	130	....	182	679	728	523
Canada	....	127	....	10	25	....	431
Newfoundland	2,467	2,484	1,359	2,044	1,589	1,669	1,100
Mexico	7,792	6,217	4,888	5,679	8,781	8,268	7,945
Peru	741	998	3,041	5,163	8,220	9,512	7,580
Plata River	94	190	124	63	73	84	242
Other countries	797	1,613	1,807	8,232	3,633	4,756	1,289
Total tons fine	121,073	121,760	132,568	135,488	156,185	148,250	160,904

The quantities of copper in different forms imported into Great Britain and France from the United States are given in the following table:

Imports of copper into England and France from the United States, 1889–1902.

[Long tons.]

Country.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
England:							
Ore	349	5	4	18	23	5	....
Matte	26,581	18,897	19,109	24,668	20,700	2,133	8,337
Bars and ingots	3,799	1,269	7,007	1,427	14,924	28,357	12,250
Total	30,729	20,171	26,120	26,113	35,647	30,495	20,587
France	1,058	1,733	8,329	4,340	12,483	9,248	11,806
United States into England and France	31,787	21,904	34,449	30,453	48,130	39,743	32,393

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
England:							
Matte	10,016	5,259	2,181	354	2,767	6,299	2,899
Bars and ingots	29,780	27,591	36,790	20,739	29,267	15,112	40,733
Total	39,796	32,850	38,971	21,093	32,034	21,411	43,632
France	21,998	26,165	22,753	24,695	29,100	14,008	29,455
United States into England and France	61,794	59,015	61,724	45,788	61,134	35,419	73,087

In recent years considerable quantities of bars and matte reach Europe from Mexico and Canada in transit from this country. Therefore it is doubtful whether the quantities stated are really the product of the copper mines of the United States.

The exports of copper from Great Britain, estimating the fine contents of alloys, have been as follows:

Exports of copper from Great Britain, 1896–1902.

[Long tons.]

Character.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
English, wrought and unwrought, and sheets	38,734	35,951	40,223	42,992	28,632	37,753	35,379
Yellow metal, at 60 per cent	6,773	6,609	6,172	4,156	5,279	5,497	7,901
Brass, at 70 per cent	4,172	3,936	3,733	3,994	4,224	4,072	4,462
Sulphate of copper	13,155	14,844	13,078	10,045	10,728	9,004	10,822
Total	62,834	61,340	63,206	61,187	48,863	56,326	58,564
Fine foreign	9,655	10,046	13,242	24,129	18,862	23,074	21,414
Total	72,489	71,386	76,448	85,316	67,725	79,400	79,978

THE GERMAN COPPER TRADE.

The consumption of copper in Germany is greater than in any other country, the United States excepted. It declined very suddenly as the result of the industrial crisis in 1901, but recovered somewhat in 1902. Aron Hirsch & Sohn, of Halberstadt, as the result of careful investigations have reached the results shown in the following table:

Copper consumption of Germany, 1895–1902.

[Metric tons.]

	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Imports	59,742	73,123	82,903	89,772	89,746	106,676	78,538	97,249
Exports	10,893	12,452	12,568	14,957	20,304	15,618	14,825	13,571
Excess of imports	48,849	60,671	70,335	74,815	69,442	91,058	63,713	83,678
Production	26,013	29,489	29,468	30,704	37,676	32,423	30,335	29,728
Total	74,862	90,160	99,803	105,519	107,118	123,481	94,048	113,406
Copper content of imported[a] copper ore and iron pyrites	4,500	5,000	3,500	4,000	4,500	6,500	4,500	5,500
Home consumption	70,362	85,160	96,303	101,519	102,618	116,981	89,548	107,906

[a] Deducted to avoid duplication, being included in both imports and production.

The authority quoted above estimates the distribution of the consumption, by manufacturers' requirements, as follows:

Consumption, by manufacturers' requirements, 1900, 1901, and 1902.

[Metric tons.]

Use specified.	1900.	1901.	1902.
Electrical works	43,000	26,000	37,000
Copper rolling mills (rods and sheets)	18,000	16,000	18,000
Brass rolling mills and wire works	35,000	29,000	32,000
Chemical works, inclusive of blue vitriol	2,000	2,000	2,000
Shipyards, railroads, for castings, alloys, German silver, etc	19,000	17,000	19,000
Total	117,000	90,000	108,000

The German Government has taken increasing pains in recent years to trace the source of the ingot copper imported into Germany. In consequence it is possible to arrive at a close estimate of how much copper shipped from the United States has gone into Germany, even though passing at first in transit through other countries. The figures reflect the movement better, therefore, than our export statistics, which stop at the first destination. Thus most of the copper exported to Holland ultimately reaches Germany. The copper imports in other forms are added.

Source of German imports of ingot copper.

[Metric tons.]

Country.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Free port (Hamburg)	1,689	1,185	2,371	2,669	2,873	2,496	2,222	1,899	1,598
Belgium	356	356	115	9	216	19	177	29	162
France	303	152	81	268	121	93	87	149	49
Norway	128	362	71	45	32	1	11	9	35
Austria-Hungary	50	197	11	9	12	105	224	124	141
Sweden	33	83	198	250	328	215	161	10	268
Switzerland	....	....	5	6	2	1	1	6	....
Spain	10	....	10	41	69	31	446	1,164	868
England	7,430	7,363	7,478	8,660	12,754	14,350	9,545	7,653	8,536
Netherlands	109	139	73	18	19	184	216	34	152
United States	23,795	31,311	42,504	50,420	52,473	47,742	66,264	42,422	60,274
Japan	2,072	1,932	1,916	2,655	2,196	3,050	2,377	3,158	2,493
Chile	884	825	827	2,217	1,216	1,187	1,016	931	886
Australasia	....	313	183	259	742	581	593	948	493
Other countries	173	147	271	46	25	39	162	84	94
Total ingot	37,032	44,365	56,114	67,572	73,078	70,094	83,502	58,620	76,049
Coins and scrap	1,227	1,703	3,170	4,199	4,720	4,992	4,602	4,535	4,368
Brass, at 66⅔ per cent	825	706	709	1,082	1,155	1,397	1,532	1,139	795
Copper ores	6,000	6,000	5,000	1,510	1,528	2,720	6,010	2,537	4,504
Pyrites	7,420	6,968	8,130	8,540	9,079	10,543	11,030	11,707	11,533
Total	52,504	59,742	73,123	82,903	89,560	89,746	106,676	78,538	97,249

Of course the quantities of ingot copper credited to England and to some minor countries are drawn from copper-producing countries. It is impossible to state to what extent the United States participates in them. In the case of copper credited to England it is probable that a considerable quantity originated in the mines of this country.

The production of copper in Germany for a series of years is shown in the table below. It should be noted that outside of the Mansfeld company, which is separately given, the production of copper from German mines is small, the mines at Stadtberge contributing 780 tons of it. By far the greater part of the difference between the total figures and those representing Mansfeld is product obtained at German metallurgical works from the treatment of foreign ores and furnace materials. The figures are interesting as showing the extent of the pyrites-extracting and copper-smelting industry of Germany.

Copper production of Germany.

[Metric tons.]

Year.	Total production.	Production of Mansfeld.	Year.	Total production.	Production of Mansfeld.
1891	24,688	15,365	1897	29,468	18,248
1892	25,406	15,588	1898	30,704	18,335
1893	24,011	14,358	1899	37,676	24,315
1894	25,857	15,217	1900	32,423	18,675
1895	26,013	15,083	1901	31,572	19,079
1896	29,489	18,541	1902	29,728	18,749

The export statistics of Germany are particularly interesting because that country has become an important factor in the world's markets. It will be observed from the following table that since 1894 the first decline has occurred in 1902:

Exports of copper manufactures from Germany, 1894–1902.

[Metric tons.]

Product.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Rods and sheets	5,009	4,700	5,429	5,712	5,369	4,869	5,270	4,951	6,188
Wire	4,433	3,975	5,909	6,175	5,930	7,578	9,604	7,832	10,122
Cables	2,193	3,713	7,631	8,119	10,432	11,481	15,444	13,902	9,900
Miscellaneous	501	556	279	245	263	243	212	195	215
Coarse forgings	2,538	2,643	2,648	2,703	2,988	3,162	3,174	3,087	3,475
Cartridges, caps, etc	3,376	4,450	4,156	2,712	3,288	2,682	1,731	1,880	3,244
Fine copper goods	4,117	4,912	7,837	7,425	8,454	9,855	11,177	10,018	11,772
Perforated sheets and netting	....	....	....	....	275	306	327	375	345
Total	22,167	24,949	33,889	33,091	36,999	40,176	46,939	42,240	45,261
Less imports	1,778	1,892	2,301	1,606	2,449	2,811	3,073	2,680	2,870
Net exports	20,389	23,057	31,588	31,485	34,550	37,365	43,866	39,560	42,391

THE FRENCH COPPER TRADE.

Fourth in the list of the greater copper-consuming countries is France, which showed a recovery in 1902.

According to the French official statistics, the imports of bars, ingots, etc., have been as follows:

Imports and exports of bar and ingot copper into France, 1895–1902.

[Metric tons.]

Source.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
England	8,250	5,596	3,884	5,970	8,650	3,289	5,400	4,963
Chile	3,494	4,573	2,804	4,469	4,442	3,509	2,690	3,698
United States	11,157	21,279	28,118	26,210	24,470	33,187	22,001	35,401
Other countries	11,717	12,197	14,830	10,712	13,650	14,246	14,318	7,825
Total	34,618	43,645	49,636	47,361	51,212	54,231	44,409	51,887
Less exports	4,910	5,144	4,766	5,458	8,285	7,651	7,510	5,513
Net imports	29,708	38,501	44,870	41,903	42,927	46,580	36,899	46,374

In order to arrive at the consumption, it is necessary to add the net imports of old material and the copper contents of foreign ores and pyrites, and to account for fluctuations in stocks. The following table summarizes the results:

Copper consumption of France.

[Metric tons.]

	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Net imports, raw material..	25,743	34,352	44,026	50,060	48,060	49,667	54,862	40,214	50,168
Contents of ore............	4,635	6,074	5,570	8,685	7,024	6,004	7,976	5,000	5,000
Total..................	30,378	40,426	49,596	58,745	55,084	55,671	62,838	45,214	55,168
Increase (+) or decrease (−) of stocks.............	+1,459	−103	−589	−379	−515	+670	−1,006	+966	−382
Consumption..........	31,837	40,323	49,007	58,366	84,569	56,341	61,832	46,180	55,550

OTHER COUNTRIES.

The consumption of Russia increased during 1902, having been, according to estimates, 24,398 metric tons, as compared with 17,459 metric tons in 1901, and with 19,133 tons in 1900. In 1901 the consumption was of imports of fine copper 10,582 tons, imports of manufactures 344 tons, and of a home production of 6,263 tons. In 1902 the imports of copper were 16,098 tons, and the imports of manufactures are estimated at 300 tons and the production at 8,000 tons. It is interesting to note that of the imports of fine copper into St. Petersburg during 1902, which aggregated 8,160 tons, 7,580 tons was American copper.

Austria-Hungary imported, in 1902, 21,072 metric tons of copper in the form of ingots and bars, and in ores, pyrites, and manufactures as compared with 19,982 tons in 1901, and 21,574 tons in 1900. The production was, respectively, 1,368, 1,335, and 1,130 tons; and the exports of manufactures of ores, etc., amounted to 3,636 tons in 1902, 3,459 tons in 1901, and 3,524 tons in 1900. According to official statistics the imports from America were 9,790 metric tons in 1902, 5,978 tons in 1901, and 10,487 tons in 1900.

Italy imported, in 1902, 10,563 metric tons, net, as compared with 8,589 tons in 1901, these totals including fine copper and manufactures, exports being deducted. The production of the country is estimated at 3,000 tons in 1901 and 3,500 tons in 1902.

THE WORLD'S PRODUCTION.

Messrs. Henry R. Merton & Co., of London, have compiled the following statement of the world's production, the figures being modified by this office where official statistics are available:

The copper production of the world, 1895–1902.

[Long tons.]

Country.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
EUROPE.								
Great Britain	580	555	555	640	635	777	532	*a* 600
Spain and Portugal:								
Rio Tinto	32,985	34,501	33,923	33,705	34,370	35,732	35,348	34,480
Tharsis	12,000	12,000	*a* 11,000	*a* 11,150	9,448	7,965	7,427	6,710
Mason and Barry	*a* 4,100	*a* 3,900	*a* 4,300	3,600	3,600	3,460	3,729	3,330
Savilla	1,050	1,025	810	800	1,200	1,460	1,292	1,545
Tinto and Santa Rosa	4,300	3,400	500	815	1,000	1,580	1,640	1,285
Other mines			2,550	2,305	2,550	2,675	4,185	2,440
Germany:								
Mansfield	14,860	18,265	17,960	18,045	20,785	18,390	18,780	18,750
Other German	1,695	1,800	2,185	2,040	2,675	2,020	2,940	2,855
Austria	869	1,065	1,210	1,110	915	865	1,015	1,027
Hungary	239	205	445	430	590	490	335	350
Sweden	203	500	545	480	520	450	320	....
Norway	2,685	2,500	3,450	3,615	3,610	3,935	3,375	4,565
Italy	2,236	3,400	3,480	2,965	3,032	2,797	*a* 3,000	3,370
Russia	5,326	5,832	6,941	7,291	7,533	7,893	6,263	*a* 6,000
Turkey	....	....	975	470	920	520	980	1,100
Total	83,128	88,948	90,829	89,461	93,383	91,039	91,341	88,407
NORTH AMERICA.								
United States	169,917	205,384	220,571	235,050	253,870	270,588	268,782	294,423
Canada	3,923	4,190	5,938	8,040	6,731	8,446	18,496	17,486
Newfoundland	1,800	1,800	1,800	2,100	2,700	2,700	2,336	2,586
Mexico:								
Boleo	10,450	9,940	10,170	9,435	10,335	11,050	10,795	10,785
Other Mexican	1,170	1,210	*a* 4,200	*a* 7,000	*a* 9,000	*a* 11,000	*a* 19,635	*a* 30,000
Total	187,260	222,524	242,679	261,625	282,636	303,784	320,044	355,280
SOUTH AMERICA.								
Chile	22,075	23,500	21,900	24,850	25,000	25,700	30,780	28,930
Bolivia:								
Corocoro	2,250	2,000	2,200	2,050	2,500	2,100	*a* 2,000	*a* 2,000
Peru	450	740	1,000	3,040	5,165	8,220	9,520	7,850
Argentina	150	100	200	125	65	75	780	240
Total	24,925	26,340	25,300	30,065	32,730	36,095	43,080	39,020
AFRICA.								
Algiers	35	....	....	50	....	....	....	....
Cape of Good Hope:								
Cape Company	3,350	5,470	5,290	4,660	4,140	4,420	5,072	2,750
Namaqua Company	1,730	1,980	2,150	2,400	2,350	2,300	2,400	1,700
Total	7,115	7,450	7,440	7,110	6,490	6,720	7,472	4,450
ASIA.								
Japan	18,430	21,000	23,000	25,175	27,560	28,121	27,475	29,775

a Estimated.

The copper production of the world, 1895-1902—Continued.

Country.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
AUSTRALASIA.								
New South Wales	3,322	4,467	6,922	5,743	5,394	a 5,500	a 6,000	a 6,500
South Australia	5,251	4,877	4,705	5,000	a 6,500	a 5,386	a 7,120	a 8,000
Tasmania	....	1,928	4,956	5,200	a 9,000	a 10,000	a 12,000	a 9,650
Queensland	....	....	....	....	....	384	3,061	3,784
Total	8,573	11,272	16,583	15,943	20,894	21,270	28,181	27,934

a Estimated.

RECAPITULATION.

Country.	1890.	1891.	1892.	1893.	1894.	1895.
Europe	79,952	80,751	84,648	82,922	82,474	83,128
North America	124,711	138,065	166,941	158,553	172,994	187,260
South America	33,960	29,015	29,015	27,320	26,810	24,925
Africa	6,570	6,120	6,120	6,090	6,500	7,115
Asia	17,972	18,500	19,000	18,000	20,050	18,430
Australasia	9,455	10,292	8,785	6,158	6,791	8,573
Total	272,620	282,743	314,509	299,043	315,619	329,431

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Europe	88,948	90,829	89,461	93,383	91,009	91,341	88,407
North America	222,524	242,679	261,625	282,636	303,784	320,044	355,280
South America	26,340	25,300	30,065	32,730	36,095	43,080	39,020
Africa	7,450	7,440	7,110	6,490	6,720	7,472	4,450
Asia	21,000	23,000	25,175	27,560	28,121	27,475	29,775
Australasia	11,272	16,583	15,943	20,894	21,270	28,181	27,934
Total	377,534	405,831	429,379	463,693	486,999	517,593	544,866

FOREIGN COUNTRIES.

CANADA.

The production of copper in Canada is reported officially at 39,168,202 pounds fine, as compared with 40,951,196 pounds in 1901. British Columbia, which is the heaviest contributor, recorded a gain of from 9,997,080 pounds in 1900 to 27,603,746 pounds in 1901, and 29,636,057 pounds in 1902. The different districts contributed to this total as follows: Boundary, 14,955,582 pounds; Rossland, 11,667,807 pounds; Coast, 2,496,681 pounds; Nelson, 491,144; and other districts, 24,843 pounds.

BRITISH COLUMBIA.

The development of the boundary district of British Columbia has been rapid and promises to exhibit a further steady growth, being dependent chiefly upon large deposits of practically self-fluxing low-grade copper-gold ores, carrying from 25 to 35 pounds of copper, 25 to 40 cents of silver, and $1.50 to $2.50 of gold per ton. The tonnage of ore, which was 386,675 long tons in 1901, is estimated at 519,962 long tons in 1902, and would have been greater had it not been for a shortage of coke from the Crow's Nest district, and for low water which restricted the generation of electric power. The principal undertakings are the Granby Consolidated Mining, Smelting and Power Company, Limited, in which New York, Boston, and Montreal capitalists are interested; the British Columbia Copper Company, Limited, a New York corporation, and the Montreal and Boston Copper Company, whose headquarters are also in New York.

The Granby Company, which owns a group of mines of which the Old Ironsides and Knob Hill are the most conspicuous, mined in 1902 310,601 tons of ore, which yields about 27 pounds of copper and $2 of gold per ton. The ore is extracted from open quarries. The company owns a smelting plant at Great Forks, which is equipped with four furnaces. Two additional furnaces and a converter plant are to be put in. When in full operation the output is expected to reach about 2,000,000 pounds of fine copper per month, the ultimate aim being double that quantity. Interests identified with the company have acquired an interest in coal property at Blairmore, in the district of Alberta, where coke ovens are to be erected.

The British Columbia Copper Company controls the Mother Lode at Deadwood Camp, near Greenwood, from which there was mined in 1902 137,577 tons of ore. The company owns a smelting plant at Greenwood.

The Montreal and Boston Copper Company, Limited, owns the Sunset and Crown silver group of mines near Deadwood Camp and a smelting plant at Boundary Falls.

There has been considerable activity in the copper districts of Vancouver. In the Mount Sicker district the Leonora and Tyre mines have become producers, and two smelting works have been started, one at Crofton on Osborne Bay, with two furnaces and a converter plant, and the other at Ladysmith. The Van Anda mines on Texada Island are also being worked.

In the Rossland district the Le Roi mine is the most important. During the fiscal year ending September 30, 1902, the amount of ore mined was 63,262 short tons, which yielded 3,001,027 pounds of copper, 32,435 ounces of gold, and 82,548 ounces of silver, the total value of which was $1,068,916, an average of $16.89 per ton. The cost was $5,021 for mining and $7,870 for smelting. The total receipts of the company were £117,894, the expenses at the mine being £64,347, at the London office £3,086, and for miscellaneous purposes £5.434. The net balance was £44,987.

NEWFOUNDLAND.

The production of copper ore in Newfoundland is officially stated to have been 71,485 long tons; 35,538 tons having been shipped during the year to the United States and 35,947 tons to Great Britain. It is estimated that the copper ore produced contained 2,586 long tons of fine copper.

MEXICO.

There has been a good deal of activity in the development of copper properties in Mexico, and the production has greatly increased. In Sonora the Greene and Nacosari companies are yielding copper on a large scale. The Descubridora property in Durango is now equipped with a smelter, and the Jimulco Company is shipping ore steadily. In Coahuila the Coahuila Mining and Smelting Company has erected a furnace at Viesca and is treating local carbonates. At Mazapil in Zacatecas the Mazapil Copper Company is producing steadily. The French enterprise in Michoacan, the Inguaran Copper Company, of which so much is expected, has not yet become a contributor to the world's metal markets.

The production of copper at the Boleo mine in Lower California in 1902 was 10,953 metric tons, within a few tons of the output of 1901. There were mined 249,895 tons of ore in 1902, as compared with 275,685 tons during the previous year, but the yield has risen from 3.95 per cent to 4.383 per cent, due to a closer sorting. The Boleo ores are ferruginous, manganiferous, siliceous, and argillaceous. The latter do not smelt readily, but the bodies are large and they are cheaply mined. Their copper contents are more regular, but the grade is low. When the price of copper is high, the percentage of argillaceous ores mined is increased; but when the price is low, the necessity for reducing costs causes the quantity of the poorer ores, more difficult to reduce, to be lessened. The old smelting plant has been dismantled. The profits of the company in 1902 were 1,750,961.08 francs, or 544,705.48 francs greater than those of 1901.

The annual report of the Greene Consolidated Copper Company for the year 1902 gives full details relative to the mining property and the plant at Cananea, Sonora. The concentrating plant of 600 tons daily capacity is used to utilize some of the ores of the Capote and Veta Grande mines, which are highly siliceous. The smelting plant embraces eight Mitchell hot-blast furnaces, and the converting works are equipped with five stands, the production aimed at being 6,000,000 pounds of copper per month. From the beginning of the operations of the Greene Consolidated Copper Company, the company smelted 73,981 tons of iron ore, and 173,750 tons of copper ore, producing 31,519 net tons of matte carrying 28,540,980 pounds of copper and

233,696 ounces of silver. The statement is made that the direct cost of labor, fuel, supplies and material for mining the ore, transportation to the smelter, and reduction to marketable form, amounts to 4.18 cents per pound of copper produced.

TASMANIA.

The Mount Lyell Mining and Railway Company is the largest producer. During the six months ending September 30, 1902, the smelter treated 183,676 long tons of ore, and produced blister copper containing 3,608 tons of fine copper, 341,346 ounces of silver, and 11,681 ounces of gold. This blister copper is shipped for refining to the United States, the company having arranged for a three years' extension of the contract. The net profit for the half year was £45,348, or less by £7,700 than that of the previous half year.

GERMANY

The year 1902 has not been a favorable one for Germany's great copper producer, the Mansfeld'sche Kupferschiefer bauende Gewerkschaft, of Eisleben. The production of the mines was 680,784 metric tons of ore in 1902, as compared with 695,321 tons in 1901, but the average cost was reduced from 32.88 marks per ton in the latter year to 28.60 marks in 1902. The four smelting plants treated in 1902 682,882 tons of ore and produced 49,179 metric tons of matte, which carried on an average 27.12 per cent of copper and 0.156 per cent of silver, the consumption of coke being 135,908 tons. There were roasted 47,360 tons of matte, producing 22,012 tons of chamber acid. In the second matte smelting there were handled at two plants 48,999 tons of roasted matte and 3,338 tons of raw ore, producing 25,041 tons of second matte and 70 tons of blister copper. The matte from one plant carried 74.2 per cent of copper and 0.4446 per cent of silver, and that from the second works contained 74.4 per cent of copper and 0.4202 per cent of silver. In the silver-extraction works 24,044 tons of second matte were roasted and 99,045 kilograms of cement silver were produced, yielding 98,446 kilograms fine silver. The leached matte yielded 17,094 tons of fine copper. There were also produced 1,548 tons of electrolytic copper and 107 tons of fine copper from foreign materials. The total production, therefore, was 18,749 metric tons of copper in 1902, as compared with 19,080 tons in 1901.

The total sales of the Mansfeld Company were 29,634,971.15 marks, as compared with 37,564,592.35 marks in 1901. The costs of the mining and smelting were 29,634,971.15 marks in 1902, against 34,757,171.84 marks in 1901. A profit of 2,807,420.51 marks in 1901 was therefore converted into a loss of 590,891.65 marks in 1902, thus indicating an inability to compete at the low prices prevailing for copper and silver in 1902. The Mansfeld Company, however, makes some profit on a large number of incidental and subsidiary enterprises, including the manufacture of slag brick, a narrow-gauge railroad, an electrolytic plant, a copper mill, a colliery, and coke plant in Westphalia, the alkali mine, Ernsthall, in course of development, forests, real estate, etc. These converted the loss in 1902 on the mining operations proper into a profit of 108,110.24 marks.

SPAIN.

The Rio Tinto Company made a profit in 1902 of £912,303, as compared with £1,279,250 in 1901. The amount of copper marketed was 34,136 long tons in 1902, as compared with 34,604 tons in 1901, the production by treatment at the mines being 21,659 and 21,100 long tons in the respective years. The Rio Tinto completed a new Bessemer converting plant during the year.

Owing to the exhaustion of the Tharsis and Laguanza mines, the copper production of the old Tharsis Sulphur and Copper Company declined from 7,427 long tons in 1901 to 6,708 long tons in 1902, the ore extraction declining from 400,162 tons in 1901 to 342,692 tons in 1902. The Calanas mine, however, continues to do well. The deliveries of pyrites to consumers were 225,861 tons in 1902, as compared with 208,309 long tons in 1901. After writing off £15,000 on the mines £13,000 on the railroad property and the piers, and £10,482 on property and plant in Spain, there remained a net profit of £213,388.

One of the more recent Spanish pyrites mines which is being developed is the Pena Copper Mines, Limited, in the Huelva district. During 1902 the company laid down for leaching 161,928 long tons, thus making the stock of ore on the heaps 351,574 tons. The production of precipitate has only begun. It was 413 tons in 1901 and 624 tons in 1902. There were reserved in 1902 33,928 long tons for export without treatment. There were shipped in 1902 92,057 long tons of ore, consisting of 19,927 tons of cupreous ore, 62,982 tons of roasted ore, and 9,148 tons of sulphur ore. The average content of the ore mined in 1901 was 47.06 per cent of sulphur and 1.296 per cent of copper; in 1902 the figures were, respectively, 47.24 per cent and 1.36 per cent.

LEAD.

By Charles Kirchhoff.

INTRODUCTION.

Under the influence of a lower range of prices for lead, assisted in the case of the Rocky Mountain districts by low returns for the accompanying silver, the lead-mining industry did not prosper in 1902 as much as other branches of metal mining. The principal cause was that in the previous years a very large stock of lead had accumulated. This was successfully worked off during 1902, which was a year of enormous consumption in all the metals. The stock of lead, which was 53,733 short tons at the beginning of the year, had been carried down to 11,595 short tons at its close. If an effort had been made to force values up, it would have opened the door to importations, the markets abroad being low throughout the year.

Under the circumstances, the fact that production was as large in 1902 as it was in 1901 is encouraging, but there has been some shifting of the territorial source of production. Relatively, the Mississippi region has gained in importance, showing an increase in output at the expense of the Rocky Mountain districts, which declined in production. The one counterbalanced the other closely, the production of the country in 1902 having been practically the same as it was in 1901 and 1900.

PRODUCTION.

The following table presents the figures of the total gross production of lead in the United States from 1825. Up to the year 1882 the figures have been compiled from the best data available. Since 1882 the statistics are those collected by this Office, with the exception of the year 1889, when they were gathered by the Census Office.

Production of lead in the United States, 1825–1902.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*
1825........	1,500	1848........	25,000	1867........	15,200	1886........	130,629
1830........	8,000	1849........	23,500	1868........	16,400	1887........	145,700
1831........	7,500	1850........	22,000	1869........	17,500	1888........	151,919
1832........	10,000	1851........	18,500	1870........	17,830	1889........	156,397
1833........	11,000	1852........	15,700	1871........	20,000	1890........	143,630
1834........	12,000	1853........	16,800	1872........	25,880	1891........	178,554
1835........	13,000	1854........	16,500	1873........	42,540	1892........	173,305
1836........	15,000	1855........	15,800	1874........	52,080	1893........	163,982
1837........	13,500	1856........	16,000	1875........	59,640	1894........	162,686
1838........	15,000	1857........	15,800	1876........	64,070	1895........	170,000
1839........	17,500	1858........	15,300	1877........	81,900	1896........	188,000
1840........	17,000	1859........	16,400	1878........	91,060	1897........	212,000
1841........	20,500	1860........	15,600	1879........	92,780	1898........	222,000
1842........	24,000	1861........	14,100	1880........	97,825	1899........	210,500
1843........	25,000	1862........	14,200	1881........	117,085	1900........	270,824
1844........	26,000	1863........	14,800	1882........	132,890	1901........	270,700
1845........	30,000	1864........	15,300	1883........	143,957	1902........	270,000
1846........	28,000	1865........	14,700	1884........	139,897		
1847........	28,000	1866........	16,100	1885........	129,412		

For many years the only method for arriving closely at the lead product of the mines of the United States has been to depend upon the smelting works to furnish statistics showing the source of the material worked by them. These statistics of production do not necessarily agree with the commercial statistics which include the lead obtained by smelting foreign ores and by desilverizing foreign base bullion in bond. To avoid misapprehension, these must be clearly and sharply separated. The figures given in the table of production are arrived at by making an allowance for loss in smelting the ores and in refining the base bullion derived from that smelting.

The returns of the smelters in the United States aggregate as follows:

Lead content of ores smelted by the works in the United States, 1894–1902, by States.

State or Territory.	1894.	1895.	1896.	1897.	1898.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Colorado	50,613	46,984	44,803	40,576	57,352
Idaho	33,308	31,638	46,662	58,627	59,142
Utah	23,190	31,305	35,578	40,537	39,299
Montana	9,637	9,802	11,070	12,930	10,745
New Mexico..............................	2,973	3,040	3,461	9,123	5,797
Nevada..............................	2,254	2,583	1,173	959	4,714
Arizona	1,480	2,053	1,165	2,184	2,224
California	478	949	691	383	482
Washington .... Oregon, Alaska, South Dakota, Texas....	150	381	1,006	638	1,349
Missouri, Kansas, Wisconsin, Illinois, Iowa, Virginia, and Kentucky..........	46,300	53,596	51,887	56,542	54,469
Total lead content American ores smelted	170,383	182,331	197,496	222,499	235,573
Content Mexican ores....................... Content Canadian ores.......................	*a* 21,000	16,437 5,040	15,403 10,100	13,430 19,515	10,520 17,377
Content miscellaneous or unknown......	....	....	2,118	344	428

a Estimated.

Lead content of ores smelted by the works in the United States, 1894–1902, by States— Continued.

State or Territory.	1899.	1900.	1901.	1902.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Colorado	70,308	82,137	73,265	51,833
Idaho	52,154	85,444	79,654	84,742
Utah	29,987	48,044	49,870	53,914
Montana	10,227	....	5,791	4,438
New Mexico	4,856	....	1,124	741
Nevada	3,388	....	1,873	1,269
Arizona	3,377	....	4,045	599
California	487	520	881	175
Washington	862	....	1,029	1,457
Oregon, Alaska, South Dakota, Texas				(A) 2,184
Missouri, Kansas, Wisconsin, Illinois, Iowa, Virginia, and Kentucky	54,444	....	67,172	79,445
Total lead content American ores smelted	230,090	....	284,204	280,797
Content Mexican ores	10,293	....	11,844	8,755
Content Canadian ores	5,110	....	9,615	2,164
Content miscellaneous or unknown	772	....	804	(B) 3,975

The total production to A, of 201,352 tons, includes the lead content of the ores smelted in 1902 by the works which treat argentiferous material. Besides this there was treated in one of these works domestic material, source unknown, containing 1,307 net tons of lead (included in B), which must be added in making the calculation. Then, there were treated in silver-lead works ores from Missouri, Kansas, Wisconsin, etc., to the extent of 5,395 tons of lead content, leaving 74,050 tons of direct nonargentiferous lead. The 5,395 tons which pass through the smelting and desilverizing process must undergo the usual allowance for waste in smelting and desilverizing. The total production of lead from argentiferous material was, therefore, 208,054 short tons. Assuming the yield of the ores smelted by silver-lead smelters and desilverizers to be 94 per cent, a total of 195,571 short tons of commercial lead is reached. To this must be added the 74,050 tons of pig lead produced by the soft-lead smelters, and a resulting total is reached of 269,621 short tons of lead as the production of the United States for 1902. To indicate the fact that it is an estimate, this figure is rounded off to 270,000 short tons.

Returns from the smelters show that considerably less of foreign ores were handled. This is due partly to the destruction by fire of the El Paso works of the American Smelting and Refining Company, and to the decline in the receipts of ore from Canada. On the other hand, considerably larger quantities of South American and Central American ores were smelted in smelting works in this country.

PRODUCTION OF DESILVERIZERS AND SMELTERS.

It was first in 1886 that the treatment of foreign material in American works attained some importance. At first it was foreign ores that were smelted. Subsequently growing quantities of foreign base bullion were imported to be desilverized in bond, the greater part of the refined lead thus made being exported. In the beginning it was possible to arrive at the net American production by deducting from the total pig lead production of the works the lead content of the foreign base bullion and ores. The commercial statistics and the domestic production statistics were identical. Later on the supply to the home markets included, besides the product of our own mines, varying quantities of "exempt" lead, being a certain tonnage of lead obtained from foreign material which did not pay a duty. The following table shows the total production of refined lead in the United States, irrespective of the source from which it was drawn, the production of desilverized lead, and of soft lead. A column is also added showing the amount of lead reported by the works as having been obtained from foreign base bullion and foreign ores.

Production of refined lead in the United States, 1883–1902.

Year.	Total production.[a]	Desilverized lead.[a]	Soft lead.[b]	From foreign ores and base bullion.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
1883	143,957	122,157	21,800	....
1884	139,897	119,965	19,932	....
1885	129,412	107,437	21,975	....
1886	135,629	114,829	20,800	[c]5,000
1887	160,700	135,552	25,148	[c]15,000
1888	180,555	151,465	29,090	28,636
1889	182,967	153,709	29,258	26,570
1890	161,754	130,403	31,351	18,124
1891	202,406	171,009	31,397	23,852
1892	213,262	181,584	31,678	39,957
1893	229,333	196,820	32,513	65,351
1894	219,090	181,404	37,686	59,739
1895	241,882	201,992	39,890	76,173
1896	264,994	221,457	43,537	77,738
1897	291,036	247,483	43,553	83,671
1898	310,621	267,842	42,779	99,945
1899	304,392	263,826	40,566	95,926
1900	377,679	329,658	48,021	106,855
1901	381,688	323,790	57,898	112,422
1902	377,061	303,011	74,050	100,606

[a] Including foreign base bullion refined in bond.
[b] Including a small quantity of lead produced in the Southern States.
[c] Estimated.

Hard lead.—Since 1891 special returns from desilverizers have been made on the quantity of antimonial or hard lead produced. The quantity was 4,043 tons in 1891, 5,039 tons in 1892, and 5,013 tons in 1893. In 1896 the production of hard lead was 7,507 tons, rising to 8,867 tons in 1897, and declining again to 8,473 tons in 1898. It amounted to 6,345 tons in 1899, to 9,906 tons in 1900, to 10,656 tons in 1901, and to 9,169 tons in 1902.

DOMESTIC PRODUCERS.

On the whole, the production of lead in southeast Missouri and the Joplin-Galena district in soutwest Missouri and Kansas increased considerably. In the latter district the Serage works were idle in 1902, but a new plant has been established at Galena, Kans., by the C. V. Petraeus Smelting and Mining Company. The Granby Company added considerably to its production, and the St. Joseph Lead Company made its record production in 1902. The smelting operations of the Markle, Desloge, and Federal plants were considerably enlarged. The production of the Central, Mine la Motte, and Picher companies has remained stationary.

The desilverizers handle considerably less than formerly of the nonargentiferous ores, having smelted ores containing 5,395 tons out of a total of 79,445 tons.

The Joplin Galena district, however, did not come up to its record of 1901. Local statisticians estimate that the total ore sales, which were 35,177 short tons in 1901, fell off to 31,625 tons in 1902. The exact metal yield of this ore can not be stated, since a considerable quantity of the ore is converted into a pigment. The local smelters produced, however, in 1902, 18,628 short tons of pig lead, as compared with 15,464 short tons in 1901, thus proving that a larger proportion is being converted into pig lead in the immediate vicinity of the mines.

The heavy increase in the production of lead in Missouri is due to the rapid development of the mines of southeastern Missouri, a part of the ores being smelted at local works. During 1902 the St. Joseph Lead Company, the Desloge, Central, and Mine la Motte mines made at their own works 41,192 short tons of lead, as compared with 35,132 tons in 1901. St. Louis has become a growing lead smelting center.

Practically the whole of the production of Idaho is derived from the Coeur d'Alene district, by far the most productive in the United States. Under an arrangement with the American Smelting and Refining Company the leading producers were not running up to full capacity, nor have any steps been taken in 1902 to make important additions to either the mines or the mills. Under local tax laws sworn statements are filed, showing the quantity of ore mined, the gross value, the cost of extraction, freight, and other items. According to these statements there were mined in 1902 in the Coeur d'Alene 877,407 short tons of ore, with a gross value of $8,125,043, the principal producing mines being the Empire State, Idaho, 262,509 tons; the Morning, 209,852 tons; the Standard, 155,525 tons; the Mammoth, 74,994 tons, and the Bunker Hill and Sullivan, 34,109 tons. The ores vary quite widely in metal content, but the average value per ton for the district is placed at about 10 per cent of lead and 7 ounces of silver.

The production of lead in Colorado was less than in former years, Leadville showing a further decline. The lead content of the ores mined was estimated at about 20,000 short tons. The Arkansas Valley plant, at Leadville, of the American Smelting and Refining Company has been enlarged, so as to concentrate at a single works the operations hitherto carried on at a number of plants in the district. At Pueblo the work at the former Philadelphia smelter has been suspended, largely because the Utah ores are now treated at the new Murray works; and the Durango smelter is being enlarged to smelt the ores of the San Juan region. The new plant of the Ohio and Colorado Smelting and Refining Company at Salida, Colo., was blown in on October 25, the chief owners being interested in the New Monarch mine at Leadville. The plant is equipped with four lead furnaces, and is also arranged for copper smelting. It draws its ores from Colorado, Utah, and Idaho.

Utah has shown a further gain. In Park City the Daly-West Mining Company has acquired the Quincy property and produced in 1902 ore containing 14,300 short tons of lead, 2,851 ounces of gold, 3,245,460 ounces of silver, and 1,034,880 pounds of copper. Out of total receipts of $1,885,637, dividends aggregating $1,044,000 were paid. Among the other heavy shippers of the Park City district are the Silver King, the Daly-Judge, and Ontario. The concentrates and shipping ores average per ton about 35 per cent in lead, 50 ounces of silver, and $2 to $3 in gold.

The Tintic district has not made much progress in 1902. The Bingham, Ophir, and Stockton districts are expected to show an increase during the year 1903.

CONSUMPTION.

According to the direct returns from smelters and desilverizers there were handled 100,606 short tons of foreign material.

The records of the Bureau of Statistics of the Department of Commerce and Labor make the following exhibit, the monthly details being given in the table published elsewhere.

Official returns of warehouse transactions in lead during 1901 and 1902.

	1901.	1902.
	Pounds.	*Pounds.*
In warehouse at beginning of year	42,379,270	33,225,677
Direct importation	221,030,779	200,571,318
	263,410,049	233,796,995
Deduct in warehouse at end of year	33,225,677	47,817,806
	230,184,372	185,979,189
Addition by liquidation	592,977	253,875
Total	230,777,349	186,233,064

The disposition of this was as follows:

Disposition of lead in warehouses in 1901 and 1902.

	1901.	1902.
	Pounds.	*Pounds.*
Exported	194, 199, 419	157, 834, 807
Withdrawn for consumption	16, 035, 929	14, 084, 741
Deducted by liquidation	23, 373, 544	60, 245, 134
Total	233, 608, 892	232, 164, 682

The consumption figured for 1901 and 1902, when a complete statement of stocks was first available, may be compared with estimates of previous years, which were made on a somewhat different basis, in some cases with partial data as to stocks, and in others without any reliable figures relating to them.

Estimate of the consumption of lead in the United States, 1894–1902.

	1894.	1895.	1896.	1897.	1898.
Supply—	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Total product desilverized lead	181, 401	201, 992	221, 457	247, 483	267, 827
Soft lead	37, 686	39, 890	43, 537	43, 553	42, 779
Imports, foreign refined	8, 200	22, 947	2, 020	2, 000	437
Stock, domestic, begining of year	7, 496	8, 586	9, 557	9, 299	17, 608
Stock, foreign in bond, beginning of year[a]	3, 302	7, 181	9, 865	4, 124	6, 691
Total supply	238, 088	280, 596	286, 436	306, 459	335, 342
Deduct—					
Foreign base bullion and ores refined in bond and exported	29, 000	18, 130	57, 612	62, 409	84, 666
Lead in manufactures exported under drawback	950	2, 000	1, 500	500	1, 200
Stock, domestic, close of year	8, 586	9, 557	9, 299	17, 608	14, 683
Stock, foreign in bond[a]	7, 181	9, 865	4, 124	6, 694	7, 341
Total	45, 717	39, 552	72, 535	87, 211	107, 890
Apparent home consumption	192, 371	241, 044	213, 901	219, 248	227, 452

	1899.	1900.	1901.	1902.
Supply—	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Total product desilverized lead	263, 826	329, 658	323, 790	303, 011
Soft lead	40, 566	48, 021	57, 898	74, 050
Imports, foreign refined	215	452	538	1, 544
Stock, domestic, beginning of year			39, 050	53, 733
Stock, foreign in bond, beginning of year[a]	7, 341	11, 320	21, 190	16, 613
Total supply	311, 948	389, 451	442, 466	448, 951
Deduct—				
Foreign base bullion and ores refined in bond and exported	73, 313	97, 959	97, 100	76, 962
Lead in manufactures exported under drawback	1, 000	1, 000	1, 000	1, 000
Stock, domestic, close of year			53, 733	11, 595
Stock, foreign in bond[a]	11, 320	21, 190	16, 613	23, 909
Total	85, 633	120, 149	168, 446	113, 466
Apparent home consumption	226, 315	269, 302	274, 020	335, 485

[a] Lead in ore and bullion.

The striking feature is the decline in the stocks of domestic refined lead from 53,733 tons at the opening of 1902 to 11,595 tons at its close. The domestic consumption was greater than ever before in the history of the country.

IMPORTS AND EXPORTS.

In previous volumes of the Mineral Resources tables of imports and exports of lead have been presented which go back to the year 1867, the figures being supplied by the Bureau of Statistics. The following tables supply the data since 1890:

Lead imported and entered for consumption in the United States, 1890–1902.

Year ending December 31.	Ore and dross.		Pigs and bars.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
1890	11,065,865	$504,067	19,336,233	$593,671
1891	40,692,478	1,120,067	3,392,562	104,184
1892	54,249,291	1,278,114	1,549,771	110,953
1893	58,487,319	1,004,295	3,959,781	129,290
1894	33,020,250	437,999	39,168,529	895,496
1895	45,050,674	687,222	109,551,082	2,052,209
1896	37,829,583	631,381	10,551,148	191,479
1897	31,036,882	535,094	16,050,987	314,549
1898	16,610,607	331,116	311,502	8,787
1899	6,824,556	125,344	3,473,252	78,062
1900	10,209,742	623,802	3,673,616	76,141
1901	10,324,119	272,396	3,604,157	88,056
1902	14,499,339	316,005	12,443,615	319,035

Lead imported and entered for consumption in the United States, 1890–1902.

Year ending December 31.	Sheets, pipe, and shot.		Not otherwise specified.	Total value.
	Quantity.	Value.		
	Pounds.			
1890	91,660	$5,591	$1,136	$1,104,465
1891	334,179	12,406	604	1,237,261
1892	90,135	6,207	2,063	1,397,337
1893	59,798	2,955	1,691	1,138,231
1894	44,080	2,050	536	1,336,081
1895	128,008	5,030	1,277	2,745,738
1896	96,010	3,818	644	827,322
1897	95,891	4,042	513	854,198
1898	242,759	9,389	312	349,604
1899	110,372	4,402	8,626	216,434
1900	27,945	1,393	877	702,213
1901	56,735	2,773	1,234	364,459
1902	224,209	7,765	5,258	648.063

Lead, and manufactures of lead, of domestic production, exported, 1890–1902.

Year ending December 31.	Manufactures of lead.		Pigs, bars, and old.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1890	....	$181,030	....	....	$181,030
1891	....	173,887	....	....	173,887
1892	....	154,375	....	....	154,375
1893	....	508,090	....	....	508,090
1894	....	456,753	....	[a]$41,240	497,993
1895	....	164,083	1,696,879	50,773	214,856
1896	....	164,877	[b]16,359,452	442,496	607,373
1897	[c]150,473	[d]49,816	[b]7,725,624	223,037	433,319
	....	[e]160,466			
1898	[c]265,062	[d]97,862	118,960	4,450	215,239
	....	[e]112,927			
1899	[c]314,348	[d]115,137	93,115	4,286	273,919
	....	[e]154,496			
1900	[c]363,600	[d]130,758	1,993,773	88,664	459,571
	....	[e]240,149			
1901	500,460	178,752	4,787,107	214,842	624,534
	....	230,940			
1902	[c]458,423	[d]153,309	6,542,760	286,548	696,010
	....	[e]256,153			

[a] Not enumerated between 1868 and July 1, 1894.
[b] Part of this is foreign lead returned by collectors of customs by mistake as domestic lead.
[c] Type.
[d] Value of type.
[e] Value of all other manufactures.

According to the returns of the Bureau of Statistics the sources of imports of lead in the calendar years 1895, 1896, 1897, 1898, 1899, 1900, 1901, and 1902 were as follows:

Sources of imports of lead.

Country.	1895.	1896.	1897.	1898.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
United Kingdom	8,161,411	1,365,132	1,120,528	2,326,937
Germany	1,113,148	....	....	....
Other Europe	36,618,228	1,235,981	1,101,151	....
Total refined pig lead	45,892,787	2,601,113	2,221,679	2,326,937
British North America	15,860,906	25,672,833	44,171,421	34,453,299
Mexico	138,312,146	130,388,173	137,364,677	142,030,670
Total ore and base bullion	154,173,052	156,061,006	181,536,098	176,483,969
Other countries	931,116	1,656,398	1,560,635	480,384
Total imports	200,996,955	160,318,517	185,318,412	179,291,290

Sources of imports of lead—Continued.

Country.	1899.	1900.	1901.	1902.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
United Kingdom	317,321	567,482	402,552	792,607
Germany	....	225,222	671,294	952,878
Other Europe	111,952	111,905	2,453	1,342,193
Total refined pig lead	429,273	904,609	1,076,299	3,087,678
British North America	17,871,875	42,139,262	52,130,002	19,464,937
Mexico	173,432,976	178,602,486	163,453,526	187,484,666
Total ore and base bullion	191,304,851	220,741,748	215,583,528	206,949,603
Other countries	1,142,950	7,147,092	8,282,502	5,195,174
Total imports	192,877,074	228,793,449	224,942,329	215,232,455

The subdivision by groups representing refined pig lead and lead in ore and base bullion is made by this office.

WAREHOUSE TRANSACTIONS.

The following table, furnished by the Bureau of Statistics, shows the warehouse transactions of lead in ore and in base bullion monthly during 1902, and the corresponding totals for the years 1901, 1900, 1899, 1898, and 1897.

Imports of lead in ore and base bullion during the calendar year 1902, showing warehouse transactions by months.

Month.	Remaining in warehouse first day of each month.	Entered warehouse.		Additions by liquidation.
		Of direct importation.	From other districts.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
January	33,225,677	19,641,930	8,466,782	63,387
February	23,009,808	14,867,220	5,893,168	27,239
March	24,991,993	18,146,014	20,212,005	48,633
April	40,354,060	17,478,566	6,875,247	28,660
May	30,964,000	16,296,102	8,359,360	45,870
June	21,498,747	11,385,677	8,100,731	20,967
July	20,907,428	20,031,112	21,883,045	16,056
August	37,487,232	10,249,257	8,522,958	90
September	31,647,301	17,012,840	24,907,320	....
October	39,924,391	16,738,087	11,401,864	....
November	50,113,161	18,506,500	8,575,569	2,973
December	46,893,370	20,218,013	9,321,959	....
January (1903)	47,817,806	....	....	....
Total	....	200,571,318	142,520,008	253,875
Total, 1901	....	221,030,779	204,702,170	592,997
Total, 1900	....	226,644,190	249,674,008	1,576,397
Total, 1899	....	188,512,454	216,031,498	1,156,632
Total, 1898	....	170,017,006	177,837,309	1,326,934
Total, 1897	....	163,365,627	167,963,673	305,862

Imports of lead in ore and base bullion during the calendar year 1902, showing warehouse transactions by months—Continued.

Month.	Withdrawn from warehouse. For exportation.	Withdrawn from warehouse. For transportation.	Withdrawn from warehouse. For consumption.	Deductions by liquidation.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
January	15,345,487	8,953,784	2,149,573	11,939,124
February	11,264,720	5,379,750	157,617	2,003,355
March	16,359,670	3,569,293	339,529	2,776,093
April	19,111,183	9,061,480	830,408	4,769,462
May	14,144,364	6,367,641	4,708	13,649,872
June	11,078,151	7,221,441	419,022	1,380,080
July	12,552,495	11,438,630	246,586	1,112,698
August	15,631,907	7,121,586	348,685	1,510,058
September	12,537,420	8,218,859	564,480	12,322,311
October	9,505,430	6,487,444	407,231	1,551,076
November	8,970,067	10,123,167	5,639,663	5,571,936
December	11,333,913	12,645,315	2,977,239	1,659,069
January (1903)	....	....	....	....
Total	157,834,807	96,588,390	14,084,741	60,245,133
Total, 1901	194,199,419	201,870,617	16,035,929	23,373,514
Total, 1900	195,917,622	217,565,289	15,829,631	28,842,770
Total, 1899	151,202,762	204,545,816	14,403,027	27,591,976
Total, 1898	147,978,938	163,405,296	7,844,184	28,650,385
Total, 1897	109,847,156	183,006,461	23,929,569	7,769,593

PRICES.

In previous volumes of the Mineral Resources the highest and the lowest prices of lead at New York were given for each month since 1870, the figures being compiled from market quotations. The following table shows the fluctuations since 1890:

Highest and lowest prices of lead at New York City, monthly, 1890–1902.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1890	3.85	3.80	3.85	3.75	3.95	3.85	4.07½	3.85
1891	4.50	4.05	4.50	4.25	4.37½	4.25	4.32½	4.10
1892	4.30	4.10	4.25	4.05	4.22½	4.10	4.30	4.20
1893	3.90	3.85	3.95	3.90	4.05	3.85	4.12½	4.05
1894	3.25	3.15	3.35	3.20	3.45	3.25	3.45	3.37½
1895	3.12½	3.05	3.12½	3.07½	3.10	3.07½	3.12½	3.05
1896	3.15	3	3.20	3.07½	3.22½	3.07½	3.07½	3.02½
1897	3.12½	3.02½	3.37½	3.12½	3.40	3.35	3.40	3.25
1898	3.70	3.55	3.80	3.55	3.70	3.60	3.62½	3.55
1899	4.25	3.90	4.50	4.25	4.45	4.30	4.35	4.27½
1900	4.75	4.70	4.75	4.70	4.75	4.70	4.75	4.65
1901	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½
1902	4.10	4	4.10	4.05	4.10	4.05	4.10	4.05

Highest and lower prices of lead at New York City, monthly, 1890-1902—Continued.

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1890	4.35	4	4.50	4.25	4.50	4.40	4.72½	4.35
1891	4.37½	4.20	4.50	4.35	4.45	4.30	4.53	4.40
1892	4.25	4.20	4.20	4.05	4.25	4	4.15	4
1893	4	3.75	3.90	3.45	3.60	3.30	3.75	3.25
1894	3.40	3.30	3.37½	3.25	3.65	3.37½	3.70	3.30
1895	3.25	3.07½	3.30	3.25	3.50	3.30	3.55	3.50
1896	3.05	3	3.05	3	3	2.90	2.90	2.65
1897	3.37½	3.22½	3.60	3.25	3.90	3.65	4.10	3.70
1898	3.80	3.60	3.90	3.75	4	3.80	4.10	3.90
1899	4.50	4.37½	4.50	4.45	4.60	4.50	4.60	4.50
1900	4.70	4	4.25	3.75	4.25	4	4.37½	4.25
1901	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½
1902	4.10	4.05	4.10	4.05	4.10	4.05	4.10	4.05

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1890	5	4.67½	5.25	5	5.25	4.60	4.60	4.05
1891	4.55	4.40	4.55	4.10	4.35	4.10	4.25	4.25
1892	4.15	4	3.95	3.85	3.85	3.70	3.85	3.70
1893	3.95	3.75	3.75	3.25	3.37½	3.30	3.30	3.20
1894	3.30	3.10	3.15	3.05	3.12½	3.10	3.12½	3.02½
1895	3.45	3.32½	3.35	3.30	3.27½	3.15	3.30	3.20
1896	2.80	2.72½	2.92½	2.72½	3.05	2.85	3.05	2.95
1897	4.35	4.25	4.25	3.85	3.85	3.75	3.75	3.65
1898	4.05	3.90	3.90	3.60	3.70	3.65	3.80	3.60
1899	4.60	4.55	4.60	4.57½	4.60	4.57½	4.75	4.57½
1900	4.37½	4.35	4.37½	4.35	4.37½	4.35	4.37½	4.35
1901	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4
1902	4.10	4.05	4.10	4.05	4.10	4.05	4.10	4.05

In January, 1902, the American Smelting and Refining Company advanced the price of lead from 4 cents, which had been named in December, 1901, to 4.10 cents for moderate lots, and at that price the metal was held during the remainder of the year.

ZINC.

By Charles Kirchhoff.

PRODUCTION.

During 1902 the production of spelter in the United States was greater than ever before, having attained a total of 156,927 short tons. The development of the industry is shown by the following figures:

Production of spelter in the United States, 1873–1902.

Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*
1873	7,343	1891	80,873
1875	15,833	1892	87,260
1880	23,239	1893	78,832
1882	33,765	1894	75,328
1883	36,872	1895	89,686
1884	38,544	1896	81,499
1885	40,688	1897	99,980
1886	42,641	1898	115,399
1887	50,340	1899	129,051
1888	55,903	1900	123,886
1889	58,860	1901	140,822
1890	63,683	1902	156,927

In the different States the production has been as follows:

Production of spelter in the United States, by States, 1882–1902.

Year.	Eastern and Southern States.	Illinois.	Kansas.	Missouri.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1882	5,698	18,201	7,366	2,500	33,765
1883	5,340	16,792	9,010	5,730	36,872
1884	7,861	17,594	7,859	5,230	38,544
1885	8,082	19,427	8,502	4,677	40,688
1886	6,762	21,077	8,932	5,870	42,641
1887	7,446	22,279	11,955	8,660	50,340
1888	9,561	22,445	10,432	13,465	55,903
1889	10,265	23,860	13,658	11,077	58,860
1890	9,114	26,243	15,199	13,127	63,683
1891	[a] 8,945 [b] 4,217	28,711	22,747	16,253	80,873
1892	[a] 9,582 [b] 4,913	[c] 31,383	24,715	16,667	87,260
1893	[a] 8,802 [b] 3,882	[c] 29,596	22,815	13,737	78,832

[a] Eastern. [b] Southern. [c] Including Indiana.

Production of spelter in the United States, by States, 1882–1902—Continued.

Year.	Eastern and Southern States.	Illinois.	Kansas.	Missouri.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1894	[a]7,400 [b]1,376	[c]28,972	25,588	11,992	75,328
1895	[a]9,484 [b]3,697	[c]35,732	25,775	14,998	89,686
1896	[a]8,139 [b]2,427	[c]36,173	20,759	14,001	81,499
1897	[a]7,218 [b]3,365	[c]37,876	33,396	18,125	99,980
1898	8,631	[c]47,103	40,132	19,533	115,399
1899	8,805	[c]50,118	52,021	18,107	129,051
1900	8,259	38,750	62,136	14,741	123,886
1901	8,603	[c]44,896	74,240	13,083	[d]140,822
1902	12,180	[c]47,096	86,564	11,087	[e]156,927

[a] Eastern. [b] Southern. [c] Including Indiana.
[d] Including 2,716 short tons dross spelter. [e] Including 2,675 short tons dross spelter.

The statistics of the production of spelter include always the metal produced by several works that treat drosses exclusively. In 1901 these made 2,716 short tons and in 1902 they produced 2,675 short tons. This conveys an impression of the magnitude of this industry in recent years.

It may be of interest to note that the Edgar Zinc Company, controlled by the American Steel and Wire Company, a constituent company of the United States Steel Corporation, produced in 1902 in its Cherrydale, Kans., and Carondelet, Mo., plants 23,982 short tons of spelter.

During 1902 the Illinois Zinc Company began the erection of an additional furnace, increasing its capacity by 15 per cent. The furnace was completed early in 1903. The Granby Mining and Smelting Company, which ranked among the makers of spelter in the earlier days of the industry, and which produces a good deal of ore, acquired a plant at Neodesha, Kans. The Sandoval Zinc Company, which has produced spelter for some years at Sandoval, Ill., has purchased and is operating the works at Marion, Ind. In Virginia the Bertha Mineral Company has purchased the property of the Wythe Lead and Zinc Company, which in former years produced spelter. The plant, however, has been idle for a long time, operations being confined to mining. A new works of two blocks is building at Laharpe, Kans.

CONSUMPTION.

The consumption of spelter in 1902 was heavy, the principal industries in which it is a factor being extremely busy. The following table gives an estimate—which is approximate, however—in respect to stocks. All of the producers do not report, but the incomplete data at least partially reflect the movement:

Estimated consumption of spelter, 1895–1902.

Source, etc.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Production	89,686	81,499	99,980	115,399	129,051	123,886	140,822	156,927
Imports	432	428	1,279	1,303	1,392	961	357	448
Stock at beginning of year	4,911	5,802	7,477	5,709	3,695	2,798	5,813	1,905
Total supply	95,029	87,729	108,736	122,411	134,138	127,645	146,992	159,280
Deduct—								
Exports of foreign	....	4	....	18	....	23	....	....
Exports of domestic	1,530	10,130	14,245	10,499	6,755	22,410	3,390	3,237
Stock at end of year	5,802	7,477	5,709	3,695	2,798	5,813	1,905	3,361
Total	7,332	17,611	19,954	14,212	9,553	28,246	5,295	6,598
Apparent home consumption	87,697	70,118	88,782	108,199	124,585	99,399	141,697	152,682

THE ZINC MINES.

JOPLIN-GALENA DISTRICT.

The Joplin-Galena district has had a prosperous year, production being large and prices satisfactory. Mr. Jesse A. Zook, of Joplin, has compiled for the Daily Globe the following statement of ore sales for 1902, by camps:

Sales of zinc and lead ore in the Joplin-Galena district in 1902.

Camp.	Zinc ore.				Lead ore.		
	Quantity.			Value, 1902.	Quantity.		Value, 1902.
	1900.	1901.	1902.		1901.	1902.	
	Short tons.	*Short tons.*	*Short tons.*		*Short tons.*	*Short tons.*	
Joplin	54,876	67,232	73,690	$2,418,737	12,227	10,206	$473,042
Galena and Empire	45,043	33,930	30,339	871,103	5,270	3,096	191,558
Carterville	39,146	44,348	44,693	1,335,721	8,772	9,118	424,975
Webb City	12,643	13,741			840		
Duenweg	5,147	4,235	13,679	596,628	1,479	1,640	75,775
Aurora	22,197	20,435	19,395	521,175	566	261	21,313
Prosperity	....	....	10,929	231,596	....	1,182	55,564
Oronogo	18,473	16,480	9,225	278,575	877	477	21,767
Zincite	9,386	9,452	7,503	248,885	176	205	9,480
Alba and Neck City	4,086	7,633	7,043	225,648	26	233	9,641
Granby	7,838	7,941	8,459	181,347	1,075	1,089	50,434
Carthage	3,287	4,283	5,958	196,307	10	28	1,393
Cave Springs	3,882	3,804	4,594	142,559	364	242	11,212
Spurgeon and Spring City	....	4,512	4,383	104,268	1,883	1,159	52,030
Central City and Roaring	3,955	3,470	3,630	94,172	292	234	11,198
Springs	3,578	3,614			189		
Stotts City	3,716	1,124	1,431	43,035	46	....	....
Carl Junction	2,883	6,723	7,051	238,573	177	....	....
Miscellaneous	4,493	3,963	4,336	135,274	639	972	45,436
Total 1902	....	....	256,338	7,863,603	....	30,142	1,454,818
Total 1901	....	....	256,920	6,318,249	....	34,908	1,610,981
Total 1900	....	....	244,629	6,583,944	....	29,176	1,402,678
Total 1899	....	....	255,088	....	....	23,888	....

The most striking increase has been made by the Duenweg district, but Carterville, Joplin, and Webb City have also done well. Among the camps whose product is grouped under "Miscellaneous" is the new district of Fortuna, in central Missouri, 6 miles south of Tipton. It also includes Gillham, Harrison, and Imboden, in Arkansas.

For previous years the ore sales have been as follows:

Ore sales in the Joplin-Galena district, 1894–1902.

Year.	Zinc ore.	Lead ore.	Total value both ores.
	Short tons.	*Short tons.*	
1894	147,310	32,199	$3,535,736
1895	144,487	31,294	3,775,929
1896	155,333	27,721	3,857,355
1897	177,976	30,105	4,726,302
1898	234,455	26,687	7,119,867
1899	255,088	23,888	10,715,307
1900	244,629	29,176	7,986,622
1901	256,920	34,938	7,929,230
1902	256,338	30,142	9,318,421

The average base prices, from month to month, for the ores of the district have been as follows in 1900, 1901, and 1902:

Average base prices of zinc and lead ores in the Joplin-Galena district in 1900, 1901, and 1902, by months.

Month.	Zinc, per short ton.			Lead, per 1,000 pounds.		
	1902.	1901.	1900.	1902.	1901.	1900.
January	$26.75	$23.73	$30.23	$21.00	$22.80	$28.00
February	27.00	23.96	29.36	21.61	22.50	27.50
March	28.00	23.70	28.45	21.65	23.10	26.50
April	28.85	24.58	28.42	21.75	22.76	26.86
May	29.23	24.38	26.92	22.00	23.69	24.50
June	34.10	24.22	25.00	22.80	23.52	22.80
July	34.37	24.38	24.23	24.00	23.49	21.35
August	32.50	23.88	25.67	24.10	22.90	23.00
September	33.00	22.82	24.55	24.50	23.16	23.00
October	33.58	24.63	24.25	24.75	23.15	22.71
November	32.10	26.15	21.45	24.95	23.14	22.80
December	29.25	28.24	25.40	25.00	22.35	22.19
Year	30.33	24.21	26.50	23.05	22.99	24.16

Prices, therefore, were quite satisfactory during the year, and the demand was such that no ore was exported. Toward the close of 1902 a surplus accumulated, however, and a proposition was being discussed to ship it out of the country. During the year the proposal was made to form an ore-purchasing company to handle the zinc ore of the district, warehousing and grading it and reselling to the smelters at an advance of $1.50. The scheme was not carried through, however.

COLORADO.

Colorado has become an important producer of zinc ore, the output for the year 1902 being placed by Mr. Harry Allen Lee, commissioner of mines, at 26,241 short tons, valued at $2,544,993.48. Of this quantity 23,819 short tons are credited to Lake County, 1,024 short tons were mined in Mineral County, and 665 short tons in Summit County. In Leadville increased attention has been paid to the handling of low-grade zinc and lead ores and dumps. The United States Zinc Company has shipped considerable quantities from the Moyer dump of the Iron-Silver Company to its Canyon City plant. A mill was also successfully started by the A. Y. and Minnie Company, and a large new plant for the Resurrection mine was approaching completion at the end of 1902. Magnetic concentration plants for zinc ores have been built at Denver, Colo., by the Colorado Zinc Company, and the Empire Zinc Company, controlled by the New Jersey Zinc Company, has built works at Canyon City. The American Smelting and Refining Company has erected a small zinc smelting plant at Pueblo. The Colorado zinc ores have largely gone to Europe, while considerable quantities have also been shipped to the Kansas gas belt and to the zinc-white works in Wisconsin.

To the Kansas works have also gone some shipments of zinc ore from the Slocan district in British Columbia.

NEW JERSEY.

According to the report of the State geologist of New Jersey the production of the zinc mines of the State was 209,386 short tons of ore in 1902 as compared with 191,221 short tons in 1901, the entire quantity being obtained from the Franklin mines of the New Jersey Zinc Company.

THE SOUTH.

The mines in Marion County, Ky., have continued to ship ore; in Tennessee further prospecting has been done; and in Virginia operations were confined to the work of the Bertha Mineral Company, which had acquired the mines of the Wythe Lead and Zinc Company at Austinville.

IMPORTS AND EXPORTS.

The imports have continued light in 1902; the exports, however, of zinc ore have shown a further increase, as is exhibited in the following tables.

For a series of years the imports and exports have been as follows:

Zinc imported and entered for consumption in the United States, 1867–1902.

Year ending—	Block or pigs.		Sheets.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*	
1867	5,752,611	$256,366	5,142,417	$311,767
1868	9,327,968	417,273	3,557,448	203,883
1869	13,211,575	590,332	8,306,723	478,646
1870	9,221,121	415,497	9,542,687	509,860
1871	11,159,040	508,355	7,646,821	409,243
1872	11,802,247	522,524	10,704,944	593,885
1873	6,839,897	331,399	11,122,143	715,706
1874	3,593,570	203,479	6,016,835	424,504
1875	2,034,252	101,766	7,320,713	444,539
1876	947,322	56,082	4,611,360	298,308
1877	1,266,894	63,250	1,341,333	81,815
1878	1,270,184	57,753	1,255,620	69,381
1879	1,419,791	53,294	1,111,225	53,050
1880	8,092,620	371,920	4,069,310	210,230
1881	2,859,216	125,457	2,727,324	129,158
1882	18,408,391	736,964	4,413,042	207,032
1883	17,067,211	655,503	3,309,239	141,823
1884	5,869,738	208,852	952,253	36,120
1885	3,515,840	113,268	1,839,860	64,781
December 31—				
1886	4,300,830	136,138	1,092,400	40,320
1887	8,387,647	276,122	926,150	32,526
1888	3,825,947	146,156	295,287	12,558
1889	2,052,559	77,845	1,014,873	43,356
1890	1,997,524	101,335	781,366	43,495
1891	808,094	41,199	21,948	1,460
1892	297,969	16,520	27,272	2,216
1893	425,183	22,790	28,913	1,985
1894	387,788	13,788	39,947	2,061
1895	744,301	26,782	42,513	2,773
1896	1,040,719	32,096	27,321	1,358
1897	2,905,451	109,520	15,971	786
1898	2,605,028	104,669	39,712	2,724
1899	2,783,329	143,557	86,878	6,354
1900	1,767,756	86,653	155,144	10,801
1901	556,434	22,766	157,787	10,467
1902	895,054	36,536	136,587	8,339

Zinc imported and entered for consumption in the United States, 1867–1902—Cont'd.

Year ending—	Old. Quantity.	Old. Value.	Value of manufactures.	Total value.
June 30—	*Pounds.*			
1867			$1,835	$569,968
1868			1,623	622,779
1869			2,083	1,071,061
1870			21,696	947,053
1871			26,366	943,964
1872			58,668	1,175,077
1873			56,813	1,103,918
1874			48,304	676,287
1875			26,330	572,635
1876			18,427	372,817
1877			2,196	147,561
1878			4,892	132,026
1879			3,374	109,718
1880			3,571	585,721
1881			7,603	262,218
1882			4,940	948,936
1883			5,606	802,932
1884			4,795	249,767
1885			2,054	180,103
December 31—				
1886			9,162	185,620
1887			11,329	319,977
1888			12,080	170,794
1889			19,580	140,781
1890			9,740	154,570
1891				42,659
1892	115,203	$6,556	20,677	45,969
1893	265	21	16,479	41,275
1894	27,754	530	11,816	28,195
1895	64,398	899	9,953	40,407
1896	14,855	267	9,800	43,521
1897	41,643	886	11,459	122,651
1898	96,899	3,417	11,211	122,021
1899	167,954	6,932	8,824	165,667
1900	155,670	6,379	24,257	128,090
1901	150,168	3,277	39,549	76,059
1902	313,537	8,299	32,708	75,882

Imports of zinc oxide, 1885–1902.

Year ending—	Dry.	In oil.	Year ending—	Dry.	In oil.
	Pounds.	*Pounds.*	December 31—	*Pounds.*	*Pounds.*
June 30, 1885	2,233,128	98,566	1894	3,371,292	59,291
December 31—			1895	4,546,049	129,343
1886	3,526,289	79,788	1896	4,572,781	311,023
1887	4,961,080	123,216	1897	5,564,763	502,357
1888	1,401,342	51,985	1898	3,342,235	27,050
1889	2,686,861	66,240	1899	3,012,709	41,699
1890	2,631,458	102,298	1900	2,618,808	38,706
1891	2,839,351	128,140	1901	3,199,778	128,198
1892	2,442,014	111,190	1902	3,271,385	163,081
1893	3,900,749	254,807			

Since 1864 the exports have been as follows:

Exports of zinc and zinc ore of domestic production, 1864–1902.

Year ending—	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
June 30—	*Cwt.* *		*Pounds.*			
1864	14,810	$116,431	95,738	$12,269	....	$128,700
1865	99,371	114,149	184,183	22,740	....	136,889
1866	4,485	25,091	140,798	13,290	....	38,381
1867	3,676	32,041	312,227	30,587	....	62,628
1868	8,344	74,706	1,022,699	68,214	....	142,920
1869	....	65,411	....	....	....	65,411
1870	15,286	81,487	110,157	10,672	....	92,159
1871	9,621	48,292	76,380	7,823	....	56,115
1872	3,686	20,880	62,919	5,726	....	26,606
1873	234	2,304	73,953	4,656	....	6,960
1874	2,550	20,037	43,366	3,612	....	23,649
1875	3,083	20,659	38,090	4,245	$1,000	25,904
1876	10,178	66,259	134,542	11,651	4,333	82,243
1877	6,428	34,468	1,419,922	115,122	1,118	150,708
1878	16,050	83,831	2,545,320	216,580	567	300,978
1879	10,660	40,399	2,132,949	170,654	....	211,053
1880	13,024 *	42,036	1,368,302	119,264	....	161,300
1881	11,390	16,405	1,491,786	132,805	168	149,378
1882	10,904	13,736	1,489,552	124,638	....	138,374
1883	3,045	11,509	852,333	70,981	734	83,224
1884	4,780	16,685	126,043	9,576	4,666	30,927
1885	6,840	22,824	101,685	7,270	4,991	35,085
December 31—						
1886	26,620	49,455	917,229	75,192	13,526	138,173
1887	4,700	17,286	136,670	9,017	16,789	43,092
1888	4,560	18,034	62,234	4,270	19,098	41,402
1889	26,760	73,802	879,785	44,049	35,732	153,583
1890	77,360	195,113	3,295,584	126,291	23,587	344,991
1891	115,820	149,435	4,294,656	278,182	38,921	466,538
1892	18,380	41,186	12,494,335	669,549	166,794	877,529
1893	980	1,271	7,446,934	413,673	224,787	639,731
1894	....	5	3,607,050	144,074	99,406	243,485
1895	480	1,008	3,060,805	153,175	50,051	204,234
1896	41,500	47,408	20,260,169	1,013,620	51,001	1,112,029
1897	165,200	211,350	28,490,662	1,356,538	71,021	1,638,909
1898	210,400	299,870	20,998,413	1,033,959	138,165	1,471,994
1899	503,940	725,944	13,509,316	742,521	143,232	1,611,697
1900	751,100	1,133,663	44,802,577	2,217,693	99,288	3,450,644
1901	788,500	1,167,684	6,780,221	288,906	82,046	1,538,636
1902	975,240	1,449,104	6,473,135	300,557	114,197	1,863,858

During 1902 there was exported a fair quantity of New Jersey ore via New York, and Colorado shipped a larger quantity via Galveston.

Exports of zinc ore by customs districts during 1900, 1901, and 1902.

Customs district.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
New York	15,187	$445,622	24,092	$694,995	20,883	$582,229
Philadelphia	10,209	300,850	2,039	62,145		
Galveston	2,273	70,844	291	8,512	27,817	834,520
New Orleans	9,150	294,684	13,003	402,032	290	8,600
Newport News					587	17,610
Detroit	349	10,300				
Huron	364	10,713				
All other districts	23	650			185	6,145
Total	37,555	1,133,663	39,425	1,167,684	49,762	1,449,104

The following table shows the destination of the ore exports:

Exports of zinc ore by countries during 1900, 1901, and 1902.

Country.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Austria-Hungary					90	$2,700
Belgium	11,280	$361,323	13,167	$406,734	30,138	895,824
Netherlands	25,375	745,750	26,137	757,295	19,244	541,980
Germany			1	40		
United Kingdom	161	4,830	120	3,615	290	8,600
Canada	736	21,663				
Mexico	3	97				
Total	37,555	1,133,663	39,425	1,167,684	49,762	1,449,104

The exports of spelter by customs districts and by countries of destination are exhibited in the following tables:

Exports of zinc; by customs districts, during 1900, 1901, and 1902.

Customs district.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
New York	1,897,004	$109,910	3,827,740	$159,832	1,455,101	$63,731
Philadelphia	5,017	315				
Norfolk and Newport News	768,213	45,593	710,200	30,631	4,277,241	198,156
Baltimore	2,354,186	121,113			16,525	900
Galveston	19,761,628	1,011,694				
New Orleans	17,918,915	834,457	1,171,068	53,074	1,344	78
Detroit	317,972	16,945			3,838	229
Huron	416,447	19,114	936,227	38,507	196,549	9,331
All other districts	1,363,195	58,552	134,986	6,862	522,537	28,132
Total	44,802,577	2,217,693	6,780,221	288,906	6,473,135	300,557

A very important part of the spelter exports from Atlantic ports is the high-grade spelter of New Jersey, Pennsylvania, and Virginia. The Western spelter is exported from Gulf ports.

The destination of the exports of zinc is shown in the following table:

Exports of zinc, by countries, during the calendar years 1900, 1901, and 1902.

Country.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
Belgium	4,195,509	$189,838	83,545	$3,770	....	....
France	5,712,129	279,215	....	....	....	....
Germany	65,669	3,543	1,000	50	162,351	7,394
Netherlands	615,003	31,723	....	....	68,851	3,197
United Kingdom	33,378,240	1,669,950	5,167,274	218,841	5,256,329	237,345
Canada	746,744	36,824	1,035,020	43,753	234,390	12,256
All other countries	89,283	6,600	493,382	22,492	751,214	40,365
Total	44,802,577	2,217,693	6,780,221	288,906	6,473,135	300,557

PRICES.

So far as the prices realized for spelter during 1902 are concerned, the year was a favorable one, since the demand was quite large. The year opened quietly, with spelter selling at New York at 4.25 to 4.30 cents per pound, but showed a weakening disposition, the price declining to 4 cents. Toward the end of February the market strengthened and prices recovered to 4.25 cents. Toward the close of March a number of Missouri ore producers endeavored to organize a pool to force higher prices for ore, and spelter moved in sympathy, but its early failure left the market in an indifferent mood. May brought an advance to 4.65 cents, New York, as the result of threatened labor troubles at Kansas zinc works. The strike did take place in June and affected two plants, but it was of short duration. Heavy consumption, however, held up values and led to an advance in July to $4\frac{7}{8}$ to 5 cents, New York. The activity continued during August, carrying the metal up to $5\frac{3}{8}$ cents, New York, and prices held well during September. October, however, brought a declining tendency, which was checked by a fire that crippled the Cherryvale works in Kansas. In November the market weakened, and showed a further decline in December, closing the year with spelter at 4.50 to 4.55 cents, New York.

The following table summarizes the prices of spelter since 1875:

Prices of common western spelter in New York City, 1875–1895.

[Cents per pound.]

Year.	Highest.	Lowest.	Year.	Highest.	Lowest.
1875	7.35	6.20	1886	4.60	4.25
1876	8.00	6.37	1887	5.87	4.40
1877	6.50	5.50	1888	5.37	4.50
1878	5.75	4.25	1889	5.35	4.62
1879	6.25	4.12	1890	6.10	4.20
1880	6.75	4.62	1891	6.00	4.65
1881	6.00	4.75	1892	4.90	4.35
1882	6.00	4.50	1893	4.50	3.55
1883	4.75	4.30	1894	4.00	3.25
1884	4.65	4.00	1895	4.35	3.10
1885	4.62	4.00			

Price of common Western spelter in New York City, 1896–1902.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	4.05	4.00	4.15	4.00	4.15	4.10	4.20	4.05
1897	4.10	3.90	4.10	4.00	4.15	4.10	4.15	4.10
1898	4.00	3.90	4.10	3.90	4.25	4.15	4.30	4.15
1899	5.70	5.15	6.50	5.70	6.50	6.25	6.80	6.20
1900	4.75	4.50	4.75	4.55	4.70	4.50	4.75	4.55
1901	4.15	4.02	4.02	3.92	3.95	3.87	4.05	3.92
1902	4.30	4.25	4.25	4.00	4.35	4.20	4.45	4.40

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	4.15	4.00	4.15	4.00	4.10	3.90	3.90	3.65
1897	4.20	4.10	4.25	4.15	4.30	4.20	4.35	4.25
1898	4.30	4.10	5.15	4.30	4.80	4.45	4.75	4.45
1899	7.00	6.75	6.75	6.15	6.25	6.00	6.00	5.30
1900	4.55	4.50	4.40	4.15	4.25	4.15	4.15	4.10
1901	4.02	3.92	4.00	3.95	3.92	3.90	4.00	3.92
1902	4.65	4.40	4.85	4.80	5.35	5.00	5.50	5.35

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	3.70	3.60	3.75	3.65	4.25	3.75	4.25	4.15
1897	4.35	4.25	4.30	4.15	4.25	3.90	3.90	3.75
1898	4.82½	4.70	5.15	4.82½	5.25	5.15	5.30	4.90
1899	5.75	5.20	5.50	5.15	5.00	4.50	4.70	4.55
1900	4.10	4.05	4.15	4.05	4.30	4.10	4.25	4.05
1901	4.10	4.00	4.35	4.07	4.37	4.30	4.50	4.30
1902	5.50	5.30	5.50	5.40	5.35	5.10	5.00	4.50

THE WORLD'S PRODUCTION.

Messrs. Henry R. Merton & Co. (Limited), of London, on the basis of detailed reports, make the production of spelter in Europe as follows:

Production of zinc in Europe, 1895–1902.

[Long tons.]

Country or district.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Rhine, Belgium, and Holland	172,135	179,730	184,455	188,815	189,955	186,320	199,285	200,140
Silesia	94,015	95,875	94,045	97,670	98,590	100,705	106,385	115,280
Great Britain	29,495	24,880	23,550	27,940	31,715	29,830	29,190	39,610
Austria and Italy	8,355	9,255	8,185	7,115	7,190	6,975	7,700	8,460
France and Spain	22,895	28,450	32,120	32,135	32,955	30,620	27,265	27,030
Poland	4,960	6,165	5,760	5,575	6,225	5,875	5,935	8,150
Total	331,855	344,355	348,115	359,250	366,630	360,325	375,760	398,670
United States	80,076	72,767	89,268	103,061	115,224	110,612	125,734	140,114
Total world's production	411,931	417,122	437,383	462,311	481,854	470,937	501,494	538,784
United States percentage of world's production	19.4	17.4	20.4	22.3	23.9	23.5	25.1	26.0

The leading producers in Europe in 1902 were: Vieille Montagne Company, 69,955 long tons; Hohenlohe, 28,170 long tons; Schlesische Aktien-Gesellschaft, 27,560 tons; G. von Giesche's Erben, 25,530 tons; Société Asturienne, 21,165 tons; Graf H. Henckel von Donnersmarck, 18,400 tons; Stolberg, 18,140 tons; G. Dumont & frères, 13,535 tons; Société Prayon, 12,515 tons, and Rhein-Nassau, 10,015 tons. In this list the Lanyon Zinc Company would rank second, the Edgar Zinc Company would follow the fourth name, the Prime Western Spelter Company the fifth, and the Illinois Zinc Company and the Matthiessen & Hegeler Zinc Company the seventh.

None of the American producers and very few of the European spelter companies publish full annual reports. A conspicuous exception is the Vieille Montagne, which in 1902 produced 70,872 metric tons of crude zinc, the rolling mills making 62,945 metric tons of sheet zinc, and the zinc-white factories 8,642 tons of various products. The Baelen-Wezel works marketed 48,840 tons of sulphuric acid. The gross profit in 1902 was 5,736,017.87 francs, and deducting 1,210,685.54 francs for general expenses, interest, discounts, etc., the net profits were 4,525,332.33 francs. Besides setting aside for depreciation, according to law, 815,066.50 francs, paying 407,533.25 francs to the administration, and 101,883.30 francs to the directors, there were paid 5 per cent, or 450,000 francs, interest on the capital stock of 9,000,000 francs and 2,700,000 francs in dividends. The company has outstanding 8,000,000 francs of bonds, and has 3,978,447.18 francs in employees' saving funds, and 1,527,678.99 in life and retirement funds of employees. There is a fund of 1,315,668.49 francs for emergencies; 822,602.04 francs for fire and maritime insurance; 1,000,000 francs of special reserve, and 1,585,000 francs of an emergency fund created in 1887.

Another company, the Société Anonyme Métallurgique de Prayon produced in 1902, 12,716 metric tons of crude zinc, of which 4,754 tons was rolled. The company realized a profit of 864,018.52 francs after deducting general expenses. The company paid dividends of 275,000 francs on its capital of 2,000,000 francs, the bonded indebtedness being 800,000 francs at 4½ per cent. During the year the company erected two additional trains of rolls, to double the output of sheet zinc.

ALUMINUM AND BAUXITE.

By Joseph Struthers.

ALUMINUM.

PRODUCTION.

The production of aluminum in the United States during 1902 was approximately 7,300,000 pounds, as compared with 7,150,000 pounds in 1901, an increase of 150,000 pounds. The Pittsburg Reduction Company, operating the Hall patents, continues to be the sole producer of aluminum in the United States, and, although the company is in patent litigation with the Cowles Electric Smelting and Aluminum Company, of Cleveland, its plants are being developed vigorously. It has in operation 11,000 horsepower at Niagara Falls, N. Y., and 5,000 horsepower at Shawinigan Falls, Quebec, Canada (the Royal Aluminum Company), a total of 16,000 horsepower, which is equivalent to a capacity of 4,500 tons of metal yearly, or more than the output of the rest of the world. In addition, the Pittsburg company has purchased a large tract at Massena, N. Y., and is installing a large plant on the St. Lawrence River, which will consist of four 300-horsepower sets generating 1,500 volts. The increased activity on the part of the company has been due to the fact that some of its fundamental patents will expire within a few years, and it is striving to perfect the methods employed to such an extent that after the expiration of the patents it will be in position to compete successfully with new producers that may enter the field.

Although the demand for aluminum has increased from the more extended use of the metal for the manufacture of electrical conductors and special alloys, the price per pound has continued practically stationary throughout the years 1901 and 1902, as is detailed in the subjoined table:

Prices of aluminum and its alloys during 1901 and 1902.

	Small lots.	100-pound lots.	1,000-pound lots.	2,000-pound lots.
	Cents.	*Cents.*	*Cents.*	*Cents.*
No. 1 (aluminum, 99.75 per cent)	37	35	34	33
No. 2 (aluminum, 90 per cent)	34	33	32	31
Nickel-aluminum casting metal (10 per cent nickel)	39	35	34	33
Special casting alloy (80 per cent aluminum)	35	30	29	27

An international agreement between all of the aluminum producers has been drawn up and the price of ingot aluminum fixed for 1903. The following table shows the production of aluminum in the United States for each year since the inception of the industry in 1883:

Production of aluminum in the United States, 1883–1902.

Year.	Quantity.	Year.	Quantity.
	Pounds.		*Pounds.*
1883	83	1894	550,000
1884	150	1895	920,000
1885	283	1896	1,300,000
1886	3,000	1897	4,000,000
1887	18,000	1898	5,200,000
1888	19,000	1899	6,500,000
1889	47,468	1900	7,150,000
1890	61,281	1901	7,150,000
1891	150,000	1902	7,300,000
1892	259,885	Total	40,962,779
1893	333,629		

There are in the world at the present time five companies that produce aluminum at plants at nine locations, the details of their equipment being given in the subjoined table:

Aluminum works in Europe and America, 1902.

Name of company.	Locality of works.	Horsepower. Available.	Horsepower. In use.[a]	Process.	Capital.
The Pittsburg Reduction Co.	Niagara Falls		11,000	Hall	$1,600.00
Do	do			do	
Do. (Royal Aluminum Co.)	Shawinigan Falls	6,000	5,000	do	
The British Aluminium Co.	Foyers	14,000	5,000	Heroult	3,360,000
Société Electro-Metallurgique Française.	Le Praz	12,500	5,000	do	2,880,000
Compagnie des Produits Chimiques d'Alais.	St. Michel	6,000	2,000	Hall & Minet	
Société Anonyme pour l'Industrie de l'Aluminium.	Neuhausen	4,000	4,000	Heroult	3,077,000
Do	Rheinfelden	5,000	5,000	do	
Do	Lend Gastein	5,000	(?)	do	

[a] With the exception of the American and Canadian works, all these works manufacture other products in addition to aluminum.

For several years past the various companies have continued their secretive policy concerning the development of the industry, and practically nothing has been published in regard to modern improvements beyond the descriptions of patents, which have been granted mainly for the purification of bauxite—the chief raw material used in the manufacture of the metal.

Aluminum is used mainly for the transmission of electric currents, although a large proportion of the output is manufactured into articles for domestic and culinary use. It is also utilized for the construction of parts of machines and apparatus which require lightness rather than great strength, and in the manufacture of special alloys. Two other uses of growing importance are for lithographic work, the metal being used as a substitute for stone and zinc, and for the production of intense heat by the combustion of the metal in powder.

The use of aluminum as a substitute for uncovered overhead transmission lines is still expanding in the United States, and is one of the most important outlets for the metal produced here. Despite the severe criticism of this use of the light metal, chiefly on account of corrosion, a number of electric light and railway companies have purchased very large quantities for transmission purposes. Corrosion seems more vigorously to attack drawn wires than rods, and a "weatherproof wire," coated with a preparation that forms an impervious cover, is now manufactured.

Another use of aluminum is for the manufacture of special alloys possessing exceptional physical and chemical properties. Apart from those alloys, which contain a small proportion of aluminum with other metal or metals, as, for instance, aluminum bronze, the principal metals forming useful binary alloys with aluminum are magnesium, tungsten, and zinc. Other metals forming useful ternary alloys with aluminum are copper, nickel, and zinc. A few of these alloys, with their trade names and approximate composition, are as follows:

(1) *Magnalium*—Alloys containing aluminum and magnesium, of which there are two distinct products, in the definite chemical proportions of $AlMg_2$ and $AlMg$. Alloys of this class containing from 2 to 10 per cent of magnesium are found to be the most valuable on account of their ductility and malleability.

(2) *Wolframinium*—Alloys containing aluminum and tungsten. There are three distinct products of this class, containing the two metals in the respective proportions of AlW, Al_3W, and Al_4W. An important alloy of this kind is known as *partinium*, which is reported to have a tensile strength exceeding 49,000 pounds to the square inch.

(3) *McAdamite*—An alloy of aluminum, zinc, and copper containing approximately Al 72 per cent, Zn 24 per cent, and Cu 4 per cent. This is said to possess a tensile strength of more than 44,000 pounds to the square inch.

(4) *Aluminum-silver*—An alloy containing approximately Cu 57 per cent, Ni 20 per cent, Zn 20 per cent, and Al 3 per cent. Other alloys of this class are *nickel-aluminum*, having a tensile strength of more than 35,000 pounds to the square inch, and *minckin*, an alloy that contains a larger proportion of nickel than aluminum-silver and is used mainly on account of its resistance to the corrosive action of weak acids and alkali.

(5) *Albradium*—An alloy of copper, nickel, zinc, phosphorus, and aluminum.

(6) *Aluminum-zinc*—Alloys containing various proportions of the two metals, of which the hardest and strongest is that formed of two parts of aluminum to one of zinc, although the alloy with three parts of aluminum to one of zinc is the one most generally used. An alloy of Zn 95 per cent and Al 5 per cent has a special use in the construction of minor parts of machines where very little strength is required.

In lithographic work the use of aluminum as a substitute for stone and zinc is rapidly extending, and many so-called rotary aluminum presses are in operation.

Another use of growing importance is for the production of intense heat by the combustion of powdered aluminum. There are two methods, one, the Goldschmidt process, used for the welding of tramway rails, and the other for the reduction of rare metals from their oxides, the necessary heat being supplied by the oxidation of the powdered aluminum, which is intermixed with the oxides to be reduced.

Very recently a new explosive called *ammonal* has been invented, which consists of 25 per cent of powdered aluminum and 75 per cent of ammonium nitrate.

A new use of aluminum is for the manufacture of grindstones and whetstones, a purpose for which the metal is peculiarly suited on account of the property it possesses of forming under the whetting action a very fine mass which adheres strongly to steel. A microscopic examination at 1,000 diameters of a steel blade which had been sharpened on aluminum showed the cutting edge to be perfectly uniform and unbroken, which is not the case when steel is whetted on stone.

IMPORTS.

In the first table below are given the quantities and values of the aluminum imported into the United States from 1870 to 1890, and in the second table are given the quantities and values of crude and manufactured aluminum imported from 1891 to 1902.

Aluminum imported and entered for consumption in the United States, 1870–1890.

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—	*Pounds.*		June 30—	*Pounds.*	
1870		$98	1881	517.10	$6,071
1871		341	1882	556.50	6,450
1872			1883	426.25	5,070
1873	2.00	2	1884	595.00	8,416
1874	683.00	2,125	1885	439.00	4,736
1875	434.00	1,355	Dec. 31—		
1876	139.00	1,412	1886	452.10	5,369
1877	131.00	1,551	1887	1,260.00	12,119
1878	251.00	2,978	1888	1,348.53	14,086
1879	284.44	3,423	1889	998.00	4,840
1880	340.75	4,042	1890	2,051.00	7,062

Imports of crude and manufactured aluminum, 1891–1902.

Calendar year.	Crude.		Leaf.		Plates, sheets, bars, and rods.		Manufactures.	Total value.
	Quantity.	Value.	Packs of 100.	Value.	Quantity.	Value.		
	Pounds.				*Pounds.*			
1891	3,922	$6,266	10,033	$1,135	....	....	$1,161	$8,562
1892	43	51	11,540	1,202	....	....	1,036	2,289
1893	7,816	4,683	18,700	1,903	....	....	1,679	8,265
1894	5,306	2,514	10,780	1,210	....	....	386	4,110
1895	25,294	7,814	6,610	646	....	....	1,841	10,301
1896	698	591	4,657	523	....	....	2,365	3,479
1897	1,822	1,082	4,260	368	4,424	$3,058	221	4,729
1898	60	30	2,000	174	18,442	8,991	4,675	13,870
1899	53,622	9,425	693	112	4,254	2,413	5,303	17,253
1900	256,559	44,455	1,103	102	4,264	2,776	3,111	50,444
1901	564,803	104,168	....	....	7,764	5,319	261	109,748
1902	745,217	215,032	210	32	4,652	2,548	1,239	218,851

The import duty on aluminum in the United States is 8 cents per pound for ingot metal and 13 cents per sheet or manufactured metal.

WORLD'S PRODUCTION.

The following table shows the world's production of aluminum in 1900 and 1901:

World's production of aluminum in 1900 and 1901.

Country.	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*	
United States	3,244	$2,238,000	3,244	$2,238,000
France	1,026	525,600	1,200	560,000
United Kingdom	569	364,000	560	....
Switzerland	2,500	1,225,000	2,500	1,225,000
Total	7,339	4,352,600	7,504	....

BAUXITE.

PRODUCTION.

During the year 1902 the production of bauxite amounted to 29,222 long tons, valued at $128,206 at the mines, as compared with 18,905 tons, valued at $79,914, during the preceding year. Georgia yielded the greater bulk of the product, the remainder being supplied by Alabama and Arkansas.

The mining plant of the Pittsburg Reduction Company at Bauxite, Ark., was not quite completed at the close of the year 1902. The equipment for the treatment of the crude mineral consists of a wood-fired cylindrical dryer and a 60-foot rotary calciner fired by producer gas made in a 10 by 12 foot Duffs water-sealed producer; a second calciner also is being installed. A large proportion of the ground ore is calcined directly, although a small quantity is previously dried. The plant is designed with special reference to the mechanical handling of the materials, and elevators, conveyors, and cars replace hand labor to a great extent. The bauxite industry in Arkansas is still in an undeveloped state, and the exploration work that has been done at Bauxite is not sufficient to determine accurately the depth or quantity of ore in that region nor the character of the underlying stratum. The new plant will probably be in operation early in 1903, and it promises to contribute largely to the output of bauxite from Arkansas. The new refining plant of the Pittsburg Reduction Company at East St. Louis is nearing completion, and will probably become operative in the early part of 1903.

The subjoined table gives the production and value of bauxite for each year since 1889:

Production of bauxite in the United States, 1889–1902, by States.

Calendar year.	Georgia.	Alabama.	Arkansas.	Total.	Value.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	
1889	728			728	$2,366
1890	1,844			1,844	6,012
1891	3,301	292		3,593	11,675
1892	5,110	5,408		10,518	34,183
1893	2,415	6,764		9,179	29,507
1894	2,050	9,016		11,066	35,818
1895	3,756	13,313		17,069	44,000
1896	7,313	11,051		18,364	47,338
1897	7,507	13,083		20,590	57,652
1898				25,149	75,437
1899	15,736	14,499	5,045	35,280	125,598
1900	19,739		3,445	23,184	89,676
1901	18,038		867	18,905	79,914
1902	24,577		4,645	29,222	128,206

The figures showing the output and value of the production of bauxite during 1902 have been received direct from the individual producers, and have also been confirmed by Mr. William G. Neilson, of the Republic Mining and Milling Company.

Bauxite is used mainly for the manufacture of aluminum, although a considerable quantity is used for the manufacture of aluminum sulphate and crystalized alum.

CONSUMPTION.

In order to show the annual consumption of bauxite and its value in the United States during the last five years, the following table has been compiled, which includes the total production, imports, exports, and consumption, with the value of each:

Production, imports, exports, and consumption of bauxite in the United States, 1898–1902.

Year.	Total production.		Imports.		Exports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
1898	25,149	$75,437	1,201	$4,238	1,000	$2,000	25,350	$77,675
1899	35,280	125,598	6,666	23,768	2,030	4,567	39,916	144,799
1900	23,184	89,676	8,656	32,967	1,000	3,000	30,840	119,643
1901	18,905	79,914	18,313	67,107	1,000	3,000	36,218	144,021
1902	27,322	121,465	15,790	54,410	*Nil.*	....	43,112	175,875

The increased importation of bauxite during 1901 and 1902, as compared with the quantities annually imported prior to these years, was due mainly to the low ocean freight rates from foreign ports. Practically the entire quantity of bauxite imported was derived from the south of France at an average ocean rate to New York, Philadelphia, or Baltimore of $2.25 per ton, which, with the duty on bauxite of $1 per ton, allowed the ore to be laid down at a cost at the mine of $3.25 per ton. This cost, contrasted with the freight rates from Georgia or Alabama of $3.85 per ton to Philadelphia and $5 or more per ton to Boston, shows that the French ore can be delivered to seaport cities more cheaply than the domestic ore. The high percentage of iron in the French bauxite precludes its use for the manufacture of aluminum sulphate. It is consumed mainly for making aluminum hydrate, which is used in the manufacture of metallic aluminum.

WORLD'S PRODUCTION.

The following table shows the world's production of bauxite in 1900 and 1901:

World's production of bauxite in 1900 and 1901.

Country.	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*	
United States	23,556	$89,676	19,207	$79,914
France	58,530	92,596	76,620	124,168
United Kingdom	5,873	6,750	10,357	14,515
Total	87,959	189,022	106,184	218,597

ALUMINUM SALTS.

The principal salts of aluminum are aluminum sulphate and crystallized alum, for the manufacture of which bauxite and Greenland cryolite are consumed. The Pennsylvania Salt Company possesses the exclusive privilege of importing cryolite into North and South America. In 1902 the production of aluminum sulphate was 84,075 short tons, valued at $1,938,671, as compared with 74,721 short tons in 1901, and that of crystallized alum, 8,539 short tons, valued at $229,500, as compared with 7,755 short tons in 1901. The companies producing one or both of these salts during 1902, in the order of output, are: The General Chemical Company, the Pennsylvania Salt Company, Harrison Brothers, the Cochrane Chemical Company, Charles Lennig & Co., the Erie Chemical Company, the Detroit Chemical Company, and the Merrimac Chemical Company. In addition to the above list, the following companies will probably be producers during 1903: F. E. Atteaux & Co., Superior Chemical Company, and the Jarecki Chemical Company.

The production and imports of alum and aluminum sulphate into the United States from 1898 to 1902, inclusive, are given in the subjoined table:

Production and imports of alum and aluminum sulphate into the United States, 1898–1902.

Year.	Production.						Imports.[a]		
	Alum.			Aluminum sulphate.					
	Short tons.	Value.	Per ton.	Short tons.	Value.	Per ton.	Short tons.	Value.	Per ton.
1898	18,791	$563,730	$30.00	56,663	$1,416,675	$25.00	[b]893	$16,187	$18.13
1899	27,276	845,556	31.00	81,805	2,106,479	25.75	[b]858	14,953	17.49
1900	20,531	615,930	30.00	61,678	1,480,272	24.00	[b]1,169	22,283	19.07
1901	7,775	233,250	30.00	74,721	1,793,304	24.00	[b]1,091	20,781	19.05
1902	8,539	299,500	27.00	80,075	1,938,671	24.25	[b]928	16,808	18.11

[a]Includes alumina, alum, alum cake, aluminum sulphate, aluminous cake, and alum in crystals or ground.

[b]There was also imported in 1898, 1,205 short tons ($76,884) of aluminum hydrate, or refined bauxite; in 1899, 1,926 short tons ($119,202); in 1900, 2,207 short tons ($148,832); in 1901, 1,986 short tons ($146,462); and in 1902, 339 short tons ($21,235).

PLATINUM.

By Joseph Struthers.

PRODUCTION.

The production of platinum in the world ranges annually between 160,000 and 170,000 troy ounces, about 90 per cent of the total output being obtained from Russia and the remainder coming mainly from Colombia, South America. Unfortunately in the latter country the revolutions prevalent in recent years have seriously hindered the development of this important industry.

The production of platinum from domestic ores in the United States during 1902 was 94 ounces, valued at $1,814, as compared with 1,408 ounces, valued at $27,526 in 1901, a notable decrease, although but slightly less than the output in 1894. The total annual production of platinum from domestic ores is a small portion only of the total domestic consumption. The production during 1901 was the largest annual output on record since statistics of platinum produced from domestic ores were first compiled in 1880. The next largest output was in 1890, when 600 ounces, valued at $2,500, were produced.

In connection with the production of platinum from domestic ores during 1902 there were obtained also 20 fine ounces of iridium, as compared with 253 ounces in 1901. Iridium is so closely allied to platinum in its physical and chemical properties that doubtless it has formed from 15 to 25 per cent of the platinum production reported in early years.

The domestic supply of platinum in recent years has been obtained as a secondary product chiefly from gold placer deposits in Trinity and Shasta counties, Cal. The occurrence of the metal has been reported in many other gold placers of California, as well as in Washington, Oregon, Idaho, Montana, Colorado, and Alaska; the deposits have not been sufficiently rich, however, to place the extraction of the metal on a profitable basis. There have been very few new reports of discoveries of platinum during the year, among them being the occurrence of the metal in the auriferous sands of the Corozal River, Porto Rico. The Rambler mine, near Encampment, Albany County, Wyo., continues to attract attention, and one or two other mines in that region claim to have covellite (CuS, copper monosulphide) carrying sperrylite ($PtAs_2$, platinum diarsenide) in the ore. Nothing has been done to extract the metal on a commercial scale. A second district of interest is at Kerby, near Grants Pass, Josephine County, Oreg., where the Waratah Minerals Company operated a concentrator for the treatment of platinum ores. A considerable quantity of the metal was collected during the year, but was not put on the market. Samples of earth from the region of the Grand Canyon of the Colorado, supposed to contain platinum, were examined by Dr. David T. Day. The material contained white pyrite, which has the appearance of platinum, but no platinum whatever was found on analysis. The reported occurrence of platinum in commercial quantities on an island in the Lake of the Woods, 12 miles from Rat Portage, has not been verified. Efforts have been made recently to extract the metal from the nickel-copper ores of the Sudbury district, Ontario, Canada. So far, the experiments have not been reported as successful. It is within the range of probability that platinum associated with chromite will be found in place in the basic magnesium rocks of California and Oregon as well as in peridotite, the basic magnesium rock of North Carolina, Georgia, Pennsylvania, and Maryland, which frequently contains chromite. An interesting occurrence of platinum is noted by Prof. James F. Kemp[a] in the ash of Australian coal of the following analysis:

Analysis of the ash of Australian coal.

	Per cent.
Carbon	65.2
Hydrogen	4.6
Oxygen	21.8
Nitrogen	1.9
Sulphur	3.8
Water	.7
Ash	1.7
Total	99.7

The ash contains 25.1 per cent vanadium and 3.6 per cent platinum metals, which makes the coal the richest platinum ore yet discovered.

The following table gives the production of crude platinum in the United States from 1880 to 1900, and of refined metal from domestic ores during 1901 and 1902, which shows the extremely small proportion of the domestic consumption supplied from domestic sources:

[a] Bull. U. S. Geol. Survey No. 193, 1902, p. 35.

Production of crude platinum in the United States, 1880 to 1900, and of refined metal from domestic ores in 1901–2.

Year.	Quantity.	Value.[a]	Year.	Quantity.	Value.[a]
	Ounces.			*Ounces.*	
1880	100	$400	1892	80	$550
1881	100	400	1893	75	517
1882	200	600	1894	100	600
1883	200	600	1895	150	900
1884	150	450	1896	163	944
1885	250	187	1897	150	900
1886	50	100	1898	225	3,375
1887	448	1,838	1899	300	1,800
1888	500	2,000	1900	400	2,500
1889	500	2,000	1901	1,408	27,526
1890	600	2,500	1902	94	1,874
1891	100	500			

[a] The chief variations in price have been due to the quality of the crude grains. In 1901 and 1902, however, the average price for the refined metal has been given.

Prof. James F. Kemp has prepared a very interesting and valuable report on The Geological Relations and Distribution of Platinum and Associated Metals.[a] The platinum deposits are classified into three types: (1) Placers, as exemplified by those in the Urals, Colombia, Brazil, and British Columbia. (2) Veins, as at Tilkerode in the Hartz; Minas Geraes, Brazil; Santa Rosa, California; Beresovsk, Russia; Gualdalcanal, Spain (with tetrahedrite and bournonite); and Rambler mine, Wyoming (sperrylite—platinum diarsenide—with covellite). (3) Disseminated in eruptive rocks, in two ways: (*a*) Sperrylite, with the copper-nickel ores in uralitized norite, Sudbury, Canada, and (*b*) the native metal in basic eruptive rocks, especially peridotites, frequently intimately associated with chromite.

The conclusions of practical value arrived at by Professor Kemp are: 1. That platinum is very sparsely distributed in the mother rock so that the chances of finding it in quantity sufficient to mine are small; also, if found, the recovery of the platinum other than by stamping and washing is yet to be solved; furthermore, the metal may be in a very finely disseminated state, and its extraction will necessarily be difficult. 2. Large and permanent placers may be sought only on very old land areas which have been subjected to protracted degradation and concentration. 3. In the assay of antimonial, arsenical, and other copper ores (especially tetrahedrite) it is advisable to search for small percentages of platinum. 4. Deposits of chromite should be tested for the presence of the metal.

The discovery of a use for osmium, which occurs to a considerable extent in the American platinum as the mineral osmiridium, will greatly benefit the platinum industry of the United States, as in the

[a] Bull. U. S. Geol. Survey No. 193.

past this element has interfered most seriously with the sale of the crude platinum product. The demand for osmium for the new Auer and Nernst incandescent electric lights makes it almost as desirable as platinum.

IMPORTS.

The imports of platinum during 1902 were valued at $1,987,980, distributed as follows: Unmanufactured, 632 pounds ($171,967); ingots, bars, sheets, and wire, 6,713 pounds ($1,778,395); vases, retorts, and other apparatus, vessels and parts thereof for chemical uses ($34,913); manufactures of, not specially provided for ($2,705). The imports during 1901 were valued at $1,695,895, distributed as follows: Manufactured, and ingots, bars, sheets, and wire, 6,226 pounds ($1,673,926); vases, retorts, etc. ($21,969).

PRICES.

The uses of the metal would be greatly increased if it could be obtained in sufficiently large quantity to lower the price. Unfortunately, for many purposes there is no metal to take its place, and the limited supply maintains the price almost equal to that of gold. The attempts that have been so far made to replace platinum by other metals or alloys have been ineffectual; the demand for it has continued to increase; and as a result the price has steadily risen. During 1901, until May 15, the price in New York was $18.20 per ounce for ingot platinum, rising to $20 and $21 later in the year. In January, 1902, the price continued at $20 to $21, but fell in February to $19.50, and in June to $19, a figure which prevailed to the close of the year. Best hammered platinum was quoted as follows: January, 1902, 82 cents per gram; June, 76 cents; July, 74 cents; August, 73.5 cents; and December, 72.5 cents. Osmiridium is quoted at from $6 to $10 per ounce.

Practically the price of platinum is determined by Johnson, Matthey & Co., of London, who refine a large proportion of the Russian output. There are two platinum refineries at St. Petersburg, where a part of the domestic product is treated; the greater bulk, however, is exported in the crude state. In Russia crude platinum is sold at from $3,090 to $3,605 per pood (1 pood equals 36 pounds); 1.25 poods of concentrates yields 1 pood of refined metal, valued at from $8,240 to $9,270; the cost of refining is $154.50 per pood. The accompanying metals—iridium, palladium, and osmium—are also recovered. In the period from 1884 to 1897, 1,833 poods of platinum costing 29,748,953 francs were exported to the United States and sold for 42,472,276 francs, the net profit being 42.7 per cent. The recently formed Franco-Russian Platinum Industry Company, which was organized to free the Russian industry from the control of foreign smelters, did not accomplish its aim, although its efforts resulted in raising the price to be paid by the refiner for the concentrates to $8,240 per pood.

PLATINUM IN RUSSIA.

The Russian sources of platinum supply, which furnish at least 90 per cent of the total consumption of the world, are comparatively limited. The platinum-bearing areas extend along the eastern watershed of the Ural Mountains in Eastern Perm and along the western watershed farther south. Until within a few years the greater part of the Russian output was derived from the district of Nijni-Tagilsk; but at present it is obtained in the Goroblagodat and Bisersk districts, 130 miles to the north. The platinum occurs chiefly in the sands of the Tura, Tagil, Salda, Lala, and Loswe rivers on the boundaries of the district of Goroblagodat, as well as on the property of Count Schuwalow and on that controlled by the manufacturing works of Bogoslovsk and Demidow. The richness of the ore varies from a few milligrams to from 10 and 13 grams per ton. The depth of the platinum sands is about 1 meter, and the depth of the overlying turf is usually from 2 to 3 meters, although in some cases it is from 10 to 14 meters. Generally the platinum grains are small, but an occasional lump is found. Apart from the occurrence of the metal in sands, it is found in slight quantities in native gold. Recently a discovery of platinum in place was made on the Martian River in the Nijni-Tagilsk circle, where the metal is found in peridotite, diallage, and in serpentine. It has also been reported in the gold sands of Birussia.

PLATINUM IN THE RAMBLER MINE, WYOMING.

By J. F. Kemp.

Great interest was excited in December, 1901, upon the announcement by Prof. W. C. Knight,[a] of the University of Wyoming, that the platinum group of metals had been detected in the copper ores of the Rambler mine, Wyoming. The further announcement two months later by Professors Wells and Penfield,[b] of Yale University, that they had found in the ore and had separated from it sperrylite (platinum diarsenide), drew additional attention from scientific men to this unique occurrence. In consequence, the writer was requested by Dr. David T. Day to visit the locality and to prepare the following brief description of its geologic relations:

GEOLOGY OF THE RAMBLER MINE.

SITUATION.

The Rambler mine is an old discovery which has been developed on a serious scale only within the last two years. It is situated in the Medicine Bow Range, Wyoming, near the headwaters of Douglas Creek, a tributary of the North Platte River. It is reached by stage which runs from Laramie, at first due west for about 30 miles across the open plateau, then turns southward around the shoulder of Sheep Mountain and follows up the Little Laramie River to the divide at the head of one of its tributaries, crosses this divide and reaches the sources of Douglas Creek. The mine is about 10 miles north of the Colorado line, and is located in the SW. ¼, sec. 33, T. 15 N., R. 79 W. The total distance from Laramie is about 45 miles, and the altitude is believed to be about 8,500 feet above tide.

TOPOGRAPHY.

In the vicinity of the mine the topography is rolling and gentle. Mountain meadows, at times of considerable width, are traversed by brooks, while on the gentle slopes of the hills spruces flourish and afford the usual woodlands of the higher ranges. The roads are laid out through these forests. Down Douglas Creek, at a distance of 2

[a] Eng. and Min. Jour., December 28, 1901.

[b] Am. Jour. Sci., 4th series, vol. 13, 1902, p. 95.

or 3 miles from the Rambler, the meadows cease, and the creek traverses a deep rocky gorge with precipitous cliffs. Almost the entire surface is covered by a capping of the products of weathering in the form of the so-called "wash." Only rarely are natural outcrops

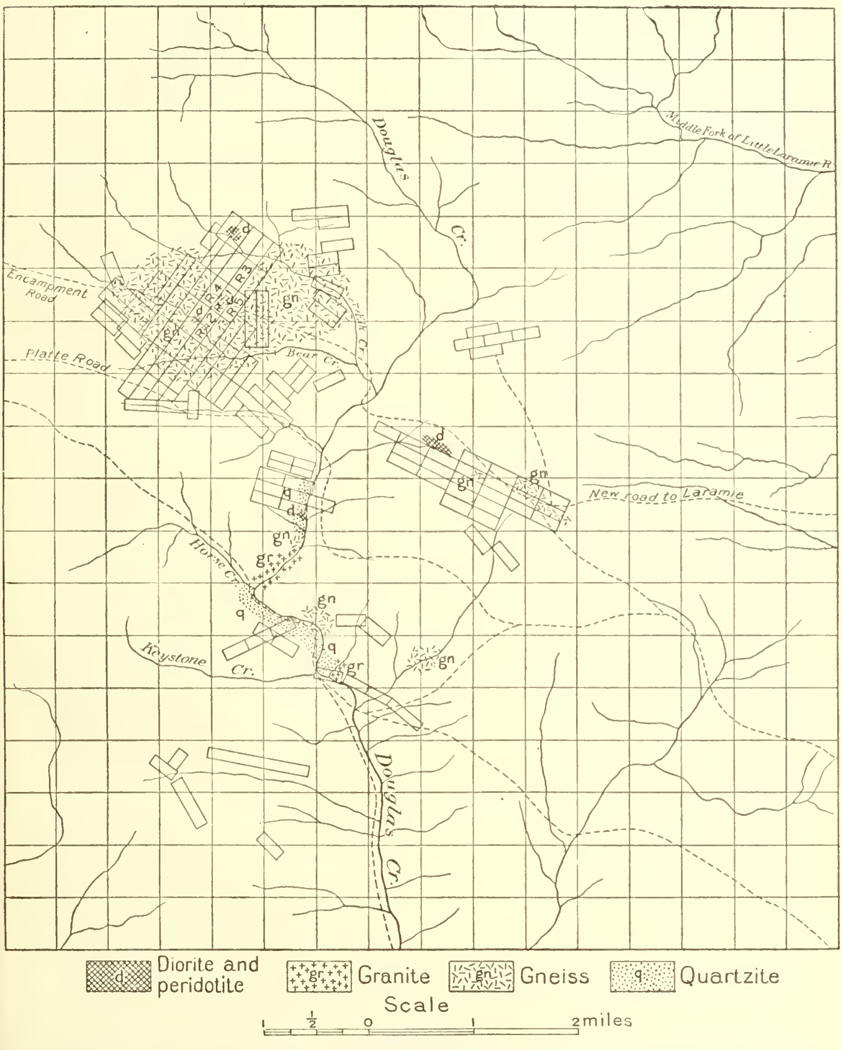


FIG. 1.—Map of the Rambler mining district, Wyoming. R1, R2, R3, R4, and R5 mean Rambler claims 1, 2, 3, 4, and 5. The mine is on R1.

of the country rock to be met. The extensive prospecting has, however, quite frequently cleared away the loose materials down to the bed rock, and, as the accompanying map shows, has served to reveal the essential rock formations which are present.

GEOLOGY.

Systematic observation in the area about the mine soon served to show that the commonest country rock in its immediate vicinity is a gneiss of the general mineralogy of granite. Its distribution and that of the other local formations are shown on the map, fig. 1. The gneiss is somewhat poorly foliated and is very badly broken by irregular sets of joints, which divide it into small angular fragments on the outcrops and in the prospects. Under the microscope, the rock exhibits in a still more pronounced way the effects of granulation. Central nuclei of the constituent minerals are surrounded by mosaics of fine grains.

Only rarely can a definite strike be obtained. Making a correction of 15° for the eastward declination of the needle, the following two cases were recorded: About 1 mile north of east from the Rambler, strike N. 70° W.; 4 miles farther, strike N. 62° E., dip 58° W. In the quartzite on Douglas Creek below the Douglas mine the strike is N. 35° W., dip 20° W. The strikes are therefore variable. Joints were recorded bearing N. 30° W. and N. 38°–40° W., respectively, a mile east and west from the Rambler. With the latter there was a minor set striking N. 60° E. In other respects the joints were too irregular to be considered of much significance. It is worthy of remark, however, that, so far as the streams appear on the map, they approximately follow one or the other of these directions.

Besides the gneisses which are so extensively developed near the Rambler mine, there are quartzites visible along Douglas Creek, near the Douglas mine. Likewise farther down, at the Keystone mine, there is more quartzite, forming the walls of the vein. Along the creek there is much gneiss and some eruptive granite, and east of the Keystone more granite appears again.

In addition to the above varieties of rock and of more immediate importance in connection with the Rambler mine, there are in several places large dikes of dark and relatively basic rocks, which are in great contrast with those already mentioned. The Rambler ore occurs in the outcrop of one of these dikes, and there is another along Douglas Creek, south of the Douglas mine, and one other northwest of the Cuprite claim. Though only exposed in a limited way, except in the second case, it will be assumed that these rocks constitute dikes of considerable size, and under this name they will be nore particularly described.

THE RAMBLER DIKE.

The Rambler dike is a dark, granitoid rock where revealed in the mine. It is a typical diorite in mineralogy. It consists of green hornblende as the chief component, with which is associated some brown biotite. The hornblende contains many little inclusions of poikilitic quartz. Plagioclase is present in considerable abundance and from its extinction angles appears to belong in the labradorite or bytownite series. Apatite is likewise present in the usual relations, and pyrites and magnetite in more than the normal quantity. The last two appear in the perfectly fresh rock, so far as one may judge from the slides, and with no such evidence of alteration in the associated minerals as one would anticipate, if the sulphides were of later infiltration. The small metallic minerals especially appear in the dark silicates; they fail in the feldspars.

All around the Rambler shaft the surface is formed of loose wash. To the southwest, however, in the claims known as Rambler No. 2 and Alberta No. 1, dark basic rock is again encountered. The rock from Rambler No. 2 proves on microscopic examination to be a hornblende-peridotite of the marked poikilitic texture shown in the similar rocks of the Cortland series in the valley of the Hudson. The rock consists of green hornblende, olivine, and hypersthene, but the first and last are so thickly set with small augites as to be essentially large skeleton crystals provided with inclusions almost greater in amount than the host itself. The rock may not belong to the same dike as the diorite appearing in the Rambler mine, but it probably is a basic extension of it.

For nearly a mile to the north of the Rambler mine the bed rock is concealed by wash. On the north side, however, of a small brook and on the claims named Tinker No. 3 and No. 4, the dark basic rock appears again in a cliff which is roughly parallel with the brook. In thin section it reveals green, secondary hornblende, plagioclase, and magnetite, and it is obviously a crushed gabbro or diorite. Heavy wash covers the country farther to the north, and no explorations were made in that direction.

It is impossible to say that the outcrops on the Tinker claims belong to the same intrusion as do the basic rocks at the Rambler claims, but it does appear that along a north-south belt from the Rambler No. 2 to the Tinker No. 4 the basic rock is met, and not elsewhere in this vicinity.

Somewhat over 2 miles to the southeast from the Rambler mine, and on a claim lying northwest from the Cuprite, there is another ledge of dark, basic rock, which appears, to the eye alone, to be the same as the peridotite on the Rambler No. 2 claim. It has not been examined microscopically.

The dike on Douglas Creek, just below the Douglas mine, shows about 30 feet of actual outcrop, and is then cut off by quartzite. Under the microscope it proves to be a diorite, with green hornblende, plagioclase, and magnetite. The hornblende is secondary and may have been derived from original augite.

The above sketch of the geologic relations, fragmentary though it be, and based on scattered outcrops, nevertheless correctly gives what are doubtless the main features of the local geology. An ancient series of much crushed, granitic gneisses is associated with assured quartzites, and both are penetrated by intrusions of granite, diorite, and peridotite. The ore which has thus far been discovered is in the area of a typical diorite, and does not appear outside of it. It remains to describe the local associations of the ore, which are peculiar and of great scientific interest.

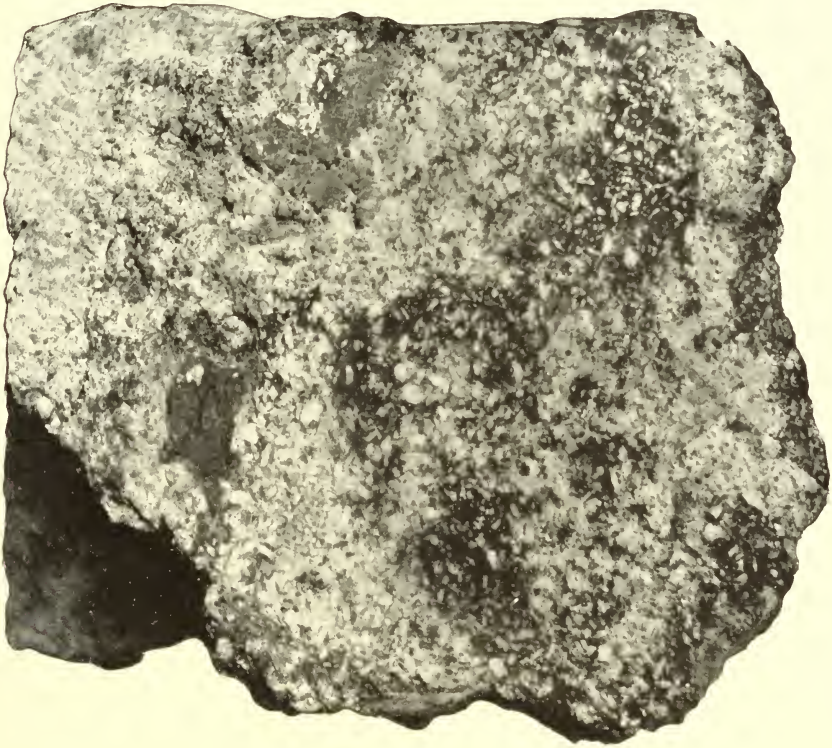
DETAILS OF THE ORE BODY.

The mine was first developed by a short shaft about 88 feet west of the present one. The old shaft went down vertically about 30 feet, and then by incline eastward at an angle of 47° to an additional vertical depth of about 68 feet. It grounded at 98 feet from the surface. At a total depth from the surface of about 67 feet the incline struck rich ore. A level, called the first level, was run off to the south, and by it was developed a large bunch of so-called carbonate ore nearly 40 feet in diameter and doming upward to 30 to 35 feet. At this 67-foot level some minor drifting was done to the north and west in lean ore. The material through which the drifts and stopes were driven is kaolinized rock, much of it soft and plastic.

The new vertical shaft has been sunk in the wall rock at a point 88 feet almost due east of the old shaft. The first level from it, but really the second level of the mine, counting the level driven from the incline at the 67-foot point as the first level, was started at the same depth as the bottom of the incline, viz, 98 feet. This was driven westward about 30 feet, until it intersected the incline. A crosscut was then turned south for 15 feet, all through kaolinized materials, opening up within 12 or 15 feet a large stope of good ore. It was in part under the carbonate stope, but was not cut through to the latter. Its height was about 25 feet, and it developed in the kaolinized materials a large pocket of ore, whose horizontal dimensions were 30 feet north and south by 50 feet east and west.

From this stope a drift extends about 40 feet to the west, and then turns north through kaolinized materials, developing within 15 feet of the turn another large pocket of rich ore. It has been stoped out about 40 feet in length from north to south, by 25 feet in height and 12 to 20 feet in width. At the time of the writer's visit the kaolinized products, with one rich streak of covellite, formed the walls on all sides.

The third level of the mine has been turned off from the vertical shaft at a depth of 136 feet from the surface and 38 feet below the second level just described. It runs northwest for about 10 feet; then due west for about 55 feet. At 15 or 20 feet from the bend a cross-



POLISHED SPECIMEN OF COPPER ORE FROM THE RAMBLER MINE, WYOMING.

The dark mineral is covellite; the light, kaolinized feldspar.

cut has been turned north about 30 feet and another south about 20 feet. About 18 feet farther a second crosscut has been turned a little west of south and driven 30 feet. Its end was under the first stope mentioned on the second level, and a winze has been upraised to the latter.

No ore was cut in the third level, the walls being of much jointed and altered diorite. The change to chlorite was marked, and considerable pyrite could sometimes be noted in seams. It is possible, if the level were driven still farther west, with longer crosscuts south, so as to be under the stopes on the level above, that more ore might be found. It would, however, involve less uncertainty to follow the ore of the second level downward with winzes.

The fourth level is being driven from the bottom of the shaft, 177 feet from the surface, and again westward. Its 25 feet or so were all in fresh, unaltered diorite.

This ore body, therefore, presents some interesting and exceptional features. The usual vein minerals of the gangue, such as quartz, calcite, etc., are lacking. Instead we have over an area of nearly a hundred feet east and west and the same distance north and south, and we do not know to what extent beyond, the decomposition products of an eruptive dike in place. Whether a belt of shattering dips away to the west, along which alteration may be followed to still greater depths, is a question. This surmise would occur to an observer, but the proof is not at hand. Although it can not be denied that uprising waters may have served to decompose the rock and impregnate it with ore, it would seem more likely that a great dike of diorite originally charged with sulphides of copper and iron and with minerals involving the platinum group of metals has suffered from atmospheric weathering. The presence of the sulphides has facilitated its extensive alteration, and the secondary minerals thus formed have descended and become precipitated so as to impregnate and enrich the residual kaolins. A line of shattering and consequent alteration may have facilitated the process.

The presence of the platinum metals in an eruptive and moderately basic dike is thus in accord with experience gained elsewhere. The sperrylite separated by Professor Penfield from the covellite would then be in similar situation and relations to that from the Sudbury nickel-copper mines. From the chalcopyrite of the latter it has been separated by one of the writer's students, Mr. C. W. Dickson, as described in the American Journal of Science.[a]

The texture of much of the ore, as is illustrated in Pl. I, shows that the dark minerals of the diorite have been replaced by covellite, while the feldspar has been changed to some alteration product, whose appearance suggests kaolin. This ore presents the familiar textures

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[a] Am. Jour. Sci., 4th series, vol. 15, 1903, p. 137.

of the diorite, but they have not always been so well preserved. On the contrary, streaked masses of chalcopyrite and chalcocite are occasionally to be seen, and much cellular and open-textured covellite. Opaline silica was obtained in the midst of the kaolin in one stope. Further alteration has developed the blue and green carbonates of copper and the red oxide, and also much limonite.

The chemical changes involved in the above replacements deserve further investigation, but this the writer has not yet had opportunity to make, and he has entrusted them to C. W. Dickson, Ph. D. The geological relations appear to be equally unique with the occurrence of the platinum metals.

Cordial thanks are due to Mr. Avery T. Holmes, the president of the company, and to Mr. J. T. Halliday, managing director, for every facility in the study of the mine. Acknowledgments should also be made to Mr. Frank Halliday for much assistance in the field work.

NOTE.—Since the above was written Dr. C. W. Dickson has treated, at the writer's request, 1,000 grams of covellite from the Rambler mine with nitric and hydrofluoric acids, after the manner followed by Professor Penfield, in the hope of obtaining an appreciable sample of sperrylite, which in this case no doubt contains palladium. Only three or four minute crystals resulted, apparently not as many as the assay values would lead one to anticipate. The Rambler ore seems to have less of its platinum in this form than does the chalcopyrite of Sudbury, Ontario.

QUICKSILVER.

By Joseph Struthers.

PRODUCTION.

The production of quicksilver in the United States during 1902 amounted to 34,291 flasks of 76½ pounds each, valued at $1,467,848,[a] as compared with 29,727 flasks, valued at $1,382,305, in 1901, an increase in quantity of 4,564 flasks and in value of $85,543. California contributed the greater part of the output, amounting to 28,972 flasks, as compared with 26,720 flasks in 1901. Texas reported 5,319 flasks, as compared with 2,932 flasks in 1901, both States thus showing an increase in the production above that of the preceding year. Oregon, which furnished 75 flasks in 1901, reported no production during 1902, the quicksilver-mining operations in that State being limited to development work.

CALIFORNIA.

Cinnabar, or mercury sulphide (Hg_2S), occurs widely distributed over the entire State of California. At present, however, the deposits of commercial importance lie within the Coast Range and are limited to an area bounded by Trinity County on the north and San Luis Obispo County on the south, both inclusive. During 1902 the mines in San Benito, Napa, and Santa Clara counties contributed nearly 20,000 flasks of the total of 29,199 flasks for the State. The chief producing companies during 1902 were, in the order of their outputs, as follows:

New Idria Quicksilver Mining Company	San Benito County.
The Quicksilver Mining Company	Santa Clara County.
Napa Consolidated Mine	Napa County.
Karl Quicksilver Mining Company	San Luis Obispo County.
Boston Quicksilver Mining Company	Napa County.
Great Western Mine	Lake County.
Empire Consolidated Quicksilver Mining Company	Colusa County.
Great Eastern Quicksilver Mining Company	Sonoma County.

The largest increase among the individual companies in the quantity produced during 1902 was that of the New Idria Quicksilver Mining Company, which reported an output nearly 2,500 flasks greater than that of 1901. In percentage of output the Karl Quicksilver Mining Company, of San Luis Obispo County, stands the highest, its production during 1902 amounting to four times that of the preceding year.

[a] In addition to the quicksilver, there were produced but not treated nor marketed of cinnabar, or crude, in California 10,427 short tons, valued at $67,242, and in Texas 1,300 short tons, valued at $15,000.

Of the eight companies mentioned in the preceding list, three reported a decreased output during 1902, which, however, was more than counterbalanced by the increased production of the remaining five companies, the net gain being almost 5,000 flasks.

Several new mines were added to the list of producers during the year, those of an output of 100 flasks or more being the Helen mine, in Lake County; the Mercury Mining Company, in Sonoma County, and the Silver Creek mine, in Santa Clara County.

Other new companies reported to have begun operations in 1902 are the Monterey Quicksilver Mining Company, near New Idria, San Benito County; the Modoc Chief mine, 18 miles east of Reading, Shasta County; the Mariposa and Elizabeth mines and the Uncle Sam and Eureka quicksilver mines, near Cambria, San Luis Obispo County, and the Summit, Adobe Valley, and Orestimba properties, in Stanislaus County. Deposits of good grade cinnabar ore are reported 25 miles southeast of Cedarville, in Modoc County, which is in the extreme northwest part of the State, an entirely new section for cinnabar. The claims here have not been sufficiently developed to prove the commercial value of the property.

The following detailed review of the progress in quicksilver mining in California during 1902 has been contributed by Mr. William Forstner:

The quicksilver industry in California during 1902 has continued to experience a slight improvement in so far that there appears some desire to reopen a few more of the old mines and that capital, more especially from California, is to some extent invested in these undertakings. The old mines appear to hold their own, some with a steadily increasing output, as, for instance, the New Idria. The price of quicksilver in San Francisco, although not high, has been sufficient to render the operations in most mines profitable.

Calusa County.—Mr. G. V. Northey, at the Manzanite mine, Sulphur Creek, has permanently established the fact that wet concentration is not only feasible, but can be made very profitable.

Lake County.—The Sulphur Bank and Abbott mines, belonging to the Empire Consolidated Quicksilver Mining Company, have suffered from the litigation in which the company has lately been involved. The Great Western mine is continuing its regular output and developing its mine for future working. The Standard Company is still working the Bullion mine, and Mr. A. Rocen is opening the Helen mine, with a fair promise of success.

Napa County.—At the Oathill mines one of the two furnaces has been entirely renovated, and the adjacent Corona and Twin Peak mines both produce quicksilver. In the Ætna mines prospecting work to determine the future of the property is being actively prosecuted. In the Knoxville district, the old Redington mine, now the Boston, has been reopened and is a steady producer; the Manhattan also is steadily operated and producing.

San Benito County.—The New Idria mine has entered upon a new era of prosperity, producing about 160 tons per day and having a great quantity of ore available. In the Cerro Benito mine some work has been done to reopen the old workings, and the old furnace has been rebuilt. In the Picacho mine development work has been done.

San Luis Obispo County.—Considerable activity is shown in this county. The Karl mine is a steady producer, and the Oceanic, where the new Scott furnace has been recently put into operation, promises to become the same. Furthermore, development work has been actively pushed on a large number of smaller properties, as, for example, the Alice, Modoc, Libertad, Madrone, and Pine Mountain mines, while others have changed hands and been purchased or bonded by parties who intend active operation. The Stayton mine is being reopened by its former owners.

Santa Clara County.—The New Almaden mine continues to be a large producer, and the Guadalupe mine is producing quicksilver from the works near the surface and seriously endeavoring to unwater the mine. At the Santa Teresa mine a new Scott furnace is in course of erection. The Summit mine, on the line of Santa Clara and Stanislaus counties, has recently passed into the hands of a corporation formed by the previous owners, which is also starting the erection of a Scott furnace.

Sonoma County.—A number of old mines were reopened during 1902 in the Pine Flat district. The Crown Point is reopening the old Sonoma mine; the Pacific Company has done sufficient work on the property adjoining that of the Crystal Company to justify the erection of a furnace, which will be installed during 1903. The Cloverdale is steadily operating its 7-ton furnace; the Culver Bear will begin to treat ore in its new modified Livermore furnace; the Great Western, near Guerneville, still continues to be a regular producer, and the Socrates has been producing during the last four or five months.

Trinity County.—The Altoona property is again producing quicksilver from the surface works and dumps; the Boston and Integral Companies and several minor concerns are steadily engaged in development work.

Fresno, Kings, and Monterey counties.—Progress of more or less merit is being made on a number of prospects in these counties.

Under ordinary circumstances quicksilver can be produced in California at a cost of $3 per ton of ore mined and smelted, which makes it possible to work profitably ores averaging from 0.3 to 0.6 per cent of quicksilver, and occasionally ores of lower grade. The cost of producing quicksilver from the average mine in California equipped with a modern furnace plant is stated to exceed $35 per flask, not including interest on capital invested and the cost of development work. Despite the fact that the greater well-known quicksilver mines are in a measure exhausted, it is practically assured that the future production of quicksilver in the State will occupy a prominent position of economic importance for many years to come. It is not probable that other mines equal in extent to the New Almaden or the New Idria will be discovered, yet, on the other hand, there are numerous smaller mines throughout the State, many of which contribute an output of from 20 to 300 flasks a month. Ten years ago it was the general belief that the New Idria, Ætna, Oat Hill, New Almaden, and other prominent mines were practically exhausted, a pessimistic view which has been disproved, as the production from these properties still continues to be an important factor in the total output of metals in the State.

California has produced nearly the entire output of quicksilver in the United States, and the subjoined table has been compiled to show the total product in that State from 1850 to 1902, inclusive. In the period of fifty-three years covered by this table the grand total of production has amounted to 1,913,031 flasks of 76½ pounds net, which makes an average of 36,095 flasks per year. Of this quantity, one mine alone, the New Almaden, in Santa Clara County, has produced more than 50 per cent. The greatest activity in quicksilver mining in California was from 1875 to 1882, when an average of 64,000 flasks a year was produced. Since 1883 the production has approximated 30,000 flasks a year.

Total production of quicksilver in California, 1850–1902.

[Flasks of 76½ pounds net.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1850	7,723	1869	33,811	1888	33,250
1851	27,779	1870	30,077	1889	26,464
1852	20,000	1871	31,686	1890	22,926
1853	22,284	1872	31,621	1891	22,904
1854	30,004	1873	27,642	1892	27,993
1855	33,000	1874	27,756	1893	30,164
1856	30,000	1875	50,250	1894	30,416
1857	28,204	1876	72,716	1895	36,067
1858	31,000	1877	79,395	1896	30,765
1859	13,000	1878	63,880	1897	26,691
1860	10,000	1879	73,684	1898	31,092
1861	35,000	1880	59,926	1899	29,454
1862	42,000	1881	60,851	1900	26,317
1863	40,531	1882	52,732	1901	26,720
1864	47,489	1883	46,725	1902	28,972
1865	53,000	1884	31,913	Total	1,913,031
1866	46,550	1885	32,073		
1867	47,000	1886	29,981		
1868	47,728	1887	[a]33,825		

[a] Includes 65 flasks from Oregon.

The production of quicksilver in California, by counties, for 1901 and 1902 is given in the subjoined table, permission to publish the production by individual mines having been withheld:

Production of quicksilver in California, by counties, during 1901 and 1902.

[Flasks of 76½ pounds net.]

County.	1901.		1902.	
	Quantity.	Value.	Quantity.	Value.
Colusa	235	$10,575	504	$21,748
Lake	4,395	211,324	3,797	161,406
Napa	7,798	388,176	7,300	311,339
San Benito	4,800	242,300	7,289	306,096
San Luis Obispo	840	41,513	2,546	107,686
Santa Clara	5,220	236,608	5,779	243,599
Solano	....	....	....	....
Sonoma	2,130	95,850	1,519	66,373
Trinity	1,302	58,668	238	10,251
Total	26,720	1,285,014	28,974	1,228,498

OREGON.

There was no production of quicksilver in Oregon during 1902, as compared with 75 flasks in the preceding year. Prospecting has been quite active and considerable development work has been accomplished at several properties. The smelting furnace of the Blackbutte Quicksilver Mining Company, at Blackbutte, Lane County, which furnished the output during 1901, was not operated during 1902 owing to delay in rebuilding the condensing plant.

TEXAS.

The production of quicksilver in Texas during 1902 was 5,319 flasks, valued at $239,350, as compared with 2,932 flasks, valued at $132,438, in 1901, which shows a very active development of the industry in this State; the entire output for both years was made by the Marfa and Mariposa Mining Company, operating at Terlingua, Brewster County. The total quantity of quicksilver produced since the inception of the industry in 1900 aggregates 9,001 flasks. According to Mr. B. F. Hill, in Bulletin No. 4 of the University of Texas Mineral Survey, cinnabar occurs in the Terlingua mines either in hard and durable limestones or in soft and friable argillaceous beds. In the Excelsior claims the quicksilver occurs mainly as cinnabar, but small quantities of native mercury, calomel, and terlinguaite (a new mineral species consisting of mercury oxychloride), are also found. A 10-ton Scott furnace to treat these ores was erected in August, 1900, by Messrs. Norman, Sharpe, and Golby (who formed the Marfa and Mariposa Company in February, 1901), and a second 10-ton furnace was installed early in 1902. The Terlingua Mining Company built a 40-ton Scott furnace in 1902, which, however, was closed down shortly after it was completed. The Colquit Mining Company is building a 10-ton Scott furnace to treat the ore from the Excelsior mines, which occurs in the veins from 8 inches to 3 feet in width and in occasional pockets. The operations of this company have been limited mainly to the surface. The present treatment of the ore consists in hand sorting, crushing to lumps of from 1 to 2 inches in size, and conveying by belts to the ore bins above the level of the top of the furnace. The crushed ore is charged into the furnace through hoppers. The greater part of the ore is oxidized or treated with lime in a Scott continuous furnace, a small quantity only being distilled directly in retorts.

PRICES.

There was no very great variation in the average prices of quicksilver at San Francisco during 1902, the range being given by months in the table following based upon sales of 29,500 flasks during the year for both home and foreign consumption.

Average price of quicksilver, per flask, at San Francisco during 1901 and 1902, by months.

	1901.	1902.		1901.	1902.
	Price.	*Price.*		*Price.*	*Price.*
January	$47.25	$45.30	August	$47.25	$42.71
February	47.00	44.29	September	47.50	42.35
March	46.75	45.56	October	47.50	42.37
April	46.25	45.00	November	47.00	42.64
May	46.75	44.83	December	47.50	45.00
June	47.50	45.77	Average	47.19	44.10
July	48.00	43.39			

The lower averages during 1902, shown in this table, indicate the periods of largest sales for export; the higher averages indicate periods of sales for domestic consumption.

The average monthly price of quicksilver, per flask, at New York during 1902 was $48.37 for January and $48 for the remainder of the year.

IMPORTS.

Compared with the total production of quicksilver in the United States the quantity imported during the last ten years has been inconsiderable, as would naturally result from the fact that during this time about one-half of the domestic product has been exported. During the last five years the quantity of quicksilver imported has been merely nominal.

The following table shows the quantity and value of the imports of quicksilver from 1867 to 1902, inclusive:

Quicksilver imported and entered for consumption in the United States, 1867–1902.

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—	*Pounds.*		December 31—	*Pounds.*	
1867	....	$15,248	1886	629,888	$249,411
1868	152	68	1887	419,934	171,431
1869	....	11	1888	132,850	56,997
1870	239,223	107,646	1889	341,514	162,064
1871	304,965	137,332	1890	802,871	445,807
1872	370,353	189,943	1891	123,966	61,355
1873	99,898	74,146	1892	96,318	40,133
1874	51,202	52,093	1893	41,772	17,400
1875	6,870	20,957	1894	7	6
1876	78,902	50,164	1895	15,001	7,008
1877	38,250	19,558	1896	305	118
1878	294,207	135,178	1897	45,539	20,147
1879	519,125	217,707	1898	81	51
1880	116,700	48,463	1899	131	83
1881	138,517	57,733	1900	2,616	1,051
1882	597,898	233,057	1901	1,441	789
1883	1,552,738	593,367	1902	(a)	2,166
1884	136,615	44,035			
1885	257,659	90,416			

a Not stated.

EXPORTS.

Many causes are operative in affecting prices at which quicksilver is sold, the two most important factors being quantity and whether the sale is for home consumption or for export. Quicksilver sold in this country for export must compete in all foreign markets with the European product, and hence brings the lowest prices. These prices, too, are varied by rates for transportation from the various entry ports of consumption in competition with the European product. Higher prices, for instance, are obtained at western coast ports of Mexico than at interior points of consumption adjacent to railroads.

The following table gives the exports of quicksilver from San Francisco only during the year 1902, amounting to 8,913 flasks, valued at $383,578:

Exports of quicksilver from San Francisco during 1902, by countries.

[Flasks of 76½ pounds.]

Country.	Quantity.	Value.
China (Hongkong)	4,498	$186,750
Mexico	3,326	148,784
Honduras	976	42,955
Alaska	42	1,885
British Columbia	28	1,263
Colombia	21	953
Salvador	12	531
Costa Rica	10	457
Total	8,913	383,578

As stated above, during the last ten years nearly one-half of the total product of quicksilver in the United States has been exported. Since 1880, when the records of the exports of quicksilver were first kept, the exports have greatly exceeded the imports, except during the years 1886 and 1890. In the following table the quantity and value of quicksilver exported from the United States are given, the quantities being expressed in flasks of 76½ pounds net. Previous to 1901 nearly all the quicksilver exported was shipped from San Francisco, but during that year only 5,479 flasks of the total of 11,219 flasks exported were shipped from that port, practically the entire export being consigned to Mexico and Central America.

Exports of quicksilver from the United States, 1880–1902.

[Flasks of 76½ pounds net.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	37,210	$1,119,952	1892	3,518	$133,626
1881	35,107	1,025,299	1893	16,631	542,410
1882	33,875	988,454	1894	14,408	397,528
1883	30,072	808,353	1895	15,542	482,085
1884	7,370	199,685	1896	19,944	618,437
1885	6,802	209,753	1897	13,173	394,549
1886	8,091	204,956	1898	12,830	440,587
1887	11,394	441,112	1899	16,517	609,586
1888	10,684	406,899	1900	10,172	425,812
1889	5,111	213,717	1901	11,219	475,609
1890	2,069	93,192	1902	13,247	575,099
1891	3,714	145,502			

WORLD'S PRODUCTION AND VALUE.

The following table gives the production, in metric tons, and the value of quicksilver in various countries in the years 1899, 1900, and 1901:

World's production and value of quicksilver in 1899, 1900, and 1901.[a]

[Metric tons.]

Country.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	1,057	$1,452,745	983	$1,302,586	1,031	$1,382,305
Austria	536	492,021	510	499,052	525	547,513
Italy	205	246,000	260	312,000	278	361,400
Russia	362	321,814	304	270,256	(b)	(b)
Spain	1,361	1,481,229	1,095	1,193,550	754	1,105,890
Total	3,521	3,993,809	3,152	3,577,444	2,588	3,397,108

[a] Mexico exported 321 tons of quicksilver in 1899, 335 tons in 1900, and 335 tons in 1901.
[b] Statistics not yet available.

LITHIUM.

By Joseph Hyde Pratt.

SOURCES AND OCCURRENCE.

The two minerals that are mined as a source of lithium salts are lepidolite and spodumene. There is, however, another mineral, amblygonite, mentioned in the report for 1901, that will shortly be used for the same purpose.

The deposits of lepidolite at Pala, San Diego County, Cal., continue to be the largest producers of lithium minerals in the United States. The nearest railroad points are Temecula, on the narrow-gage railroad, and Oceanside, on the Santa Fe Railroad, which are 12 miles and 22 miles, respectively, from Pala. The development work that has been done on the claims in the vicinity of the old Stewart claim, which at the present time is the chief producer of lepidolite, has shown the occurrence of this mineral, either as float pieces or in place, for a distance of over a mile.

One of the interesting results of this development work, as was stated in this report for 1901, has been the discovery of large deposits of amblygonite, a lithium phosphate. This mineral has proved to be nearly as continuous as the lepidolite, and was first discovered during the work on the Stewart claim. The lepidolite gave place to a whitish mineral, and it was at first supposed that the lithium minerals had been worked out in the direction that the mining was being carried on; but, upon testing this white mineral, it was found to contain a higher percentage of lithia than the lepidolite. A subsequent analysis identified the mineral as amblygonite.

Analyses of amblygonite and lepidolite from Pala, made by Rudolph L. Seldner, of Brooklyn, N. Y., are given below:

Analyses of amblygonite and lepidolite from Pala, San Diego County, Cal., 1902.

Constituent.	Amblygonite.	Lepidolite.
	Per cent.	*Per cent.*
Lithia (lithium oxide)	8.26	4.91
Silica	1.99	48.61
Phosphorus pentoxide	45.47	....
Alumina	33.09	22.36
Iron oxide	Trace.	Trace.
Lime	1.35	.64
Potash	(a)	16.16
Soda	(a)	.38
Loss on ignition (water, etc.)	6.28	4.55
Undetermined (chiefly fluorine)	3.56	....
Undetermined (chiefly manganese)	....	2.05
	100.00	99.66

[a] Small amount.

The discovery of this large occurrence of amblygonite opens a new source of lithium salts, for the production of which it is to be utilized.

The width of the vein or dike carrying these minerals is about 30 feet, and it has been opened by means of tunnels and cuts. It is very probable that the deposits can be best worked by quarrying.

Recently most of the claims known to contain lithium minerals have been brought under the control of the American Lithia and Chemical Company, of which Mr. William H. Crane, of New York, is president. Others who own claims in this vicinity upon which lithium minerals have been found are Mr. Ed. Fletcher, of San Diego, Cal., and Messrs. Gay and Blakely, of Redlands, Cal.

The only locality where spodumene was mined during 1902 is at the Etta mine, in the Black Hills, South Dakota. Other mines in this vicinity that are known to contain spodumene in some quantity are the Sunday, the Golden Star, the Traction, and the Bob Ingersoll. It has also been found in some quantity at Branchville, Fairfield County, Conn.

USES.

Lithium is used almost exclusively in the form of the carbonate in the preparation of mineral waters for medicinal purposes and in the manufacture of effervescing lithia tablets. It has been estimated that 55,000 pounds will represent the annual consumption of lithium salts in the United States. To produce this amount, considering it all as carbonate (Li_2CO_3), would require 371 tons of mineral containing at least 3 per cent of lithia (Li_2O). It will be seen from the above that there is but a small proportion of the lithia minerals mined that are required to supply the home consumption of the lithium salts, and that the larger market will be found abroad. If the price of lithium carbonate can be reduced sufficiently, there should be a large demand for it, or for lithium nitrate, to be used in pyrotechnics for red fire.

PRODUCTION.

The amount of lithium minerals produced in the United States during 1902, as reported to the Geological Survey, was 1,245 tons, valued at $25,750 at the railroad. This is a decrease of 505 tons in quantity, and of $17,450 in value, as compared with the production of 1901, which was 1,750 tons, valued at $43,200. The value of the lithium minerals varies with the percentage of lithia and the character of the mineral. As far as can be ascertained, the greater part of the lithium minerals mined during 1902 has not been shipped. Although the price of these minerals was lower in 1902 than in 1901 for the same grade of mineral, there was apparently no increase in the home demand. There is, however, an increase in the demand for these minerals from foreign chemical manufacturers. The American Lithia and Chemical Company, which has recently been organized, expects to erect a plant on the Pacific coast for the manufacture of lithium salts and other chemical compounds. As this company will also be a producer, there should be an increase in the home consumption of these minerals.

IMPORTS.

Over a third of the lithium salts used in the United States are imported, and in 1902 the imports amounted to 21,216 pounds, valued at $22,951, or a little over $1 per pound. This importation included 5,530 pounds of lithium carbonate, valued at $8,038, and 15,686 pounds of other lithium salts, valued at $14,913.

NICKEL AND COBALT.

By Joseph Hyde Pratt

INTRODUCTION.

The two metals, nickel and cobalt, are treated together for the reason that nearly all the ores that contain one of these metals contain also a small percentage of the other. Furthermore, in the reduction of the ores of these metals both the nickel and cobalt go into the matte which is afterwards refined. The Canadian nickel ores, which furnish most of the nickel used in this country, are smelted at the mines, but the resulting matte is for the most part shipped to the United States and England for refining, the greater part being sent to this country.

There has been a slight increase in the demand for cobalt and at a slight advance in price, but the demand for salts of this metal is still limited, and there could readily be an overproduction. The demand for nickel still remains firm, and with the increased uses for it there should be a still further demand.

OCCURRENCE.

In addition to the nickel and cobalt occurrences described in the report for 1901 there is an occurrence in Idaho that has attracted considerable attention on the Pacific coast. The deposits are on Meadow Creek, Blackbird district, Lemhi County, but on account of their distance from railroad transportation they are being but little developed. The minerals are in the form of sulphides, but it is not definitely known as yet what values in nickel and cobalt the ores will carry. Dr. A. H. Franklin, president of the Blackbird Mining Company, writes that in one of their properties they encountered a streak of ore on the foot wall 2 feet wide, which assayed 20 per cent of cobalt, no statement being made regarding the nickel contents.

Mr. William Beddig, of Nampa, Idaho, who has been prospecting in the nickel fields of Oregon, has located what he considers promising deposits, and during 1902 he took out about 5 tons of ore, which were shipped for experimental purposes.

The North Carolina nickel deposits near Webster, Jackson County, have been worked during the last year, and several carloads of ore were shipped for experimental purposes. As described in the last report, this nickel ore occurs in a peridotite rock in the form of the mineral genthite or garnierite, a varity of genthite. Good results are claimed from the development work thus far done. The mineral itself carries a good percentage of nickel, but it is not yet known what the ore will carry. It does not occur in defined veins, but as thin seams, filling the crevices and cracks in the rocks from which it has been leached.

It is rumored that the Gap nickel mine, in Lancaster County, Pa., which formerly produced a considerable amount of nickel ore, will be reopened and explored for nickel-ore bodies that are still believed to exist in it. Since the shutting down of this mine there has been little or no nickel or cobalt produced in the United States, except from Mine La Motte, in Missouri, which is an important lead mine.

Practically no work was done in 1902 on the deposits of nickel and cobalt in Oregon, Washington, Wyoming, Nevada, and Arizona, beyond the necessary assessment work. In most cases the deposits are too remote from railroad transportation to make them available at the present time.

At the Mohawk mine, in the Lake Superior copper district, Michigan, an arsenide of copper, nickel, and cobalt has been found in some quantity, and it is said to have been treated successfully by the company at their smelter at Hackensack Meadows, N. J. [a]

Nearly all the nickel used in the United States is obtained from the large mines in the Sudbury district, Canada, and from the mines of New Caledonia, an island belonging to France, in the Pacific Ocean, off the east coast of Australia.

USES.

New uses are continually being devised for nickel, and in addition to those enumerated in the report for 1901 should be added the growing demand for nickel-steel rails. These have been tried for a number of years at Cumberland Gap and have given the best satisfaction. The initial cost of rails of this character is considerably more, but it is claimed that they will outlast three ordinary rails. Another use that is being favorably considered is the manufacture of a nickel-steel wire rope. It would be less corrosive and have more tensile strength than the ordinary steel wire ropes used at present.

The use of nickel in the manufacture of dies and shoes in stamp mills should also receive favorable consideration. Mr. R. S. Tappenden, in The Iron Age, July 17, 1902, states that the fact that a fracture in nickel steel is not nearly so liable to increase in size as in common

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[a] Western Min. World, Oct. 25, 1902.

steel will tend to increase its use to a much larger extent in our merchant marine. The Nickel Steel and Forge Company, of Philadelphia,[a] is erecting a plant in Carnegie, Pa., for the manufacture of a nickel steel that will contain a sufficient amount of nickel to make the alloy noncorrosive.

There is described in a British patent issued to Herr Kugel, of Berlin, a method of so depositing nickel electrolytically in layers of such thickness that the product is equivalent to rolled nickel in respect to its toughness, durability, and ductility.[b] The nickel solution is acidified with a mineral acid which is unalterable by the electric current, and it is prevented from spoiling the bath and causing the deposit to flake off by keeping the electrolyte at a temperature of over 30° C. A homogeneous noncrystalline metal is said to be deposited and may be put down in sheets of any required thickness.

An interesting article has recently appeared in the Electrochemical Industry[c] on the "History and present development of electrolytic nickel refining," by Titus Ulke. A number of the different refining plants and their methods are described. He also discusses the proposed copper and nickel refining at Sault Ste. Marie by the Consolidated Lake Superior Company. In conclusion Mr. Ulke says:

> In the processes for the electro-deposition of nickel with insoluble anodes no very recent progress has been shown. When the metal is re-covered on a large scale by the aid of soluble anodes the electrolyte is kept constantly at a predetermined degree of saturation and at the point of neutrality, on which condition largely depends the nature of the deposit and the commercial success of the process. When insoluble anodes are used in refining nickel, however, an equivalent of free acid is left in the electrolyte for every equivalent of metal deposited, and in consequence the nickel deposit is apt to deteriorate, the chemical and electrical conditions of the bath are changed, polarization ensues, and the resistance of the electrolyte increases. This, of course, means that the voltage and power required must be increased proportionately, and the cost of refining with insoluble anodes may thus become next to prohibitory, as compared with a similar process using soluble anodes. These and other difficulties have been the chief reasons why our electro-chemists, instead of making pure metallic nickel by electro-deposition, have preferred to work the nickel solutions into marketable sulphates, double sulphates, and chlorides, which have had a ready sale until recently, but which now seem likely to become a drug on the market, just as copper sulphate was before the adoption of electrolytic refining methods.

PRODUCTION.

Beyond the few carloads of nickel ore shipped from North Carolina, and the small amount from Oregon for experimental purposes, the only nickel and cobalt ores produced in the United States during 1902 were as by-products from ores obtained from Mine La Motte, Missouri. The 20 tons of matte containing these metals, which were refined at the works of the Mine La Motte Lead and Smelting Com-

[a] Am. Mfg., July 24, 1902.
[b] Jour. Frank. Inst., Aug., 1901.
[c] Electrochemical Industry, Vol. 1, Feb., 1903.

pany, yielded 5,748 pounds of metallic nickel and 3,730 pounds of cobalt oxide. This is a decrease of 952 pounds in the production of nickel and of 9,630 pounds of cobalt oxide, as compared with 6,700 pounds of nickel and with 13,360 pounds of cobalt oxide produced in 1901.

In the table following are shown the production and value of nickel obtained from domestic ores from 1887 to 1902, inclusive:

Production of nickel from domestic ores in the United States, 1887–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1887	205,566	$133,200	1895	10,302	$3,091
1888	204,328	127,632	1896	17,170	4,464
1889	252,663	151,598	1897	23,707	7,823
1890	223,488	134,093	1898	11,145	3,956
1891	118,498	71,099	1899	22,541	8,566
1892	92,252	50,739	1900	9,715	3,886
1893	49,399	22,197	1901	6,700	3,551
1894	9,616	3,269	1902	5,748	2,701

In the table following is given the production of cobalt oxide in the United States from domestic ores from 1869 to 1902, inclusive:

Production of cobalt oxide in the United States, 1869–1902.

[Pounds.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1869	811	1881	8,280	1893	8,422
1870	3,854	1882	11,653	1894	6,763
1871	5,086	1883	1,096	1895	14,458
1872	5,749	1884	2,000	1896	10,700
1873	5,128	1885	8,423	1897	19,520
1874	4,145	1886	8,689	1898	6,247
1875	3,441	1887	[a] 18,340	1899	10,230
1876	5,162	1888	8,491	1900	6,471
1877	7,328	1889	13,955	1901	13,360
1878	4,508	1890	6,788	1902	3,730
1879	4,376	1891	7,200		
1880	7,251	1892	7,869		

[a] Including cobalt oxide in ore and matte.

CANADIAN PRODUCTION.

As most of the nickel used in the United States is obtained from Canada, a table is given below showing the amount of nickel ore mined and smelted in Canada and the amount of matte obtained from it for the years 1896 to 1902, inclusive:

Production of nickel in Canada, 1896–1902.[a]

Year.	Ore produced.	Ore smelted.	Matte obtained.	Nickel in matte.
	Long tons.	*Long tons.*	*Long tons.*	*Pounds.*
1896	109,097	73,505	9,733	3,897,000
1897	93,155	96,093	14,034	3,998,000
1898	123,920	121,924	21,101	5,567,000
1899	203,118	171,230	19,215	5,744,000
1900	216,695	211,960	23,448	7,080,000
1901	326,945	270,380	45,134	8,882,000
1902	269,538	233,338	24,691	10,693,410

[a] As reported by the director of the bureau of mines, Ontario, Canada.

The final quantity of matte obtained and shipped for refinement in 1902 amounted to 24,691 long tons, this being but little more than one-half the amount of matte shipped in 1901, which was 45,134 tons. The nickel content of the matte shipped in 1902, however, was nearly 2,000,000 pounds greater than that shipped in 1901, the increase being due to the fact that a considerable proportion of the ordinary matte was re-treated and converted into a much higher grade of matte. There was also a certain amount of bessermerized matte produced by one of the plants, which does not make any low-grade matte. The total amount of this higher grade matte was 13,332 tons. This increase of 1,811,410 pounds in the production of nickel in 1902 illustrates the large growth in the nickel industry and the constantly increasing demand for the metal.

The Canadian Copper Company, of the International Nickel Company, is entirely remodeling its plant at Copper Cliff, Ontario, Canada, at a cost of about $500,000. When finished, it will be the most complete and best equipped plant of its kind in the world. It will produce a high-grade matte, which will be refined in the United States.

IMPORTS.

In the tables below are given the quantity and value of cobalt oxide and nickel imported into the United States since 1868, the larger part of the nickel being obtained from the Canadian mines:

Cobalt oxide imported and entered for consumption in the United States, 1868–1902.

Year ending—	Oxide.		Year ending—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
June 30—	*Pounds.*		December 31—	*Pounds.*	
1868		$7,208	1886	19,366	$29,543
1869		2,330	1887	26,882	39,396
1870		5,019	1888	27,446	46,211
1871		2,766	1889	41,455	82,332
1872		4,920	1890	33,338	63,202
1873	1,480	4,714	1891	23,643	43,188
1874	1,404	5,500	1892	32,833	60,067
1875	678	2,604	1893	28,884	42,694
1876	4,440	11,180	1894	24,020	29,857
1877	19,752	11,056	1895	36,155	39,839
1878	2,860	8,693	1896	27,180	36,212
1879	7,531	15,208	1897	24,771	34,773
1880	9,819	18,457	1898	33,731	49,245
1881	21,844	13,837	1899	46,791	68,847
1882	17,758	12,764	1900	54,073	88,651
1883	13,067	22,323	1901	71,969	134,208
1884	25,963	43,611	1902	79,984	151,115
1885	16,162	28,138			

Nickel imported and entered for consumption in the United States, 1868–1902.

Year ending—	Nickel.		Nickel oxide, alloy of nickel with copper, and nickel matte.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—	*Pounds.*		*Pounds.*		
1868		$118,058			$118,058
1869		134,327			134,327
1870		99,111			99,111
1871	17,701	48,133	4,438	$3,911	52,044
1872	26,140	27,144			27,144
1873	2,842	4,717			4,717
1874	3,172	5,883			5,883
1875	1,255	3,157	12	36	3,193
1876			156	10	10
1877	5,978	9,522	716	824	10,346
1878	7,486	8,837	8,518	7,847	16,684
1879	10,496	7,829	8,314	5,570	13,399
1880	38,276	25,758	61,869	40,311	66,069
1881	17,933	14,503	135,744	107,627	122,130
1882	22,906	17,924	177,822	125,736	143,660
1883	19,015	13,098	161,159	119,386	132,484
1884			[a] 194,711	129,733	129,733
1885			105,603	64,166	64,166

[a] Including metallic nickel.

Nickel imported and entered for consumption in the United States, 1868–1902—Continued.

Year ending—	Nickel.		Nickel oxide, alloy of nickel with copper, and nickel matte.		Total Value.
	Quantity.	Value.	Quantity.	Value.	
December 31—	*Pounds.*		*Pounds.*		
1886			277,112	$141,546	[a] $141,546
1887			439,037	205,232	[b] 205,232
1888			316,895	138,290	[c] 138,290
1889			367,288	156,331	[d] 156,331
1890	[e] 566,571	$260,665	247,299	115,614	376,279
1891	355,455	172,476	[f] 10,245,200	148,687	321,163
1892			[g] 4,487,890	428,062	428,062
1893			[g] 12,427,986	386,740	386,740
1894			[g] 9,286,733	310,581	310,581
1895			[g] 20,355,749	629,910	629,910
1896			[g] 23,718,411	620,425	620,425
1897			[g] 27,821,232	781,483	781,483
1898			[g] 60,090,240	1,534,262	1,534,262
1899			[g] 44,479,841	1,216,253	1,216,253
1900			[h] 57,500,800	1,183,884	1,183,884
1901			[i] 117,364,337	[i] 1,849,620	1,849,620
1902			[j] 33,942,710	[j] 1,437,649	1,437,649

[a] Including $465 worth of manufactured nickel.
[b] Including $879 worth of manufactured nickel.
[c] Including $2,281 worth of manufactured nickel.
[d] Including $131 worth of manufactured nickel.
[e] Classified as nickel, nickel oxide, alloy of any kind in which nickel is the element or material of chief value.
[f] Classified as nickel and nickel matte.
[g] Includes all nickel imports except manufactures; nearly all of this is nickel in matte from Canada containing about 20 per cent nickel.
[h] Ore and matte; in addition 455,188 pounds of nickel, nickel oxide, etc., were imported, valued at $139,786.
[i] Including $209,956, the value of imports of 635,697 pounds of nickel, nickel oxide, alloy, etc., and $2,498, the value of imported manufactures of nickel, not specially provided for.
[j] Besides nickel ore and nickel matte, these figures include 752,630 pounds, valued at $251,149, of nickel, nickel oxide, and alloys in which nickel is the chief constituent of value; and $30,128, the value of manufactures of nickel not specially provided for.

Although the importation of nickel in various forms in 1902 was over 83,000,000 pounds less than in 1901, the decrease in value of the imports was only $411,971. This decrease in quantity can readily be accounted for by the higher grade of matte shipped from the smelters and by the importation of a smaller amount of ore. This will also account for the proportionally small decrease in values.

EXPORTS.

These figures do not mean that there was a smaller amount of nickel used in this country in 1902 than in 1901, for it must be taken into consideration that of the matte and ore imported a considerable amount is exported after refining. The amount and value of the nickel exported from the United States since 1894 are given in the following table:

Exports of nickel oxide and matte from the United States, 1894–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1894 [a]	1,235,588	$247,568	1899	5,004,377	$1,151,454
1895	1,061,285	239,897	1900	5,869,906	1,382,727
1896	2,756,604	600,833	1901	5,869,655	1,521,291
1897	4,255,558	997,391	1902	3,228,607	924,579
1898	5,657,620	1,359,609			

[a] Last six months; not separately classified prior to July 1, 1894.

As is seen from this table, the exports were 2,641,048 pounds less in quantity in 1902 than in 1901 and $596,712 less in value, which shows that there was proportionally a larger amount of nickel consumed in this country in 1902 than in 1901.

The International Nickel Company, which controls the refining of nickel matte in this country, also owns or controls some of the more important nickel deposits in Canada and New Caledonia, but does all its refining at the present time in this country.

FOREIGN PRODUCTION.

There is given in the following table the production of nickel in Canada, France, and Germany from 1889 to 1901. The French production is from the New Caledonia mines, and the German from the New Caledonia and the Norwegian mines. In comparing this table with that of the nickel imported into the United States it must be borne in mind that the quantity given in the table of imports represents nickel matte, ore, etc., and not the metallic nickel as is given in the table below.

Production of nickel in Canada, France, and Germany, 1889–1902.

Year.	Canada.		France.		Germany.	
	Quantity	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Metric tons.*		*Metric tons.*	
1889	830,477	$498,286	330	$324,900	282	$279,680
1890	1,435,742	933,232	330	317,300	434	436,430
1891	4,626,627	2,775,976	330	319,200	594	644,480
1892	2,413,717	1,399,956	1,244	1,174,580	747	698,630
1893	3,992,982	2,076,351	2,045	1,175,720	893	774,630
1894	4,907,430	2,061,120	1,545	1,175,720	522	449,350
1895	3,888,525	1,360,984	1,545	1,033,220	698	575,890
1896	3,397,113	1,188,990	1,545	875,330	822	666,900
1897	3,997,746	1,399,137	1,245	704,425	898	710,980
1898	5,517,690	1,820,838	1,540	887,800	1,108	670,482
1899	5,744,000	2,067,840	1,740	1,003,600	1,115	669,517
1900	7,080,000	3,327,707	1,700	1,020,000	1,376	946,884
1901	8,882,000	4,707,460	1,800	1,440,000	1,659	1,184,263
1902	10,693,410	5,025,903	....	....	....	....

ANTIMONY.

By Joseph Struthers.

INTRODUCTION.

The process of smelting antimony ores and refining the metallic product is very difficult, and few metallurgists know the complete details of modern practice. Successful smelting, therefore, can be accomplished only under special conditions. This fact, together with the large production of the metal in foreign countries, the removal of the duty, in April, 1902, on crude antimony (which is partly refined antimony sulphide), and cheap ocean freight rates, precludes the profitable treatment of domestic antimony ores in the United States. The control of the production and trade in antimony continues to remain in the hands of Mathison & Co., of London, which firm operates the smelting plant at Chelsea, Staten Island, New York., and the works of the affiliated concern, the Chapman Smelting Company, of San Francisco, Cal.

PRODUCTION.

The sources of supply of antimony for consumption in the United States are four in number, here given in the order of their importance:

1. Hard lead, derived from the smelting of foreign and domestic ores.
2. Regulus or metal imported into the United States.
3. Antimony ores imported into the United States.
4. Antimony ores from domestic sources.

The quantity of hard or antimonial lead produced in the smelting of foreign and domestic lead ores in 1902, was 20,970,000 pounds, containing approximately 5,808,000 pounds of metallic antimony, as compared with 17,878,000 pounds, containing approximately 4,469,500 pounds of antimony, during 1901. Hard lead is used for the manufacture of various alloys and is obviously an important source of the antimony consumption in the United States.

During 1902 the net imports of foreign antimony, as regulus or refined metal, amounted to 5,388,739 pounds, valued at $333,601, as compared with 3,640,505 pounds, valued at $254,529, for the year 1901.

The antimony content of all ores imported varies from 35 to 65 per cent, and for all practical purposes the average antimony content may be taken at 52.5 per cent. Assuming a smelting extraction of 42 per cent, the quantity of antimony derivable from the net importation of foreign ores during 1902 was 1,314,000 pounds, as compared with 706,566 pounds in 1901.

The quantity of antimony metal derived from domestic ores during 1902 was nil, as compared with 100,000 pounds during 1901. The production of metal from domestic ores has always played a very unimportant part in the quantity of antimony needed to supply the consumption in the United States.

The aggregate quantity of antimony from the above-mentioned sources available as metal or as alloy in the United States during 1902 amounted to 12,510,739 pounds, as compared with 8,916,671 pounds, during 1901.

Antimony is used chiefly for making alloys with lead, tin, zinc, and other metals. The addition of antimony to lead increases its hardness up to twelvefold, and the addition of a small quantity (0.5 to 2 per cent) of bismuth to the lead-antimony alloy (type metal) causes it to expand at the moment of solidification, thus yielding a casting with clean, sharp faces, which is of special value in the manufacture of type. The most important alloys of antimony are: Type metal, composed of lead and antimony, with or without the addition of tin and bismuth; hard lead, produced in refining antimonial lead, containing generally about 25 per cent antimony; britannia metal and pewter, used extensively for tableware, the former being an alloy of tin with from 10 to 16 per cent antimony and 3 per cent copper, and the latter an alloy of tin with a smaller content of antimony; antifriction metal, also called white metal and babbitt metal, which consists of antimony and tin, with the addition of small quantities of lead, copper, zinc, bismuth, and nickel.

The principal salts of antimony are tartar emetic, an antimony-potassium tartrate, used in medicine, and in dyeing as a mordant for vegetable fiber; antimony cinnabar, a fiery red colored pigment used in oil painting, consisting of antimony trisulphide with a small amount of antimony trioxide; and antimony pentasulphide, used as a red pigment for vulcanizing rubber.

The only antimony ore of commercial importance in the United States is stibnite, antimony trisulphide (Sb_2S_3). Although many deposits of the mineral occur in the Western States, the production of metal from domestic ore has never reached an important position, the largest quantity produced in one year being but 295 short tons in 1895 in an estimated total production of 4,000 tons of metal from all sources. Since 1895 the production of antimony from domestic ores has declined until there was practically none so produced in 1902, as compared with 50 short tons in 1901.

The annual production of antimony in the United States from 1880 to 1902, inclusive, is shown in the following table:

Production of metallic antimony from domestic and foreign ores and that contained in hard lead in the United States, 1880–1902.

Year.	Contained in hard lead.[a]		Produced from foreign and domestic ores.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1880	([b])	....	50	$10,000	....	....
1881	([b])	....	50	10,000	....	....
1882	([b])	....	60	12,000	....	....
1883	([b])	....	60	12,000	....	....
1884	([b])	....	60	12,000	....	....
1885	([b])	....	50	10,000	....	....
1886	([b])	....	35	7,000	....	....
1887	([b])	....	75	15,000	....	....
1888	([b])	....	100	20,000	....	....
1889	([b])	....	115	28,000	....	....
1890	809	$136,752	129	40,756	938	$177,508
1891	1,011	170,950	278	47,007	1,289	217,957
1892	1,260	219,950	metallic 150 ore 380	56,466	1,790	276,416
1893	1,253	225,540	250	45,000	1,503	270,540
1894	1,187	213,706	200	36,000	1,387	249,706
1895	1,563	236,169	[c] 450	68,000	2,013	304,169
1896	1,877	263,249	[c] 601	84,290	2,478	347,539
1897	2,217	320,356	[c] 844	121,944	3,061	442,300
1898	2,118	348,051	[c] 1,120	184,050	3,238	532,101
1899	1,586	307,314	[c] 1,275	251,875	2,861	559,189
1900	2,476	490,916	[c] 1,750	346,980	4,226	837,896
1901	2,235	457,150	[d] 403	82,752	2,639	539,902
1902	2,904	505,340	[d] 657	129,166	3,561	634,506

[a] Estimated at 25 per cent of the total quantity of hard lead produced from both foreign and domestic ores, except for the year 1902, when an average of 27 per cent was taken.
[b] No statistics available.
[c] Principally from imported ores.
[d] Exclusive of foreign ores imported and reexported.

IMPORTS.

The subjoined table gives the aggregate quantity and value of antimony ore (including crude antimony) and metallic antimony (regulus) imported into the United States from 1867 to 1902, as reported by the Bureau of Statistics of the Treasury Department. An inspection of the table shows that the quantity of ore imported has increased from 116,495 pounds in 1893 to the maximum quantity of 6,089,134 pounds in 1900, a year in which there was a marked over-importation of both ore and metal. In 1901 the importation of antimony ore was 1,731,956 pounds, valued at $24,256, of which quantity 49,655 pounds, valued at $1,536, were exported, leaving a net import of 1,682,301 pounds, valued at $22,720. In 1902 the importation of antimony ore was 3,337,600 pounds, valued at $67,750, of which 208,531 pounds, valued at $4,602, were exported, leaving a net import of 3,129,069 pounds, valued at $62,968.

The imports of antimony as regulus or metal in 1902 were 5,425,923 pounds, valued at $336,311, of which 37,184 pounds, valued at $2,710, were exported, the remaining net import for 1902 being 5,388,739 pounds, valued at $333,601, as compared with 3,640,505 pounds of imported regulus or metal, valued at $254,529, in 1901.

Antimony and antimony ore imported and entered for consumption in the United States, 1867–1902.

Year ending—	Metal and regulus.		Crude antimony and ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
June 30, 1867	....	$63,919	....	....	$63,919
1868	1,033,336	83,822	....	....	83,822
1869	1,345,921	129,918	....	....	129,918
1870	1,227,429	164,179	....	....	164,179
1871	1,015,039	148,264	....	$2,364	150,628
1872	1,933,306	237,536	....	3,031	240,567
1873	1,166,321	184,498	....	2,941	187,439
1874	1,253,814	148,409	....	203	148,612
1875	1,238,223	131,360	6,460	609	131,969
1876	946,809	119,441	8,321	700	120,141
1877	1,115,124	135,317	20,001	2,314	137,631
1878	1,256,624	130,950	20,351	1,259	132,209
1879	1,380,212	143,099	34,542	2,341	145,440
1880	2,019,389	265,773	25,150	2,349	268,122
1881	1,808,945	253,054	841,730	18,199	271,253
1882	2,525,838	294,234	1,114,699	18,019	312,253
1883	3,064,050	286,892	697,244	11,254	298,146
1884	1,779,337	150,435	231,360	6,489	156,924
1885	2,579,840	207,215	215,913	7,497	214,712
Dec. 31, 1886	2,997,985	202,563	218,366	9,761	212,324
1887	2,553,284	169,747	362,761	8,785	178,532
1888	2,814,044	248,015	68,040	2,178	250,193
1889	2,676,130	304,711	146,309	5,568	310,279
1890	3,315,659	411,960	611,140	29,878	441,838
1891	2,618,941	327,307	1,433,531	36,232	363,539
1892	3,950,864	392,761	192,344	7,338	400,099
1893	2,780,432	243,341	116,495	5,253	248,594
1894	2,653,487	193,988	375,468	[a] 18,805	212,793
1895	3,499,901	223,968	668,610	14,718	238,686
1896	2,576,371	158,975	1,180,828	21,402	180,377
1897	2,282,245	143,370	3,719,186	55,400	198,770
1898	2,103,599	148,671	3,749,222	50,256	198,927
1899	2,990,915	241,685	3,968,654	47,427	289,112
1900	3,654,822	287,937	6,089,134	75,866	363,803
1901	3,640,505	254,529	[b] 1,682,301	22,720	278,066
1902	5,388,739	333,601	[b] 3,129,069	62,968	396,569

[a] Includes $737, value of ground antimony for which no quantity was given.
[b] Excludes exports.

The large increase in the quantities of antimony regulus and ore imported and exported during 1902 has been due to a peculiar condition of the freight rates from China, which, strangely enough, were about 10 shillings per ton from China to New York and 30 shillings from China to England. The freight rate from New York to England being about 10 shillings per ton, shipments were made first to New York, whence the metal was transshipped to England, and thus practically one-third of the cost of direct transportation was saved.

CONSUMPTION.

The consumption of antimony in the United States from 1880 to 1902 is given in the subjoined table, the imported ore being estimated to contain an average of 52½ per cent antimony, and to yield 42 per cent of refined metal by smelting operations. Crude antimony, which is refined or concentrated ore and not metal, is included in the quantity of ore imported. Antimony regulus is taken as equivalent to the metal. The antimony contained in hard lead is calculated at 25 per cent, except for 1902, when an average of 27 per cent was taken.

Estimated consumption of antimony in the United States, 1880–1902.

Year.	Contained in hard lead.	From domestic ores.	From imported ores and crude antimony.	Imported metal or regulus.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1880	....	50	7	1,010	[a] 1,067
1881	....	50	221	904	[a] 1,175
1882	....	60	292	1,263	[a] 1,615
1883	....	60	183	1,532	[a] 1,775
1884	....	60	61	890	[a] 1,011
1885	....	50	57	1,290	[a] 1,397
1886	....	35	58	1,499	[a] 1,592
1887	....	75	95	1,277	[a] 1,447
1888	....	100	18	1,407	[a] 1,525
1889	....	115	38	1,338	[a] 1,491
1890	....	129	160	1,658	[a] 1,947
1891	1,011	278	377	1,309	2,975
1892	1,260	150	50	1,975	3,435
1893	1,253	250	30	1,390	2,923
1894	....	200	100	1,327	[a] 1,627
1895	....	[b] 275	[b] 175	1,750	[a] 2,200
1896	1,877	[b] 291	[b] 310	1,288	3,766
1897	2,217	[b] 245	[b] 599	1,141	4,202
1898	2,118	[b] 250	[b] 870	1,052	4,290
1899	1,586	234	1,041	1,495	4,356
1900	2,476	151	1,599	1,827	6,053
1901	2,235	50	353	1,837	4,475
1902	2,904	Nil.	657	2,694	6,255

[a] Not including antimony contained in hard lead, for which statistics are not available.
[b] Separation estimated. All antimony smelted, whether from domestic or foreign ores, was reported as of domestic production.

The decrease in the total quantity of antimony estimated to have been consumed in the United States in 1901, as compared with 1900, was due to the very large overimportation of antimony ore and, to a less extent, of antimony regulus in 1900. The above table shows the constantly increasing quantity of antimony obtained from foreign ores from 1893 to 1900, inclusive, which has been due mainly to the cheap ocean freight rates from foreign countries where the ores are mined and partly refined at a low cost.

The following table, showing the output and value of antimony metal of the world in 1901, has been compiled from the official governmental reports of the respective countries:

World's production of antimony metal in 1901.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Short tons.			*Short tons.*	
United States[a]	403	$61,820	Italy	1,898	$195,550
Austria	126	10,434	Servia	268	40,824
France[b]	1,969	240,000	Total	8,098	899,798
Germany[c]	2,783	268,250			
Hungary[d]	777	82,920			

[a] Does not include the antimony contained in hard lead.
[b] Includes product of Algeria.
[c] Includes manganese.
[d] Crude antimony and regulus.

PRICES.

From 1893 to July, 1897, there was a steady decline in the price of antimony, which dropped from 16 cents per pound for Cookson's brand to 7 cents. Beginning with August, 1897, the price began to advance, and in May, 1899, it reached 12 cents per pound, and then remained nearly constant throughout the rest of the year. During 1902 there was a slight falling off in price, and the year closed with Cookson's at $10\frac{1}{4}$ cents per pound. The tables below show, by months and years, the ruling prices of the several brands of antimony, as reported to The Iron Age and The Engineering and Mining Journal, from 1894 to 1902, inclusive:

Prices of antimony at New York, 1894–1902, by months.

[Cents per pound.]

Month.	1894.			1895.			1896.		
	Cookson's.	L. X.	Hallett's.	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	Japanese.
January	$10\frac{1}{4}$	$9\frac{1}{8}$	$9\frac{1}{2}$	$8\frac{1}{2}$ to $8\frac{5}{8}$	$7\frac{1}{8}$ to $7\frac{1}{4}$	....	$8\frac{1}{4}$	$7\frac{1}{4}$ to $7\frac{1}{2}$	7
February	10	$8\frac{7}{8}$	$9\frac{3}{8}$	$8\frac{1}{4}$ to $8\frac{1}{2}$	$7\frac{1}{8}$ to $7\frac{1}{4}$	....	$8\frac{1}{4}$	$7\frac{1}{2}$	7
March	$10\frac{1}{8}$	$8\frac{7}{8}$	$9\frac{1}{2}$	$8\frac{1}{4}$	$7\frac{1}{8}$ to $7\frac{1}{4}$	....	$8\frac{1}{4}$	$7\frac{1}{2}$	7
April	$10\frac{1}{8}$	$8\frac{7}{8}$	$9\frac{3}{8}$	$7\frac{7}{8}$ to $8\frac{1}{8}$	7 to $7\frac{1}{8}$	$6\frac{7}{8}$ to 7	$8\frac{1}{4}$	$7\frac{1}{2}$	7
May	$10\frac{1}{8}$	$8\frac{3}{4}$	$9\frac{1}{4}$	$7\frac{7}{8}$ to 8	7	$6\frac{7}{8}$	8 to $8\frac{1}{4}$	$7\frac{1}{4}$ to $7\frac{1}{2}$	$6\frac{7}{8}$ to 7
June	$9\frac{3}{4}$	$8\frac{5}{8}$	$9\frac{1}{8}$	$7\frac{7}{8}$ to 8	7 to $7\frac{1}{8}$	$6\frac{7}{8}$	8	$7\frac{1}{4}$	$6\frac{7}{8}$ to 7
July	10	$8\frac{3}{8}$	$8\frac{3}{4}$	8 to $8\frac{1}{8}$	$7\frac{1}{8}$ to $7\frac{1}{4}$	7	8	$7\frac{1}{4}$	$6\frac{7}{8}$ to 7
August	10	$8\frac{1}{4}$	$8\frac{7}{8}$	8	$7\frac{1}{8}$	7	8	$7\frac{1}{4}$	$6\frac{7}{8}$ to 7
September	$9\frac{1}{2}$	$7\frac{5}{8}$	$8\frac{7}{8}$	8	$7\frac{1}{8}$	$6\frac{7}{8}$ to 7	8	$7\frac{1}{4}$	$6\frac{7}{8}$ to 7
October	$9\frac{5}{8}$	$7\frac{1}{2}$	$8\frac{1}{4}$	$7\frac{3}{4}$ to 8	7 to $7\frac{1}{8}$	$6\frac{7}{8}$	$7\frac{1}{4}$ to $7\frac{3}{8}$	$6\frac{1}{2}$	$6\frac{3}{8}$
November	$8\frac{1}{2}$	$7\frac{3}{8}$	$8\frac{1}{4}$	$7\frac{3}{4}$ to $7\frac{7}{8}$	7	$6\frac{3}{4}$ to $6\frac{7}{8}$	$7\frac{1}{8}$ to $7\frac{3}{8}$	$6\frac{3}{8}$ to $6\frac{1}{2}$	$6\frac{1}{4}$ to $6\frac{3}{8}$
December	$8\frac{3}{8}$	$7\frac{3}{8}$	$8\frac{1}{8}$	$7\frac{3}{4}$ to $7\frac{7}{8}$	$6\frac{7}{8}$ to 7	$6\frac{3}{4}$ to $6\frac{7}{8}$	$7\frac{1}{4}$ to $7\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{3}{8}$

Prices of antimony at New York, 1894–1902, by months—Continued.

Month.	1897.			1898.			1899.		
	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	United States.
January	7¼ to 7½	6½ to 6¾	6⅜ to 6⅝	8 to 8¼	7⅛ to 7¼	7⅛ to 7¼	10 to 10⅝	9½ to 9¾	9½
February	7¼ to 7½	6⅝ to 6⅞	6½ to 6¾	8 to 8¼	7¼ to 7½	....	10¼ to 10¾	9½ to 10¼	9½ to 9¾
March	7¼ to 7½	6¾ to 7⅛	6⅝ to 7	8 to 8⅛	7⅝ to 7¾	....	11½ to 12	10½ to 10¾	10¼ to 10¾
April	7¼ to 7½	7 to 7⅛	7 to 7⅛	8⅛ to 9	7¾ to 8	....	11½ to 12	10½ to 10¾	10¼ to 10¾
May	7¼ to 7⅝	7 to 7¼	6¾ to 7¼	9¼ to 9½	8⅜ to 8¾	8¾	11½ to 12	10½ to 10¾	10¼ to 10½
June	7¼ to 7½	6½ to 7	6½ to 6¾	9¼ to 9¾	8¾ to 9	8¾ to 9	11½	10½	10¼
July	7 to 7¾	6⅞ to 7½	6¾	9⅝ to 9¾	9	9	11½	10½	10¼
August	7 to 8¼	7⅜ to 7½	6¾ to 7	9⅝ to 9¾	9	9	11½	10½	10¾ to 11
September	8 to 8¼	7¼ to 7½	7 to 7¼	9⅝ to 9¾	9	9	11½	10½	10¾ to 11
October	8 to 8½	7¼ to 7½	7 to 7⅛	9⅝ to 9¾	9	9	11½	10½	10¼
November	8 to 8½	7¼ to 7½	7 to 7¼	9⅝ to 9¾	9	8⅞ to 9	11¼ to 11½	10¼ to 10½	10 to 10½
December	8 to 8¼	7¼ to 7⅜	7 to 7¼	9⅝ to 9¾	8¾ to 9	8¾ to 8⅞	11¼ to 11½	10¼ to 10½	10 to 10¼

Month.	1900.		1901.			1902.		
	Cookson's.	Hallett's.	Cookson's.	Hallett's.	Others.	Cookson's.	Hallett's.	Others.
January	10½ to 11	9¾ to 9⅞	10¼ to 10½	9¼	8⅜ to 9	10	8 to 8¼	7¾ to 8
February	10½ to 11	9¾ to 10	10¼	9¼	8¾ to 9	10	8 to 8⅛	7¾
March	10½ to 11	9¾ to 10	10¼	8¾ to 9¼	8½ to 9	9¾ to 10	8 to 8⅛	7¾
April	11	9¾	10¼	8¾ to 9	8½ to 8¾	9¾ to 10	8 to 8⅛	7¾
May	11	9¾	10¼	8¾ to 9	8½ to 8¾	9¾ to 10	8 to 8¼	7¾ to 8
June	11	9⅝	10¼	8¾	....	9¾ to 10	8 to 8¼	8
July	10½ to 11	9½ to 9⅝	10¼	8¾	....	9¾	8¼	8
August	10½	9½	10¼	8½ to 8¾	8¼ to 8½	9¾	8 to 8¼	7¾ to 8
September	10½	9½	10¼	8½ to 8¾	8¼ to 8½	9½ to 9¾	7¾ to 8	7¼ to 7¾
October	10½	9½	10¼	8⅜ to 8½	8 to 8¼	9 to 9¾	7½ to 7¾	7¼ to 7½
November	10½	9½	10¼	8⅜	8 to 8¼	9 to 9½	7⅜ to 7⅝	7⅛ to 7¼
December	10½	9½	10¼	8¼ to 8⅜	8 to 8¼	9 to 9½	7⅛ to 7⅜	6¾ to 7

ARSENIC.

By Joseph Struthers.

PRODUCTION.

The production of arsenious oxide (white arsenic) in the United States during 1902 was 1,353 short tons, as compared with 300 short tons in 1901. The entire product was made by the Puget Sound Reduction Company, at Everett, Wash., which began the manufacture of this important substance in 1901. The largely increased output in 1902 is a very favorable sign of the success of the new industry.

Arsenic occurs widely distributed in nature, but only in a few localities is it in sufficient quantity to be of commercial value. The most frequent combination is with iron and sulphur, forming the mineral arsenopyrite commonly called "mispickel." With sulphur alone it occurs as realgar (As_2S_2) and orpiment (As_2S_3), and at Nagy Ag, in Transylvania, Hungary, it is found in the metallic condition. Arsenical ores occur widespread in the United States, especially in the West, and the manufacture of arsenic and its compounds from domestic ores should be developed to supplant the large quantities that are imported from Europe and Canada.

Previous to 1899 the supply of arsenic and its compounds was derived almost entirely from the mines in Cornwall and Devon, England, and near Freiberg, Germany; but the closing of the Devon Great Consols mine, near Tavistock, in 1901, called for an increased or new supply from other localities.

In 1900 Canada contributed a small quantity, which has since been largely increased; and in 1901 the United States became a producer on a small scale, and more than quadrupled its output in 1902.

Although arsenical pyrites (mispickel FeS_2+FeAs_2) has been reported in many localities in Ontario, the entire production of arsenic in Canada during 1901 and 1902 was obtained from the arsenical gold ores of the Deloro mine in Hastings County, which is owned and operated by the Canadian Gold Fields, Limited, a London corporation.

In addition to the gold, which assays from 8 to 15 pennyweights per ton, the ore consists essentially of quartz impregnated with arsenical pyrites and occasionally with copper pyrites, frequently accompanied by a large proportion of iron pyrites. The ore is crushed and amalgamated, yielding directly from 57 to 60 per cent of the original gold value in the ore. The pulp is then concentrated, the concentrates carrying practically the balance of the gold and the arsenic, and the tailings containing less than 2 per cent of the gold in the ore and but 0.5 per cent of arsenic. The concentrates are treated by the Sulman-Teed bromo-cyanide process, and from 87 to 92 per cent of the gold content is extracted, the total recovery of the gold amounting to approximately 90 per cent of the original gold value in the ore. The concentrates contain approximately 30 per cent of arsenious oxide and 16 per cent of sulphur, and to extract the arsenic they are dried and roasted in a revolving cylindrical furnace, the condensed fumes therefrom forming a crude product of 85 per cent arsenious oxide and from 2 to 4 per cent of sulphur. The crude arsenious oxide (called crude arsenic) is refined by sublimation in a reverberatory furnace, and the hot gases therefrom containing the volatile arsenious oxide have the impurities settled out by passage through a number of heated flues. Finally the fumes are delivered to a large brick chamber where the refined arsenious oxide is collected, ground to 100-mesh size, and automatically packed in wooden kegs, each holding 500 pounds. The marketable product contains from 99.6 to 100 per cent of arsenious oxide, the remaining impurity consisting of silica in a finely divided condition.

By far the greater part of the arsenious acid manufactured at Deloro during the last four years has been shipped to New York to supply the demand of consumers in the United States. Indeed, practically the entire supply derived from Canada and the United States is consumed in this country. The domestic production, however, even though aided by imports from Canada, was not sufficient to supply the demand during 1902, and there were imported from Canada, England, Germany, and Spain during the year 1,385,700 pounds of arsenious oxide, valued at $42,424, and 6,725,198 pounds of arsenic sulphide and orpiment, valued at $237,631. The white arsenic industry is a peculiar one, in that the consumption of the substance depends on a number of variables. Much of the product is used by sheep raisers to kill the parasite known as the "sheep tick," which lives in the wool of the animal. In the latter part of 1902 the demand in Australia for this purpose became greatly diminished, possibly due to the extermination of the tick or to the accumulation of stocks by the sheep raisers. At all events, the diminished demand in this field resulted in increased exports from Germany and England to the United States at prices which hindered to some extent the development of the industry in this country.

The production of white arsenic in Canada was 52 metric tons in 1899, 275 tons in 1900, 630 tons in 1901, and 726 tons in 1902.

In 1901 the world's production of arsenic (arsenious oxide) and arsenic sulphide (estimating the output of Turkey the same as in 1900) amounted to 7,794 metric tons (or 17,182,524 pounds), valued at $584,793, as compared with 8,128 metric tons (or 17,918,989 pounds), valued at $735,491, in 1900.

The statistics of the world's production of arsenic and its compounds from 1895 to 1902, inclusive, are given in the following table:

The world's annual production of arsenic, 1895–1902.[a]

[Metric tons.]

Year.	Canada.		Germany.[b]		Italy.[b]		Japan.	Portugal.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*		*Tons.*	*Tons.*	
1895	Nil.	....	3,005	$207,187	100	$8,000	7	....	....
1896	Nil.	....	2,632	221,165	320	24,400	6	....	....
1897	Nil.	....	2,987	295,897	200	18,600	13	524	$20,369
1898	Nil.	....	2,677	253,528	215	15,700	7	751	44,764
1899	52	$4,842	2,423	267,250	304	26,483	5	1,083	61,356
1900	275	22,725	2,414	263,250	126	12,098	5	1,031	62,522
1901	630	41,676	2,549	256,750	6	120	(c)	527	35,277
1902	726	48,000	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Year.	**Spain.[d]**		**United Kingdom.[e]**		**Turkey.[f]**		**United States.[e]**		
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Tons.		*Tons.*		*Tons.*		*Tons.*		
1895	184	$18,390	4,875	$260,990	....	....	....	....	
1896	271	27,100	3,674	227,415	....	....	....	....	
1897	244	29,256	4,232	373,975	....	....	....	....	
1898	111	13,320	4,241	268,935	....	....	....	....	
1899	101	12,156	3,890	271,180	....	....	....	....	
1900	150	18,036	4,146	335,140	274	$21,600	....	....	
1901	120	14,400	3,416	197,270	(c)	(c)	272	$18,000	
1902	(c)	(c)	2,464	....	(c)	(c)	1,226	81,180	

[a] From official reports of the respective countries.
[b] Metallic arsenic and arsenious oxide.
[c] Statistics not available at time of publication.
[d] Arsenic sulphide.
[e] Arsenious oxide.
[f] Exports.

IMPORTS.

The significance of the importation of arsenic and its compounds for the manufacturing industries of the United States may be appreciated from the statistics given in the following table:

Imports of metallic arsenic, white arsenic (arsenious acid), and arsenic sulphides (orpiment and realgar) in the United States, 1893–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1893	6,092,377	$180,333	1898	8,686,681	$370,347
1894	7,063,442	218,636	1899	9,040,871	386,791
1895	6,984,273	237,747	1900	5,765,559	265,500
1896	5,813,387	215,281	1901	6,989,668	316,525
1897	7,242,004	352,284	1902	8,110,898	280,055

PRICES.

The price for white arsenic at New York during 1902 varied from 3.34 cents per pound in January to 2.94 cents in December, the monthly average for the year being 3.16 cents. Red arsenic ranged in price from 7.03 cents per pound in January to 6.88 cents in December, the monthly average for the year being 6.86 cents a pound.

USES.

The chief use for arsenious oxide is in the manufacture of paris green, although it is used to a minor extent to make Scheele's green, London purple, lead arsenate, sodium arsenate, potassium arsenate, and other arsenic salts. In the arts or trades paris green is used to exterminate the potato beetle and other insects injurious to vegetables. Paris green has a peculiar light green shade possessed by no other pigment; but, owing to its poisonous character, its use as a dyestuff is very restricted. Arsenic, as a vermicide, is used in various ways; either in the form of the oxide or of an arsenate salt (called "sheep dip") for parasites affecting sheep and cattle; also as a weed killer. The oxide is used in the manufacture of fine grade glassware and special enamels; as a fixing and conveying substance for analine dyes; as a preservative for raw hides, both in taxidermy and in storage for manufacture into leather, and to a minor extent in the preparation of certain medicinal compounds and embalming fluids.

BISMUTH.

By Joseph Struthers.

PRODUCTION.

There was no production of bismuth ore in the United States during 1902, as compared with the marketed output of 318.6 short tons in 1901, and of 220 tons in 1900. The entire production has hitherto been obtained from Colorado. The production during 1901 was purchased by the Leadville Sampler, at Leadville; the State Ore Sampling Works, at Denver; or was shipped direct to Johnson, Matthey & Co., Limited, England.

OCCURRENCE.

Bismuth occurs both free and combined in many of the Western States. In Colorado it has been found as metallic bismuth, bismuth carbonate, bismuth telluride, and bismuth tellurate. A recent discovery of bismuth-carbonate ore is reported in Arizona, on Salt River, near its junction with the Verde River, between Fort McDowell and Superstition Mountain, and excellent specimens of bismuth tellurate (the mineral montanite, $Bi_2O_3 . TeO_3 . 2 H_2O$) have been obtained from Salida, Chaffee County, Colo. Bismuth ore varies greatly in composition. That produced during 1901 assayed from 4 to 12 per cent of bismuth, from 1 to 2 ounces of gold, and from 5 to 6 ounces of silver per ton. That produced in 1902 contained from 7.8 to 27.1 per cent of bismuth, from 3.5 to 22.6 ounces of gold, and from 3.45 to 3.5 ounces of silver per ton.

PRICE.

The production and price of bismuth and its ores continue under the control of Johnson, Matthey & Co., Limited, and the government of Saxony—a combination of interests formed in order to maintain for the products a price at which the mines could be operated with profit. The supply of metallic bismuth far exceeds the demand, and unless the output be restricted the price would fall to a point which would render the manufacture of the metal no longer profitable. The schedule of prices of ore is based on the market price of the metal. The latest published figures for Colorado, with metal at $1.25 per pound, were: Ten per cent ore, $150 per ton; 15 per cent ore, $250 per ton; 20 per cent ore, $350 per ton; 30 per cent ore, $550 per ton; 40 per cent ore, $750 per ton; 50 per cent ore, $1,000 per ton.

The price in the United States for the bismuth content of the ore varies from $8 to $11 per unit, the producers being paid also for the gold and silver contents. No price was quoted for the output during 1902, but as near as can be ascertained the value of the output in 1901 was $80 per ton, not including charges for transportation or treatment. The wholesale price for metallic bismuth throughout 1902, f. o. b. works, was $1.50 per pound.

Bismuth is usually found in ores containing other metals which render its extraction somewhat complex. The trade and the price being under control and the domestic demand being comparatively small, the erection of new works to manufacture and refine this metal in the United States is hardly attractive from a commercial point of view.

IMPORTS.

The imports of metallic bismuth into the United States in 1902 were 190,837 pounds, valued at $213,704, as compared with 165,182 pounds, valued at $239,061, in 1901. There was also imported a small quantity of bismuth salts in pharmaceutical compounds.

USES.

The metal bismuth is utilized chiefly in the manufacture of alloys which melt at comparatively low temperatures, and are, consequently, of great value for special purposes, such as safety plugs for wire circuits carrying electric current, safety plugs for steam boilers, light solders, amalgams in dentistry for filling cavities in teeth, for taking impressions of woodcuts, coins, etc., and as a tempering bath in steel works. The chief alloys of bismuth used on account of their low melting points contain bismuth, lead, tin, and cadmium, as shown in the subjoined table:

Composition of bismuth alloys of low melting points.

Name.	Composition.				Melting point.
	Bismuth.	Lead.	Tin.	Cadmium.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	°C.
Newton	20	50	30	Nil.	94.5
Rose	50	25	25	Nil.	93.75
Lichtenberg	50	30	20	Nil.	91.6
Wood	50	25	12.5	12.5	71
Lipowitz	50	27	4	3	60

TUNGSTEN, MOLYBDENUM, URANIUM, AND VANADIUM.

By Joseph Hyde Pratt.

INTRODUCTION.

Although there are still many inquiries being made regarding the occurrence and localities of minerals containing tungsten, molybdenum, uranium, and vanadium, there has not been any decided change in the quantity of these minerals that the market demands. That they are of value in the manufacture of the different ferro-alloys has been demonstrated, and undoubtedly the use of all of these metals for this purpose will increase to a certain extent. One of the noticeable changes in the industry of these metals is the lower prices asked for them at the end of 1902, as compared with those of 1901. The outlook for 1903 is for a greater production of all these minerals than during 1902, and within the next few years there will undoubtedly be a constant demand for them, with a more stable market value. At the present time there is no large or fixed market, and the prices are apt to fluctuate very widely.

Although it has been determined that these metals do have beneficial effects upon steel, when used in its manufacture, considerable study of them is necessary before their commercial position with respect to one another or to nickel and chromium can be definitely determined. They offer an interesting field of investigation from both a scientific and a commercial point of view, in regard to their relative value in the manufacture of tools and their effect upon different forms of iron to be used in various parts of machinery. Questions come up as to which of these various hardened irons are the best adapted for steel drills, for dies and shoes in stamp mills, jaws in crushers, rolls, car axles, carpenters' tools, etc.; as to which retain the best cutting edge; as to which will heat the least when in use, and as to which will make the toughest iron. These questions can be most satisfactorily answered by making comparative tests with the different alloy steels. Mr. A. B. Frenzel, of Denver, Colo., has offered prizes at a number of the schools of mines in the United States for investigations relating to these ferro-alloys, in respect of the questions raised above with regard to the physical and chemical properties of the alloys, with regard to the effect of the variation in amount of the hardening metal added, and with regard to the methods of analysis.

Sufficient deposits of all these ores are known to supply any demand that may arise for them, so that at the present time it is not a question of supply, but of market.

TUNGSTEN.

PRODUCTION.

The production of crude tungsten ores during 1902 was 184 short tons, of which not more than a few tons were sold. This does not represent the amount of tungsten ore sold in 1902, for there were 76 tons of concentrated ore mined in 1901 that were sold in 1902. Some of the tungsten ore was put on the market in the crude state and some was concentrated to from 60 to 65 per cent tungstic oxide. A product containing this percentage of tungstic oxide is valued at $2.50 to $3 per unit. In 1901 the production amounted to 179 tons of concentrated ore valued at $27,720. The larger part of the production of 1902 was from Colorado, with a smaller amount from Connecticut. There were no new localities developed during 1902, and all the production was from the old deposits. The use of tungsten steel is being introduced for steels in drilling, and it seems very probable that it will be found especially adapted for this purpose.

The Great Western Exploration and Reduction Company, of Boulder, Colo., the largest producers, placed some of their product on the market as concentrated ore and some as ferro-tungsten alloy.

There were small amounts of tungsten ore (wolframite) and tungsten iron imported into the United States in 1902, which were valued, collectively, at $7,046.

MOLYBDENUM.

As a result of the many inquiries made for the ores of molybdenum, there are a number of localities that have been developed in 1902, and preparations have been made to place their product on the market. The most work of this character has been in Washington County, Me., where the American Molybdenum Company has been developing a deposit of molybdenite near Cooper. It has erected a mill for treating the ore and expects to be in a position to ship the commercial product during 1903. The molybdenite is of good quality and is apparently in quantity.

Although there are a number of other good deposits of this mineral in the United States, there was but little development work done on them, owing chiefly to the uncertainty of the market.

PRODUCTION.

With the exception of a few tons mined for experimental purposes, the entire production of commercial molybdenite was by the Crown Point Mining Company, of Seattle, Wash., from their property in the western part of Chelan County. This production amounted to 10 or 12 tons, approximately the same as that of 1901, but none of the product was shipped in 1902. The value of these molybdenum ores is very erratic, the highest price quoted up to this time being $1,500 per ton and the lowest $100. It is very probable that with any constant demand for these ores they would be furnished in quantity at a price varying from $100 to $200 per ton for a 50 to 55 per cent ore.

URANIUM AND VANADIUM.

There has, perhaps, been more progress in the development of deposits of minerals containing uranium and vanadium during 1902 than of those containing tungsten or molybdenum. Mr. A. B. Frenzel, of Denver, Colo., has been carrying on extensive development work on the deposits at La Salle Creek, southwest of Paradox, Montrose County, Colo. The demand has increased for these metals for use in the manufacture of ferro-uranium and ferro-vanadium alloys, and also for the manufacture of salts of these metals. The larger proportion of the product mined is exported. Promising deposits of vanadinite, the vanadate of lead, have been found during the last year in Arizona and are now being investigated by Mr. Frenzel, who states that he has perfected a process for the extraction of vanadium oxide from these ores.

PRODUCTION.

There was a marked increase in the production of uranium and vanadium minerals in 1902, which, as reported to the Survey, amounted to 3,810 tons, valued at $48,125, or $12.62 per ton. This, of course, represents the crude ore. In 1901 the production was 375 tons of crude ore. A portion of the uranium ore was treated, giving a concentrated product of 25 tons, which was valued at $8,000, or $320 per ton. What percentage of uranium oxide this concentrated ore contained is not known. The crude vanadium ore, of which there were 3,000 tons produced, contained from 2.5 to 4 per cent of vanadium oxide, and the crude uranium ore from 2.5 to 5 per cent of uranium oxide. All of this production was not sold in 1902. It consisted principally of the mineral carnotite, with smaller amounts of uraninite (pitch blende) and vanadinite.

IMPORTS.

Nearly all of the uranium and vanadium ores have been shipped abroad in the crude state, as mined. It has been estimated that there are manufactured annually different salts of these metals to the value of about $200,000. Of this amount, about $15,000 in value per annum has been imported into the United States. In 1902 the value of the imports of the salts of uranium and vanadium was $12,491.

COAL.

By Edward W. Parker.

INTRODUCTION.

Two prominent features connected with the coal-mining industry in 1902 were, first, the great strike in the anthracite regions of Pennsylvania, and, second, the utterly inadequate transportation facilities throughout most of the bituminous-coal regions. Replete as is the history of the anthracite regions with strikes, lockouts, and boycotts, there has never before been a time when the mines were so completely tied up and the supply of anthracite so entirely shut off as during the summer and early fall months of 1902. Never before had the public of the Eastern States been made to feel how dependent it was upon this source for fuel. The strike, which began on May 12, was not terminated until October 25, when, at the request of the operators and miners, a Commission was appointed by the President of the United States "to inquire into, consider, and pass upon the questions in connection with the strike in the anthracite region, and the causes out of which the controversy arose." It was agreed that upon the appointment of this Commission the miners should immediately return to work, in order that the needs of the public might be filled, and that both parties should, in good faith, abide by the findings and award of the Commission. Owing to the fact that many of the mines had filled with water or been otherwise damaged by the five and a half months of idleness, full operations could not be resumed immediately, and it was several weeks before production assumed normal proportions. Fortunately, the winter was an unusually mild one, for otherwise great distress must have ensued. The Commission completed its labors and made its report to the President on March 18. It was immediately transmitted to the Senate, sitting in extra session, read, and ordered to be printed. It was given to the public on Saturday, March 21, five months after the date of the appointment of the Commission. Notwithstanding statements to the contrary which have appeared from time to time in the sensational press, there has evidently been an earnest effort on the part of both operators and miners to abide by the decisions of the Commission, and it is believed that the agreement to do so for a period of three years will insure general peace in the region for that length of time at least. The effect of the strike upon the production is referred to in the subsequent pages. The report of the Commission, which can be obtained upon application, contains some interesting statistical data in addition to the decisions rendered upon the points in controversy.

What distress there was would have been appreciably mitigated had the railroads been able to meet the demands made upon them by the miners and shippers of bituminous coal, which commodity was in enormous demand. It has been impossible, however, for the transportation companies to provide equipment and motive power rapidly enough for the great increase in business of the last five years. Cars, locomotives, and even trackage facilities fell far short of the requirements, and the greater distance of the bituminous fields from the eastern markets simply added that much more of a burden to an already overloaded industry. Large quantities of soft coal did, of course, find their way to the eastern markets, and for three or four months the atmospheres of Boston, New York, Philadelphia, Baltimore, and other cities of the Atlantic coast States were nearly as smoke-laden as some of their industrial rivals in the Middle West. It is well within moderate bounds, however, to state that if the transportation companies had been able to take care of the business offered them the production of bituminous coal would have exceeded by 20,000,000 tons the record actually made.

Outside of these notable features, the most interesting facts brought out by the statistical inquiries for 1902 were (1) an increase of nearly 8,000,000 short tons in the total production, notwithstanding a loss of over 26,000,000 short tons in the output of anthracite; (2) a marked increase in the use of mining machines, and in the tonnage produced by them; (3) comparative immunity from strikes in the bituminous regions, with the exception of West Virginia, Kentucky, and Michigan; (4) the development of large areas of new coal lands and the opening of many new mines, and the combining or merging under one head of many formerly independent concerns; (5) a perceptible increase for 1902 in the productive capacity per man employed, both for the year and for each day worked, as compared with 1901. These features are all discussed in some detail in the following pages.

The United States retains its position as first among the coal-producing countries of the world, a position taken in 1899 and strengthened each year since that date. This country now produces about one-third the entire world's supply of coal, and consumes from 97 to 98 per cent of it within its own borders.

ACKNOWLEDGMENTS.

The writer desires to express again his sincere appreciation of the many courtesies extended to him in the preparation of this report by the individual mine operators and by the officials of mining companies, who have not only willingly furnished the statements of their production, but have, without exception, cheerfully replied to any special inquiries incident to the investigation. Acknowledgments are also due to the special agents and field assistants of the Geological Survey and to the special agents of the Twelfth United States Census, who have assisted in the collection of the statistical data compiled in this report. Reviews of the coal trade in some of the important industrial cities, which have been contributed by well-known local authorities, are acknowledged by name in connection with their contributions. The subchapter on anthracite production has been, as formerly, prepared by Mr. William W. Ruley, Chief of the Bureau of Anthracite Coal Statistics, in Philadelphia.

UNIT OF MEASUREMENT.

The standard unit of measurement adopted for this report is the short ton of 2,000 pounds, although it is necessary in a few instances to use the long ton. All of the anthracite product is mined and sold upon the basis of the long ton of 2,240 pounds, and the laws of Maryland require the use of the long ton in that State. Hence, when considering the production of Pennsylvania anthracite the long ton is used, and this unit is also employed in the table showing the shipments of bituminous coal from the Cumberland region. The long ton is also used in the statistics of imports and exports. In all other cases where the production is reported in long tons the figures have been reduced to short tons, and unless otherwise expressly stated the short ton is meant when any quantity is expressed in the text.

COAL FIELDS OF THE UNITED STATES.

The coal areas of the United States are divided, for the sake of convenience, into two great divisions, anthracite and bituminous.

The areas in which anthracite is produced are confined almost exclusively to the eastern part of Pennsylvania, and as a usual thing, when the anthracite fields of the United States are referred to, those of eastern Pennsylvania are considered. This region is included in the counties of Susquehanna, Lackawanna, Luzerne, Carbon, Schuylkill, Columbia, Northumberland, Dauphin, and Sullivan, and underlies an area of about 484 square miles. In addition to these well-known anthracite fields of Pennsylvania there are two small areas in the Rocky Mountain region where the coal has been locally anthracited, although the production from these districts has never amounted to as much as 100,000 tons in any one year. One of these localities is in Gunnison County, Colo., and the other in Santa Fe County, N. Mex.

The coal, although only locally metamorphosed, is a true anthracite, and of a good quality. In previous years some coal which was classed as anthracite was mined and sold in New England. The productive area was confined to the eastern part of Rhode Island, and the counties of Bristol and Plymouth, in Massachusetts. This product, however, is in reality a graphitic and not an anthracite coal, and is no longer mined for fuel purposes. The production in the last few years has been included with the graphite production.

The bituminous areas are scattered widely over the United States, and include altogether an area of something over 335,000 square miles. They are divided into the following subdivisions:

(1) The Triassic field, embracing the coal beds of the Triassic or New Red Sandstone formation in the Richmond Basin, in Virginia, and in the coal basins along the Deep and Dan rivers in North Carolina; (2) the Appalachian field, which extends from the State of New York on the north to the State of Alabama on the south, having a length northeast and southwest of over 900 miles and a width ranging from 30 to 180 miles; (3) the northern field, which is confined exclusively to the central part of Michigan; (4) the central field, embracing the coal areas in Indiana, Illinois, and western Kentucky; (5) the western field, including the coal areas west of the Mississippi River, south of the forty-third parallel of north latitude and east of the Rocky Mountains; (6) the Rocky Mountain field, containing the coal areas in the States and Territories lying along the Rocky Mountains; (7) the Pacific coast field, embracing the coal districts of Washington, Oregon, and California.

By far the most important of these, from a productive standpoint, is the Appalachian system, which includes the areas contained in western Pennsylvania and in Ohio, Maryland, Virginia, West Virginia, eastern Tennessee and Kentucky, Georgia, and Alabama. This region contains an area underlain by coal of 70,807 square miles, and it produced in 1902 173,274,861 short tons, or 66.6 per cent of the total bituminous product of the United States. Next in importance is the central field, which contains 58,000 square miles and produced in 1902 46,133,024 short tons, or 17.73 per cent of the total. The western coal field, the third in productive importance, contains 94,076 square miles, and produced in 1902 20,727,495 short tons, or 7.97 per cent of the total. The Rocky Mountain region is the largest in point of size, having a little over 100,000 square miles of area, and produced in 1902 16,149,545 short tons, or 6.21 per cent of the total.

For a more extended description of the coal producing areas of the United States the reader is referred to the Twenty-second Annual Report of the Survey, Part III.

The following table shows the approximate areas of the coal fields in the various States, grouped according to the divisions mentioned above, with the total output from each, from 1898 to 1902:

Coal fields of the United States and their production, 1898–1902.

	Area.	1898.	1899.	1900.	1901.	1902.
Anthracite.	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	484	53,382,644	60,418,005	57,367,915	67,471,667	41,373,595
Colorado and New Mexico	16	47,095	96,196	98,404	66,869	93,937
	500	53,429,739	60,514,201	57,466,319	67,538,536	41,467,532
Bituminous.[a]						
Triassic:						
Virginia	270	38,938	28,353	57,912	12,000	16,206
North Carolina	800					23,000
Appalachian:						
Pennsylvania	15,800	65,165,133	74,150,175	79,842,326	82,305,946	98,574,367
Ohio	12,000	14,516,867	16,500,270	18,988,150	20,943,807	23,519,894
Maryland	510	4,674,884	4,807,396	4,024,688	5,113,127	5,271,609
Virginia	1,850	1,787,831	2,104,334	2,353,576	2,725,873	3,166,787
West Virginia	17,280	16,700,999	19,252,995	22,647,207	24,068,402	24,570,826
Eastern Kentucky	10,300	1,591,076	1,871,550	2,222,867	2,268,892	3,019,757
Tennessee	4,400	3,022,896	3,330,659	3,509,562	3,633,290	4,382,968
Georgia	167	244,187	233,111	315,557	342,825	414,083
Alabama	8,500	6,535,283	7,593,416	8,394,275	9,099,052	10,354,570
	70,807	114,239,156	129,843,906	142,298,208	150,501,214	173,274,861
Northern:						
Michigan	11,300	315,722	624,708	849,475	1,241,241	964,718
Central:						
Indiana	9,300	4,920,743	6,006,523	6,484,086	6,918,225	9,446,424
Western Kentucky	5,800	2,296,832	2,735,705	3,106,097	3,201,094	3,747,227
Illinois	42,900	18,599,299	24,439,019	25,767,981	27,331,552	32,939,373
	58,000	25,816,874	33,181,247	35,358,164	37,450,871	46,133,024
Western:						
Iowa	20,000	4,618,842	5,177,479	5,202,939	5,617,499	5,904,766
Missouri	23,000	2,688,321	3,025,814	3,540,103	3,802,088	3,890,154
Nebraska	3,200	....	....	....	....	....
Kansas	20,000	3,406,555	3,852,267	4,467,870	4,900,528	5,266,065
Arkansas	1,728	1,205,479	843,554	1,447,945	1,816,136	1,943,932
Indian Territory	14,848	1,381,466	1,537,427	1,922,298	2,421,781	2,820,666
Texas	11,300	686,734	883,832	968,373	1,107,953	901,912
	94,076	13,988,436	15,320,393	17,549,528	19,665,985	20,727,495
Rocky Mountain, etc.						
North Dakota	28,620	83,895	98,809	129,883	166,601	226,511
Montana	32,000	1,479,803	1,496,451	1,661,775	1,396,081	1,560,823
Wyoming	16,500	2,863,812	3,837,392	4,014,602	4,485,374	4,429,491
Utah	2,000	593,709	786,049	1,147,027	1,322,614	1,574,521
Colorado	18,100	4,053,210	4,718,590	5,182,176	5,668,886	7,348,732
New Mexico	2,890	968,330	1,012,152	1,263,083	1,050,806	1,007,437
Idaho	....	1,039	20	10	....	2,030
Nevada	....	....	....	....	....	....
	100,110	10,042,759	11,949,463	13,398,556	14,090,362	16,149,545
Pacific coast:						
Washington	450	1,884,571	2,029,881	2,474,093	2,578,217	2,681,214
Oregon	320	58,184	86,888	58,864	69,011	65,648
California	280	160,288	160,972	171,708	151,079	84,984
Alaska	....	1,600	1,200	1,200	1,300	2,212
	1,050	2,104,643	2,278,941	2,705,865	2,799,607	2,834,058
Total production, including colliery consumption	....	219,976,267	253,741,192	269,684,027	293,299,816	301,590,439

[a] Includes brown coal or lignite, semianthracite, semibituminous, etc., and scattering lots of anthracite.

The total production of each field since 1887 has been as follows:

Total production of each field, 1887–1902.

	Anthracite.	Bituminous.		
		Triassic.	Appalachian.	Northern.
Area .... square miles..	500	1,070	70,807	11,300
Year.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1887	39,548,255	30,000	55,888,088	71,461
1888	43,971,688	33,000	60,966,245	81,407
1889	45,600,487	49,633	62,972,222	67,431
1890	46,468,641	29,608	73,008,102	74,977
1891	50,665,931	37,645	77,984,563	80,307
1892	52,537,467	43,889	83,122,190	77,990
1893	54,061,121	36,878	81,207,168	45,979
1894	51,992,671	68,979	76,278,748	70,002
1895	58,066,516	82,682	90,167,596	112,322
1896	54,425,573	103,483	90,748,305	92,882
1897	52,680,756	116,950	97,128,220	223,592
1898	53,429,739	38,938	114,239,156	315,722
1899	60,514,201	28,353	129,843,906	624,708
1900	57,466,319	57,912	142,298,208	849,475
1901	67,538,536	12,000	150,501,214	1,241,241
1902	41,467,532	39,206	173,274,861	964,718

	Bituminous.			
	Central.	Western.	Rocky Mountain, etc.	Pacific coast.
Area .... square miles..	58,000	94,076	43,610	1,050
Year.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1887	14,478,883	10,172,634	3,646,280	854,308
1888	19,173,167	11,842,764	4,583,719	1,385,750
1889	16,240,314	10,036,356	5,048,413	1,214,757
1890	20,075,840	10,470,439	6,205,782	1,435,914
1891	20,327,323	11,023,817	7,245,707	1,201,376
1892	23,001,653	11,635,185	7,577,422	1,333,266
1893	25,502,809	11,651,296	8,468,360	1,379,163
1894	22,430,617	11,503,623	7,175,628	1,221,238
1895	23,599,469	11,749,803	7,998,594	1,340,548
1896	25,539,867	11,759,966	7,925,280	1,391,001
1897	26,414,127	13,164,059	8,854,182	1,641,779
1898	25,816,874	13,987,397	10,043,798	2,104,643
1899	33,181,247	15,320,373	11,949,463	2,278,941
1900	35,358,164	17,549,528	13,398,556	2,705,865
1901	37,450,871	19,665,985	14,090,362	2,799,607
1902	46,133,024	20,727,495	16,149,545	2,834,058

In order to show the development of the six principal bituminous areas since 1887, the following table has been prepared, which gives the amount produced in each field in that year, and also in 1900, 1901, and 1902, with the percentages of the total contributed by each, and the increases in 1902 as compared with 1901 and with 1887.

Production of the six principal bituminous coal fields in 1887, 1900, 1901, and 1902 compared.

Field.	1887.		1900.		1901.		1902.	
	Quantity.	Per cent of total.	Quantity.	Per cent of total.	Quantity.	Per cent of total.	Quantity.	Per cent of total.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Appalachian	55,888,088	63.11	142,298,208	67	150,501,214	66.7	173,274,861	66.60
Central	14,478,883	16.5	35,358,164	16.6	37,450,871	16.6	46,133,024	17.73
Western	10,172,634	11.49	17,549,528	8.3	19,665,985	8.7	20,727,495	7.97
Northern	71,461	.08	849,475	.4	1,241,241	.5	964,718	.37
Rocky Mountain	3,646,280	4.15	13,398,556	6.3	14,090,362	6.2	16,149,545	6.21
Pacific coast	854,308	1	2,705,865	1.27	2,799,607	1.2	2,834,058	1.07

Field.	Increase in 1902 over 1887.		Increase in 1902 over 1901.	
	Quantity.	Per cent.	Quantity.	Per cent.
	Short tons.		*Short tons.*	
Appalachian	117,386,773	210.04	22,773,647	15.13
Central	31,654,141	218.62	8,682,153	23.18
Western	10,554,861	103.76	1,061,510	5.40
Northern	893,257	1,249.99	[a] 276,523	[a] 22.28
Rocky Mountain	12,503,265	342.90	2,059,183	14.61
Pacific coast	1,979,750	231.74	34,451	1.23

[a] Decrease.

PRODUCTION.

The total production of anthracite and bituminous coal in the United States during 1902 amounted to 301,590,439 short tons, valued at $367,032,069 against 293,299,816 short tons, valued at $348,926,069 in 1901, and 269,684,027 short tons, valued at $306,688,164 in 1900. The net increase in production in 1902 over 1901, notwithstanding a loss of over 26,000,000 short tons in the output of anthracite, was 8,290,623 short tons, or 2.8 per cent. The gain in value amounted to $18,106,000, or 5.2 per cent, and represented $2 per ton on the increase in product.

It is just twenty years since the production of coal in the United States reached a total of 100,000,000 tons, that figure having been attained in 1882 when the output amounted to 103,285,789 short tons. Fifteen years later, in 1897, the production passed, for the first time, the 200,000,000-ton mark, and in five years from that date another 100,000,000 tons were added to the record. From the time that coal mining first began, about 1814, until the first 100,000,000 tons of production was reached, a period of over sixty years was required, the second 100,000,000 mark was passed in fifteen years and the third in five years. This great development in the last two decades has been due simply to the industrial growth of the United States, a fact abundantly proved by comparing the statistics of coal production with the statistics of our increase in population. Unfortunately, from lack of reliable data, this comparison can not be carried back to an earlier date than the census year of 1870, but even for this period the comparisons are interesting. In 1870 the population of the United States was 38,558,371; the coal production in that year amounted to 36,806,560 short tons, an average of 0.95 ton per capita. Ten years later, when the population was 50,189,209 the output of coal amounted to 71,481,569 short tons, or 1.42 tons per capita. In 1890 the population had grown to 63,069,756, an increase of 26 per cent over 1880, while the coal production had more than doubled to 157,770,903 short tons, the per capita production being 2.50 tons. At the latest census, in 1900, the population had increased 21 per cent to 76,303,387, while more than 70 per cent had been added to the coal production of ten years before and it had reached a total of 269,684,027 short tons, or an average of 3.53 tons for each inhabitant. In other words, while the population from 1870 to 1900 had shown an increase of 98 per cent the production of coal had increased 633 per cent. Carrying this comparison a little further we find that the production of Pennsylvania anthracite, particularly in the last twenty years, has been more nearly in proportion to the population of the States in which it finds its chief market. In 1880 the per capita production of anthracite coal in the territory naturally tributary to it was 1.82 tons; in 1890 it was 2.47 tons, and in 1900, 2.53 tons. Bituminous coal production per capita on the other hand, taking the entire population as consumers, was 0.85 ton in 1880, 1.76 tons in 1890, and 2.78 tons in 1900.

The production of anthracite in Pennsylvania in 1902 amounted to 36,940,710 long tons, or 41,373,595 short tons, valued at $76,173,586, against 60,242,560 long tons, or 67,471,667 short tons, valued at $112,504,020, in 1901. The decrease in output in 1902, as compared with 1901, was 23,301,850 long tons, or 26,098,072 short tons, with a loss of $36,330,434 in value. The percentage of decrease in tonnage was 38.7, and in the value 32.3. The decrease was due entirely to the prolonged strike in the summer and fall of 1902, which is discussed elsewhere and need not be more fully referred to here.

The bituminous coal product, as collated for this report, includes the true bituminous coals, coking or noncoking, and also such other varieties as semianthracite, semibituminous, cannel, splint, block, and lignite or brown coals. It also includes the small anthracite product of Colorado and New Mexico. This output in 1902 amounted to 260,216,844 short tons, valued at $290,858,483, which, as compared with the 225,828,149 short tons, valued at $236,422,049, in 1901, shows an increase of 34,388,695 short tons, or 15 per cent in quantity, and of $54,436,434, or 23 per cent in value. The average price of $1.12 per ton received for the bituminous coal product of 1902 was the highest record made since 1885.

Of the 30 States and Territories included in the following tables 23 increased their production over 1901, while 7 showed decreases. The most notable decrease was made in Pennsylvania, where, on account of the five-months' strike in the anthracite region, the total output of the State fell off 9,829,651 short tons. In the other six States, where decreases were shown, only one, Michigan, is located east of the Mississippi River. Two, New Mexico and Wyoming, are among the Rocky Mountain States, and two, California and Oregon, are on the Pacific coast. The sixth, Texas, is included in the areas of the Western coal field. The largest decrease in the six bituminous-coal producing States was sustained by Michigan (276,523 tons), and was due to a strike called for the purpose of enforcing certain demands of the union in the coal mines of that State. The next heaviest loss was sustained by Texas, and was due to the competition of fuel oil, brought about by the large production of that fuel at Beaumont, Sour Lake, etc. The decrease in California is also attributed to the great increase of oil production and its consumption for fuel in that State, and this was also probably responsible for the decrease in Oregon, whose principal coal market is in California. No special cause is assigned to the decreases in New Mexico and Wyoming.

The principal labor troubles in 1902 were in the anthracite regions of Pennsylvania, in the southern counties of West Virginia, and in Michigan. The total number of men on strike in 1902 was about 200,000, of whom 145,000 were anthracite workers. The aggregate time lost amounted to 16,672,217 days of ten hours. In 1901 the total number of men on strike during the year was 20,593 and the time lost 733,802 days.

The statistics regarding the use of machines in the bituminous coal mines of the United States show that in 1902 there were 5,418 machines in use, against 4,341 in 1901 and 3,907 in 1900. The machine-mined product has increased from 52,784,523 tons in 1900 to 57,843,335 tons in 1901 and to 69,611,582 tons in 1902. That the use of machines for mining coal is increasing in faster ratio than the total production is shown by the fact that the percentage of the total mined by machines has increased each year. The percentage of the total product mined by machines in the States using them was 27.09 in 1902, 25.68 in 1901, and 25.15 in 1900.

The total number of men employed in the coal mines of the United States in 1902 was 518,197, against 485,544 in 1901. The distribution of this labor in 1902 was as follows: In the anthracite mines of Pennsylvania 148,141 men, who averaged 116 days each in working time; in the bituminous coal mines, 370,056 men; average working time 230 days.

In considering the coal product, these reports include not only the coal marketed either by shipment to distant points or sold locally, but also that consumed by mine employees and by the mine operators in locomotives and for other power or heating purposes in connection with the mining operations. This latter factor is usually considered and reported as colliery consumption. There are occasional exceptions in the bituminous fields where operators use only slack, an otherwise wasted product, of which no record is kept and which is not reported in the production. It does not appear in the product nor is the miner paid for mining it. These exceptions are few and the amount is comparatively small. The coal consumed in the manufacture of coke is also considered in this report. The amount of coal made into coke at the mines in 1902 was 34,169,730 short tons. The coal sold to local trade and employees and used in the manufacture of coke is included in the marketable product. The colliery consumption in the anthracite region, which is not considered in the value of the anthracite product, ranges from 8 to 10 per cent of the total anthracite output. The colliery consumption of the bituminous mines averages between $1\frac{1}{2}$ and 2 per cent of the total bituminous product. Deducting the colliery consumption from the total in 1902, the marketable product is shown to have been 291,594,578 short tons, as compared with 282,920,270 short tons in 1901.

Coal production of the United States in 1901, by States.

State.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Alabama	6,616,594	85,029	214,952	2,182,477	9,099,052	$10,000,892	$1.10	236	17,370
Arkansas	1,754,527	11,926	49,683	....	1,816,136	2,068,613	1.14	221	3,144
California	132,566	597	17,916	....	152,379	409,706	2.60	289	428
Colorado	4,350,285	92,304	157,579	1,099,847	5,700,015	6,441,891	1.13	253	8,870
Georgia and North Carolina	259,581	550	3,930	90,764	354,825	426,685	1.20	291	791
Idaho	....	....	....	....	0	....	......	......	....
Illinois	24,295,861	2,156,344	879,347	....	27,331,552	28,163,937	1.03	220	41,880
Indiana	6,373,083	353,111	192,031	....	6,918,225	7,017,143	1.01	194	12,968
Indian Territory	2,249,100	31,370	83,183	58,128	2,421,781	3,915,268	1.62	208	6,706
Iowa	4,810,953	666,882	139,664	....	5,617,499	7,822,805	1.39	218	12,653
Kansas	4,539,990	287,909	72,629	....	4,900,528	5,991,599	1.22	224	9,928
Kentucky	4,947,716	273,046	87,947	161,277	5,469,986	5,213,076	.95	213	10,307
Maryland	5,043,991	41,282	27,854	....	5,113,127	5,046,491	.99	262	5,333
Michigan	1,158,096	44,749	38,396	....	1,241,241	1,753,064	1.41	247	2,276
Missouri	3,411,123	332,732	58,233	....	3,802,088	4,707,164	1.24	223	9,871
Montana	1,210,665	40,842	41,624	102,950	1,396,081	2,009,316	1.44	231	2,158
New Mexico	1,023,010	15,624	33,617	14,295	1,086,546	1,546,652	1.42	224	2,478
North Dakota	134,664	26,775	5,162	....	166,601	214,151	1.29	198	280
Ohio	19,303,851	1,366,378	264,478	9,100	20,943,807	20,928,158	1.00	198	32,111
Oregon	53,472	14,531	1,008	....	69,011	173,646	2.52	228	187
Pennsylvania	60,165,317	1,681,282	1,339,096	19,120,251	82,305,946	81,397,586	.99	230	101,904
Tennessee	2,807,931	78,979	60,461	685,919	3,633,290	4,067,389	1.12	228	9,046
Texas	1,084,381	4,425	19,147	....	1,107,953	1,907,024	1.72	264	3,051
Utah	1,272,848	18,333	30,446	987	1,322,614	1,666,082	1.26	259	1,712
Virginia	1,390,724	16,011	28,752	1,290,386	2,725,873	2,353,989	.86	279	4,152
Washington	2,400,276	18,553	75,678	83,710	2,578,217	4,271,076	1.66	276	4,545

Coal production of the United States in 1901, by States—Continued.

State.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
West Virginia	19,859,809	574,746	255,618	3,378,229	24,068,402	$20,848,184	$0.87	219	30,935
Wyoming..........	4,222,524	31,961	195,059	35,830	4,485,374	6,060,462	1.35	248	5,151
Total bituminous ...	184,872,938	8,266,271	4,373,490	28,314,150	225,828,149	236,422,049	1.05	225	340,235
Pennsylvania anthracite	60,137,874	1,327,737	6,006,056	....	67,471,667	112,504,020	1.67	196	145,309
Grand total.	245,010,812	9,594,008	10,379,546	28,314,150	293,299,816	348,926,069	1.19	216	485,544

Coal production of the United States in 1902, by States.

State.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Alabama	7,271,146	78,903	244,223	2,760,298	10,354,570	$12,419,666	$1.20	256	16,439
Arkansas..........	1,864,912	13,639	65,381	....	1,943,932	2,539,214	1.31	188	3,595
California and Alaska	79,755	3,563	3,878	....	87,196	273,398	3.14	302	217
Colorado	5,375,215	282,027	181,546	1,562,555	7,401,343	8,397,812	1.13	261	8,956
Georgia and North Carolina........	299,247	1,800	5,580	130,456	437,083	623,518	1.42	311	375
Idaho	....	2,030	....	....	2,030	5,180	2.50	74	20
Illinois...........	29,299,137	2,591,770	1,048,381	85	32,939,373	33,945,910	1.03	226	47,411
Indiana	8,649,144	536,899	259,681	700	9,446,424	10,399,660	1.10	205	15,457
Indian Territory .	2,587,100	25,998	96,017	111,551	2,820,666	4,265,106	1.51	232	5,574
Iowa	5,089,538	678,740	136,488	....	5,904,766	8,660,287	1.47	227	12,434
Kansas............	4,941,236	227,826	95,237	1,766	5,266,065	6,862,787	1.30	220	9,461
Kentucky	6,141,886	333,584	132,812	158,702	6,766,984	6,666,967	.98	209	13,727
Maryland	5,187,175	48,631	35,803	....	5,271,609	5,579,869	1.06	242	5,827
Michigan.........	818,687	117,978	28,053	....	964,718	1,653,192	1.71	171	2,344
Missouri..........	3,503,993	318,992	67,169	....	3,890,154	5,374,642	1.38	202	9,739
Montana	1,385,100	40,719	39,023	95,981	1,560,823	2,443,447	1.57	270	1,938
New Mexico......	973,500	19,514	33,180	22,569	1,048,763	1,500,230	1.43	217	1,849
North Dakota	182,002	35,639	8,870	....	226,511	325,967	1.44	213	402
Ohio..............	22,232,404	1,041,112	242,594	3,784	23,519,894	26,953,789	1.15	200	38,965
Oregon	42,591	11,232	11,825	....	65,648	160,075	2.44	234	265
Pennsylvania	72,938,204	1,429,568	1,541,454	22,665,141	98,574,367	106,032,460	1.08	248	112,630
Tennessee...... .	3,417,409	88,369	63,283	813,907	4,382,968	5,399,721	1.23	230	8,750
Texas	887,167	5,591	9,154	....	901,912	1,477,245	1.64	267	2,369
Utah	1,277,343	21,531	45,432	230,215	1,574,521	1,797,454	1.14	259	1,826
Virginia..........	1,444,559	20,916	32,447	1,685,071	3,182,993	2,543,595	.80	293	3,912
Washington	2,498,177	29,287	97,003	56,747	2,681,214	4,572,295	1.72	275	4,404
West Virginia	19,847,321	623,903	267,885	3,831,717	24,570,826	24,748,658	1.00	205	35,500
Wyoming	4,144,450	37,101	209,455	38,485	4,429,491	5,236,339	1.18	248	5,250
Total bituminous ...	212,378,398	8,666,862	5,001,854	34,169,730	260,216,844	290,858,483	1.12	230	370,056
Pennsylvania anthracite	35,264,454	1,115,134	4,994,007	....	41,373,595	76,173,586	1.84	116	148,141
Grand total.	247,642,852	9,781,996	9,995,861	34,169,730	301,590,439	367,032,069	1.22	197	518,197

PRODUCTION IN PREVIOUS YEARS.

In the following table are shown the quantity and value of the coal produced in the United States for the last five years, with the increases and decreases in 1902 as compared with 1901:

Quantity and value of coal produced in the United States, 1898–1902.

State or Territory.	1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	6,535,283	$4,932,776	7,593,416	$8,256,462	8,394,275	$9,793,785
Arkansas	1,205,479	1,238,778	843,554	989,383	1,447,945	1,653,618
California and Alaska	161,888	428,315	162,172	447,436	172,908	540,031
Colorado	4,076,347	4,686,081	4,776,224	5,363,667	5,244,364	5,858,036
Georgia and North Carolina	255,682	212,537	260,007	268,309	333,291	393,469
Idaho	*a* 1,039	2,675	20	100	10	50
Illinois	18,599,299	14,567,598	24,439,019	20,744,553	25,767,981	26,927,185
Indiana	4,920,743	3,994,918	6,006,523	5,285,018	6,484,086	6,687,137
Indian Territory	1,381,466	1,827,638	1,537,427	2,199,785	1,922,298	2,788,124
Iowa	4,618,842	5,260,716	5,177,479	6,397,338	5,202,939	7,155,341
Kansas	3,406,555	3,703,014	3,852,267	4,478,112	4,467,870	5,454,691
Kentucky	3,887,908	3,084,551	4,607,255	3,618,222	5,328,964	4,881,577
Maryland	4,674,884	3,532,257	4,807,396	3,667,056	4,024,688	3,927,381
Michigan	315,722	462,711	624,708	870,152	849,475	1,259,683
Missouri	2,688,321	2,871,296	3,025,814	3,591,945	3,540,103	4,280,328
Montana	1,479,803	2,324,207	1,496,451	2,347,757	1,661,775	2,713,707
Nebraska	(*b*)	(*b*)	....	....	....	....
New Mexico	992,288	1,344,750	1,050,714	1,461,865	1,299,299	1,776,170
North Dakota	83,895	93,591	98,809	117,500	129,883	158,348
Ohio	14,516,867	12,027,336	16,500,270	14,361,903	18,988,150	19,292,246
Oregon	58,184	212,184	86,888	260,917	58,864	220,001
Pennsylvania:						
Anthracite	53,382,644	75,414,537	60,418,005	88,142,130	57,367,915	85,757,851
Bituminous	65,165,133	43,352,588	74,150,175	56,247,791	79,842,326	77,438,545
Tennessee	3,022,896	2,337,512	3,330,659	2,940,644	3,509,562	4,003,082
Texas	686,734	1,139,763	883,832	1,334,895	968,373	1,581,914
Utah	593,709	752,252	786,049	997,271	1,147,027	1,447,750
Virginia	1,815,274	1,070,417	2,105,791	1,304,241	2,393,754	2,123,222
Washington	1,884,571	3,352,798	2,029,881	3,603,989	2,474,093	4,700,068
West Virginia	16,700,999	10,131,264	19,252,995	12,053,268	22,647,207	18,416,871
Wyoming	2,863,812	3,664,190	3,837,392	4,742,525	4,014,602	5,457,953
Total	219,976,267	208,023,250	253,741,192	256,094,234	269,684,027	306,688,164

a Includes Nebraska. *b* Included in Idaho.

Quantity and value of coal production in the United States, 1898–1902—Continued.

State or Territory.	1901.		1902.		Increase, 1902.		Per cent of increase.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*			
Alabama	9,099,052	$10,000,892	10,354,570	$12,419,666	1,255,518	$2,418,774	13.8	24.2
Arkansas	1,816,136	2,068,613	1,943,932	2,539,214	127,796	470,601	7.0	22.7
California and Alaska	152,379	409,706	87,196	273,398	a 65,183	a 136,308	a 42.8	a 33.3
Colorado	5,700,015	6,441,891	7,401,343	8,397,812	1,701,328	1,955,921	29.8	30.4
Georgia and North Carolina	354,825	426,685	437,083	623,518	82,258	196,833	23.1	46.1
Idaho	....	....	2,030	5,180	2,030	5,180	......	......
Illinois	27,331,552	28,163,937	32,939,373	33,945,910	5,607,821	5,781,973	20.5	20.5
Indiana	6,918,225	7,017,143	9,446,424	10,399,660	2,528,199	3,382,517	36.5	48.2
Indian Territory	2,421,781	3,915,268	2,820,666	4,265,106	398,885	349,838	16.5	8.9
Iowa	5,617,499	7,822,805	5,904,766	8,660,287	287,267	837,482	5.0	10.7
Kansas	4,900,528	5,991,599	5,266,065	6,862,787	365,537	871,188	7.5	14.5
Kentucky	5,469,986	5,213,076	6,766,984	6,666,967	1,296,998	1,453,891	23.7	27.9
Maryland	5,113,127	5,046,491	5,271,609	5,579,869	158,482	533,378	3.1	10.6
Michigan	1,241,241	1,753,064	964,718	1,653,192	a 276,523	a 99,872	a 22.3	a 5.7
Missouri	3,802,088	4,707,164	3,890,154	5,374,642	88,066	667,478	2.3	14.2
Montana	1,396,081	2,009,316	1,560,823	2,443,447	164,742	434,131	11.8	28.6
New Mexico	1,086,546	1,546,652	1,048,763	1,500,230	a 37,783	a 46,422	a 3.5	a 3.0
North Dakota	166,601	214,151	226,511	325,967	59,910	111,816	36.0	52.2
Ohio	20,943,807	20,928,158	23,519,894	26,953,789	2,576,087	6,025,631	12.3	28.8
Oregon	69,011	173,646	65,648	160,075	a 3,363	a 13,571	a 4.9	a 7.8
Pennsylvania:								
Anthracite	67,471,667	112,504,020	41,373,595	76,173,586	a 26,098,072	a 36,330,434	a 38.7	a 32.3
Bituminous	82,305,946	81,397,586	98,574,367	106,032,460	16,268,421	24,634,874	19.8	30.3
Tennessee	3,633,290	4,067,389	4,382,968	5,399,721	749,678	1,332,332	20.6	32.8
Texas	1,107,953	1,907,024	901,912	1,477,245	a 206,041	a 429,779	a 18.6	a 22.5
Utah	1,322,614	1,666,082	1,574,521	1,797,454	251,907	131,372	19.0	7.9
Virginia	2,725,873	2,353,989	3,182,993	2,543,595	457,120	189,606	16.8	8.1
Washington	2,578,217	4,271,076	2,681,214	4,572,295	102,997	301,219	4.0	7.1
West Virginia	24,068,402	20,848,184	24,570,826	24,748,658	502,424	3,900,474	2.1	18.7
Wyoming	4,485,374	6,060,462	4,429,491	5,236,339	a 55,883	a 824,123	a 1.25	a 13.6
Total	293,299,816	348,926,069	301,590,439	367,032,069	8,290,623	18,106,000	2.8	5.2

a Decrease.

In the following table is presented a statement of the annual production of anthracite and bituminous coal from 1880 to the close of 1902, a period of twenty-three years. It is interesting to note in connection with this table the rapid growth of the bituminous, or soft, coal production as compared with that of anthracite. It is seen that while the production of anthracite has increased from 25,580,189 long tons in 1880 to 60,242,560 long tons in 1901 (owing to the abnormal conditions in 1902 that year is not taken as a basis for comparison), or an increase of 136 per cent, bituminous production has increased from 42,831,758 short tons in 1880 to 225,826,849 short tons, a gain of over 400 per cent in 1901, and to 260,216,844 short tons, an increase of over 500 per cent in 1902.

It is not to be expected that anthracite production will increase materially in the future. In addition to the fact that the markets are becoming comparatively more and more restricted on account of the increased use of other fuels and to the changing conditions of life in the large cities of the east, the "bonanza" seams are becoming exhausted; and workings are being constantly carried to greater depths, which means greater expense in the operation of the mines, and in getting rid of enormous quantities of water. As mining conditions become more exacting the higher are the wages to be paid for mining; and the operators are therefore faced with a constantly to be expected increased cost of production, which must be added to the selling price of the fuel. The construction of the modern office buildings and apartments in the large cities of the east have had a perceptible influence on the consumption of anthracite, in the fact that thousands of former individual users of domestic sizes of anthracite now live in steam heated houses and use gas for cooking purposes. These buildings have, on the other hand, created a market for the small and formerly unusable sizes of coal, which to some extent makes up for the loss of markets for the domestic or profitable sizes.

When all the problems surrounding the future of the anthracite industry are considered, little hope can be held out to consumers that the prices for domestic sizes will be materially lower than those that are current at the present time.

Annual production of coal in the United States, 1880–1902.

Year.	Pennsylvania anthracite.			Bituminous coal.		
	Quantity.		Value.	Quantity.		Value.
	Long tons.	*Short tons.*		*Long tons.*	*Short tons.*	
1880	25,580,189	28,649,811	$42,196,678	38,242,641	47,508,133	$58,443,718
1881	28,500,016	31,920,018	64,125,036	48,365,341	53,961,012	60,224,344
1882	31,358,264	35,121,256	70,556,094	60,861,190	68,164,533	76,076,487
1883	34,336,469	38,456,845	77,257,055	68,531,500	76,755,280	82,237,800
1884	33,175,756	37,156,847	66,351,512	73,730,539	82,578,204	77,417,066
1885	34,228,548	38,335,974	76,671,948	64,840,668	72,823,821	82,347,648
1886	34,853,077	39,035,446	76,119,120	66,646,947	74,644,581	78,481,056
1887	37,578,747	42,088,197	84,552,181	79,073,227	88,562,014	98,004,656
1888	41,624,611	46,619,564	89,020,483	91,107,002	102,039,843	101,860,529
1889	40,665,152	45,544,970	65,721,578	85,432,717	95,684,643	94,504,745
1890	41,489,858	46,468,641	66,383,772	99,377,073	111,302,322	110,420,801
1891	45,236,992	50,665,431	73,944,735	105,268,962	117,901,237	117,188,400
1892	46,850,450	52,472,504	82,442,000	113,264,792	126,856,567	125,124,381
1893	48,185,306	53,967,543	85,687,078	114,629,671	128,385,231	122,751,618
1894	46,358,144	51,921,121	78,488,063	106,089,647	118,820,405	107,653,501
1895	51,785,122	57,999,337	82,019,272	120,641,244	135,118,193	115,779,771
1896	48,523,287	54,346,081	81,748,651	122,893,104	137,640,276	114,891,515
1897	46,974,714	52,611,680	79,301,954	131,796,415	147,617,519	119,595,224
1898	47,663,076	53,382,644	75,414,537	148,744,307	166,593,623	132,608,713
1899	53,944,647	60,418,005	88,142,130	172,609,988	193,323,187	167,952,104
1900	51,221,353	57,367,915	85,757,851	189,567,956	212,316,112	220,930,313
1901	60,242,560	67,471,667	112,504,020	201,632,276	225,828,149	236,422,049
1902	36,940,710	41,373,595	76,173,586	232,336,468	260,216,844	290,858,483

Annual production of coal in the United States, 1880–1902—Continued.

Year.	Total.		
	Quantity.		Value.
	Long tons.	*Short tons.*	
1880	63,822,830	71,481,569	$95,640,396
1881	76,865,357	85,881,030	124,349,380
1882	92,219,454	103,285,789	146,632,581
1883	102,867,969	115,212,125	159,494,855
1884	106,906,295	119,735,051	143,768,578
1885	99,069,216	110,957,522	159,019,596
1886	101,500,024	113,680,027	154,600,176
1887	116,651,974	130,650,211	182,498,737
1888	132,731,613	148,659,407	190,881,012
1889	126,097,869	141,229,613	160,226,323
1890	140,866,931	157,770,963	176,804,573
1891	150,505,954	168,566,668	191,133,135
1892	160,115,242	179,329,071	207,566,381
1893	162,814,977	182,352,774	208,438,696
1894	152,447,791	170,741,526	186,141,564
1895	172,426,366	193,117,530	197,799,043
1896	171,416,390	191,986,357	196,640,166
1897	178,771,130	200,229,199	198,897,178
1898	196,407,382	219,976,267	208,023,250
1899	226,554,635	253,741,192	256,094,234
1900	240,789,309	269,684,027	306,688,164
1901	261,874,836	293,299,816	348,926,069
1902	269,277,178	301,590,439	367,032,069

The statistics regarding the distribution for consumption of the coal product of the United States have been collected only since 1889. They are shown in the following table, together with the value and the statistics of labor employed and the average working time made:

Distribution of the coal product of the United States, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
1889	113,776,701	8,508,699	5,382,265	13,561,848
1890	128,383,658	9,009,285	5,063,953	15,331,760
1891	92,615,738	7,816,891	1,750,169	15,718,440
1892	146,372,098	9,704,678	6,210,767	17,011,528
1893	152,941,890	9,728,815	6,712,284	12,969,785
1894	142,833,319	8,764,538	6,307,296	12,836,373
1895	158,380,289	9,655,505	6,677,539	18,404,197
1896	159,176,155	9,502,927	7,184,832	16,122,443
1897	165,603,626	9,922,276	6,941,419	17,761,878
1898	180,960,111	8,927,514	7,921,289	22,167,353
1899	208,754,746	9,075,756	8,662,864	27,247,826
1900	223,782,088	9,077 242	9,189,746	27,634,951
1901	245,010,812	9,595,308	10,379,546	28,308,650
1902	247,642,852	9,781,996	9,995,861	34,169,730

Distribution of the coal product of the United States, 1889-1902—Continued.

Year.	Total product.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.				
1889	141,229,513	$160,226,323	$1.13	....	....
1890	157,788,656	176,804,573	1.12	216	318,204
1891	117,901,238	117,188,400	.994	223	205,803
1892	179,329,071	207,566,381	1.16	212	341,943
1893	182,352,774	208,438,696	1.14	201	363,309
1894	170,741,526	186,141,564	1.09	178	376,206
1895	193,117,530	197,799,043	1.02	195	382,879
1896	191,986,357	196,640,166	1.02	185	386,656
1897	200,229,199	198,897,178	.99	179	397,701
1898	219,976,267	208,023,250	.95	190	401,221
1899	253,741,192	256,094,234	1.01	214	410,635
1900	269,684,027	306,688,164	1.14	212	448,581
1901	293,299,816	348,926,069	1.19	216	485,544
1902	301,590,439	367,032,069	1.22	197	518,197

PRODUCTION OF COAL, BY STATES, FROM THE EARLIEST TIMES TO THE CLOSE OF 1902.

The early history of coal production in many States has not been recorded in any official reports and the writer's efforts to secure some definite information regarding it have not met with the most abundant success. In some cases it has been possible to secure scattered statistics of production interspersed with more or less accurate "estimates," but there are only one or two instances where consecutive records are obtainable. The accompanying table has been prepared from all available sources, missing data being supplied by estimates based upon the best information obtainable. The most complete record of coal production which we have is that of the anthracite region of Pennsylvania from which shipments began in 1820, and since that date the records have been carefully preserved. The earliest record of production ı that region was six years earlier, when an output of 22 short tons is reported to have been obtained. An estimated production of about 800 tons is distributed through the period between 1814 and 1820. The records of anthracite shipments, as reported elsewhere, have in this table been reduced to short tons and 10 per cent has been added to the shipments as an estimate of the coal sold to local trade or consumed at the collieries. In the eighty-nine years from 1814 to 1902, inclusive, the total production of anthracite in Pennsylvania has amounted to aproximately 1,554,200,000 short tons.

So far as we know, the earliest production of bituminous coal was made in the Richmond basin of Virginia. One authority states that 54,000 short tons were produced there in 1822, and that in 1824 the production amounted to 67,040 tons; in 1826 to 88,720 tons, and in 1828 to 109,080 tons. In each of these years the output exceeded that of Pennsylvania anthracite, but that condition ceased permanently in 1829, although the production of the Richmond basin continued to increase until 1832. It then began to decline and by the middle of the last century had almost disappeared.

The development of the Piedmont region, which at that time belonged to Virginia, began in 1855, and until the opening up of the Pocahontas region in 1882 and of the Wise County fields in 1891 and 1892, practically all of Virginia's production came from the northern part of the State.

Next to the anthracite region of Pennsylvania, the most authentic records we have of coal production in the United States are of the Cumberland-Piedmont district of Maryland and West Virginia. The first openings were made in Maryland on the north side of the Potomac River, and shipments began as early as 1842, 1,708 long tons of 2,240 pounds having been shipped in that year. In the accompanying table the production of the Cumberland field has been reduced to short tons and the percentage for colliery consumption has been added in order to arrive at the total production. Until 1855 all of the shipments were from Maryland.

The early records of Pennsylvania bituminous production are sadly wanting. The census for 1840 showed that the total production in that year was 464,826 short tons. This is the earliest date of which we have any record, although it is practically certain that some bituminous coal was produced in Pennsylvania prior to that year. Another authority gives the bituminous production of the State in 1846 as 760,000 tons, while still another states that in 1847 it was only 399,840. From 1841 to 1845, inclusive, and from 1848 to 1859, inclusive, there are no records of production. The census of 1860 states that the output was 2,679,773 short tons. In 1864 the production had increased to 5,839,000 tons, and in 1870 it amounted to 8,736,399 tons, since which date the records are practically complete. Estimating the production in the years for which the records are not obtainable, we find that the total output of bituminous coal in Pennsylvania has amounted, approximately, to 1,251,000,000 short tons, or about 300,000,000 tons less than the production of anthracite in the same State, making the entire production of coal in Pennsylvania during the history of the industry in that State, approximately, 2,805,000,000 short tons.

Next to anthracite mining in Pennsylvania and the records of the Richmond basin, in Virginia, the earliest statistics of coal mining which we have are for the State of Illinois. The report of the bureau of labor statistics of that State for the fiscal year ending June 30, 1902, sets forth that the records of the early history of coal mining in Illinois are very meager. The first record found is that coal was mined in Jackson County in 1810; the locality was on the Big Muddy River, and the mine was worked by drift along the outcrop in the bluffs. A flatboat was loaded with coal at this place and shipped to New Orleans. Again it is stated that in 1832 several boat loads were sent from the same vicinity to the same market. Another record is found stating that in 1833, 150,000 bushels (6,000 tons) of coal were mined in St. Clair County and hauled by wagon to St. Louis. The census of 1840 states that coal was mined in 19 counties of Illinois, with a production of 16,968 tons. From 1840 to 1860 (a period of 20 years) the Bureau of Statistics is without any general or special data in regard to the development of the coal-mining industry in the State, although there are some scattering statistics to be found in the geological reports of the State. The statistics of production from 1841 to 1859, inclusive, and for the other years for which no special information is obtainable, have been estimated by the writer. From these statistics of production and from the statistics of such years for which there are records it has been found that the total output of the State, in the seventy years from 1833 to 1902, has amounted to nearly 442,000,000 short tons.

In the well-known work, "Statistics of Coal," by R. C. Taylor (1848), the author states:

The existence of this combustible [coal] was proved by the French explorers at an early period. It was certainly known to Father Hennepin in 1679 (almost a hundred years before the Pennsylvania coal was discovered), and is marked on the map which illustrates his journal. He points out a "cole mine" about Fort Crevecoeur, on the Illinois River, near to the site of the present Ottawa.

Although some coal was undoubtedly produced in Ohio prior to 1838, that is the first year in which any production is recorded, the output being 119,952 tons. The census of 1840 shows that the production was 140,535 short tons, and the census of 1860 gives the State an output of 1,133,596 short tons, the history of production of the years between 1840 and 1860 being entirely lacking. Since 1860 the records are fairly accurate. Estimating the production in such years of which there are no records, as has been done in the case of Illinois and Pennsylvania, the production of Ohio is found to have been somewhat over 358,250,000 tons.

Among the States west of the Mississippi River the earliest production reported is in Missouri and Iowa, by the census of 1840, Missouri being credited with an output of 9,971 short tons and Iowa with 360 short tons. It is probable that very little coal was mined in either of these States prior to that time, and it may be considered that the industry began at about that date. The records of both States for the next twenty-five or thirty years are meager, but the production has been estimated from the best sources of information accessible.

The first coal discovered on the Pacific coast was in the State of Washington, in 1852, and the first mine was opened in Whatcom

County, in 1854, shipments being made from there to San Francisco by water until 1870, when the Seattle, Renton, and Talbot mines, in King County, were opened and began shipping coal also to San Francisco. There are no records, however, of any production prior to 1870, when an output of 17,844 tons was reported.

Although California has never taken high rank as a coal-producing State, it comes next in order in the history of early production, an output of 6,620 tons being reported in 1861. This increased almost steadily each year until 1874, when the maximum output of the State (215,253 short tons) was attained. It then declined rapidly until 1876, when the production was just about one-half what it had been three years before. Since that time the industry has been rather irregular, the production depending upon many outside influences.

Among the States whose history of coal production does not antedate 1863, the records are fairly complete, although we can feel satisfied that in a number of instances coal mining began prior to the earliest dates given in the accompanying statement. In Indiana, for instance, the initial production is given for 1870, with an output of 490,414 short tons. Coal mining began in the State probably twenty-five years prior to that date, but records of production are entirely wanting. Four other States—Kentucky, Tennessee, Alabama, and Washington—whose initial reported coal production is given in the census of 1870, were undoubtedly producing coal before that time.

According to the following table, the entire coal output of the United States, from the earliest times to the close of 1902, has amounted to 4,853,844,191 short tons. It is doubtful if the production not reported here has amounted to more than 6,200,000 tons, so it is safe to estimate our total coal production to December 31, 1902, at 4,860,000,000 short tons. The cubical dimensions of a ton of coal will vary from 33 to 40 cubic feet. Taking 37 cubic feet as an average for the total product of the United States, we find that this mass of 4,860,000,000 tons would contain approximately 160,000,000,000 cubic feet. A pyramid built of this material as high as Pikes Peak (14,108 feet) would have for its base a rectangle 1.14 miles square. A cube constructed of it would cover an area of 2.4 square miles. If spread out over the States of Rhode Island and Connecticut, it would cover both of them to the depth of 12 inches.

Production of coal, by States, from 1814 to 1902.

[Short tons]

Year.	Pennsylvania.	Virginia.	Illinois.	Ohio.	Pennsylvania.	Missouri.	Iowa.	Maryland.	California.	West Virginia.	Colorado.	Wyoming.	Michigan.	Kansas.	Indiana.
	Anthracite.				*Bituminous.*										
1814	22														
1815	50														
1816	75														
1817	100														
1818	200														
1819	350														
1820	450														
1821	1,322														
1822	4,583	54,000													
1823	8,563	60,000													
1824	13,685	67,040													
1825	42,988	75,000													
1826	59,194	88,720													
1827	78,151	94,000													
1828	95,500	100,080													
1829	138,086	100,000													
1830	215,272	102,800													
1831	217,842	118,000													
1832	447,550	132,000													
1833	600,907	125,000	6,000												
1834	464,015	124,000	7,500												
1835	690,854	120,000	8,000												
1836	842,832	124,000	10,000												
1837	1,071,151	110,000	12,500												
1838	910,075	107,999	14,000	119,952											
1839	1,008,322	96,000	15,038	125,000											
1840	1,064,914	88,000	16,968	140,535	464,826	9,971	360								
1841	1,182,441	79,600	35,000	160,000	475,000	12,000	500								

1842	1,365,563	73,640	58,000	225,000	500,000	15,000	750	2,104	....	....	....	....	....	....	....
1843	1,556,753	70,000	75,000	280,000	650,000	25,000	1,000	12,421	....	....	....	....	....	....	....
1844	2,009,207	65,000	120,000	340,000	675,000	35,000	2,500	18,345	....	....	....	....	....	....	....
1845	2,480,032	50,000	150,000	390,000	700,000	50,000	5,000	30,372	....	....	....	....	....	....	....
1846	2,887,815	40,000	165,000	420,000	760,000	68,000	6,500	36,707	....	....	....	....	....	....	....
1847	3,551,005	25,000	180,000	480,000	399,840	80,000	8,000	65,222	....	....	....	....	....	....	....
1848	3,805,942	18,000	200,000	540,000	500,000	85,000	10,000	98,032	....	....	....	....	....	....	....
1849	3,995,334	15,000	260,000	600,000	750,000	90,000	12,500	175,497	....	....	....	....	....	....	....
1850	4,138,164	10,000	300,000	640,000	1,000,000	100,000	15,000	242,517	....	....	....	....	....	....	....
1851	5,481,065	10,000	320,000	670,000	1,200,000	125,000	18,000	317,460	....	....	....	....	....	....	....
1852	6,151,957	25,000	340,000	700,000	1,400,000	140,000	20,000	411,707	....	....	....	....	....	....	....
1853	6,400,426	50,000	375,000	760,000	1,500,000	160,000	23,000	657,862	....	....	....	....	....	....	....
1854	7,394,875	70,000	385,000	800,000	1,650,000	175,000	25,000	812,727	....	....	....	....	....	....	....
1855	8,141,754	80,782	400,000	890,000	1,780,000	185,000	28,000	735,137	....	....	....	....	....	....	....
1856	8,534,779	52,687	410,000	930,000	1,850,000	200,000	30,000	817,659	....	....	....	....	....	....	....
1857	8,186,567	63,665	450,000	975,000	2,000,000	220,000	33,000	654,017	....	....	....	....	....	....	....
1858	8,426,102	77,690	490,000	1,000,000	2,200,000	240,000	37,500	722,686	....	....	....	....	....	....	....
1859	9,619,771	59,055	530,000	1,060,000	2,400,000	260,000	42,000	833,349	....	....	....	....	....	....	....
1860	10,488,168	64,759	568,000	1,133,596	2,679,773	280,000	48,263	907,177	....	....	....	....	....	....	....
1861	9,799,654	45,165	670,000	1,150,000	3,200,000	300,000	50,000	287,073	6,620	....	....	....	....	....	....
1862	9,695,110	45,124	780,000	1,200,000	4,000,000	320,000	53,000	346,201	23,400	....	....	....	....	....	....
1863	11,785,320	40,000	890,000	1,204,581	5,000,000	360,000	57,000	877,313	43,200	44,648	....	....	....	....	....
1864	12,538,649	40,000	1,000,000	1,815,622	5,839,000	375,000	63,000	755,764	50,700	54,888	500	....	....	....	....
1865	11,891,746	40,000	1,260,000	1,536,218	6,350,000	420,000	69,574	1,025,208	60,530	87,897	1,200	800	....	....	....
1866	15,651,183	40,000	1,580,000	1,887,424	6,800,000	450,000	99,320	1,217,668	84,020	112,068	6,400	2,500	....	....	....
1867	16,002,109	50,000	1,800,000	2,092,334	7,300,000	500,000	150,000	1,381,429	124,690	89,360	17,000	5,000	....	....	....
1868	17,003,405	59,051	2,000,000	2,475,844	7,500,000	541,000	241,453	1,529,879	143,676	109,227	10,500	6,925	28,000	....	....
1869	17,083,134	65,000	1,854,000	2,461,986	6,750,000	550,000	295,105	2,216,300	157,234	103,148	8,000	49,382	29,980	36,891	....
1870	18,315,540	69,219	2,624,163	2,830,559	8,736,399	696,562	283,467	2,005,760	141,890	75,138	13,500	105,295	31,528	38,000	490,414
1871	19,342,057	70,000	3,000,000	4,000,000	9,040,565	725,000	300,000	2,670,338	152,193	118,830	15,600	147,328	32,000	41,000	600,000
1872	24,233,166	69,440	3,360,000	5,315,294	11,695,040	784,000	336,000	2,647,156	190,859	149,521	68,540	221,745	33,600	44,800	896,000
1873	26,152,837	67,200	3,920,000	4,550,028	13,098,829	784,000	392,000	3,198,911	186,611	672,000	69,997	259,700	56,000	56,000	1,000,000
1874	24,818,790	70,000	4,203,000	3,267,585	12,320,000	789,680	799,936	2,899,392	215,352	1,120,000	77,372	219,061	58,000	85,000	812,000
1875	22,485,766	80,000	4,453,178	4,864,259	11,760,000	840,000	1,231,547	2,808,018	166,638	1,120,000	98,838	300,808	62,500	150,000	800,000
1876	22,793,245	85,000	5,000,000	3,500,000	12,880,000	1,008,000	1,250,000	2,126,873	128,049	896,000	117,666	334,550	66,000	225,000	950,000

Production of coal, by States, from 1814 to 1902—Continued.

Year.	Pennsylvania.	Virginia.	Illinois.	Ohio.	Pennsylvania.	Missouri.	Iowa.	Maryland.	California.	West Virginia.	Colorado.	Wyoming.	Michigan.	Kansas.	Indiana.
	Anthracite.				*Bituminous.*										
1877......	25,660,316	90,000	5,350,000	5,250,000	14,000,000	1,008,000	1,300,000	1,939,575	107,789	1,120,000	160,000	342,853	69,197	300,000	1,000,000
1878......	21,689,682	96,000	5,700,000	5,500,000	15,120,000	1,008,000	1,350,000	2,068,925	134,237	1,120,000	200,630	333,200	85,322	375,000	1,000,000
1879......	30,207,793	105,000	5,000,000	6,000,000	16,240,000	1,008,000	1,400,000	2,132,233	147,879	1,400,000	322,732	400,991	82,015	460,000	1,196,490
1880......	28,649,811	112,000	6,115,377	7,000,000	21,280,000	1,680,000	1,461,166	2,549,731	192,055	1,568,000	437,005	527,811	129,053	550,000	1,500,000
1881......	31,920,018	112,000	7,500,000	8,225,000	22,400,000	1,960,000	2,500,000	2,677,378	125,840	1,680,000	706,744	628,181	130,130	750,000	1,771,536
1882......	35,121,256	112,000	9,115,653	9,450,000	24,640,000	2,240,000	3,920,000	1,555,445	112,592	2,240,000	1,061,479	707,764	135,339	750,000	1,976,470
1883......	38,456,845	252,000	12,123,456	8,229,429	26,880,000	2,520,000	4,457,540	2,476,075	76,162	2,335,833	1,229,593	779,689	71,296	900,000	2,560,000
1884......	37,156,847	336,000	12,208,075	7,640,062	28,000,000	2,800,000	4,370,566	2,765,617	77,485	3,360,000	1,130,024	902,620	36,712	1,100,000	2,260,000
1885......	38,335,974	567,000	11,834,459	7,816,179	26,000,000	3,080,000	4,012,575	2,833,337	71,615	3,369,062	1,356,062	807,328	45,178	1,212,057	2,375,000
1886......	39,035,446	684,951	11,175,241	8,435,211	27,094,501	1,800,000	4,315,779	2,517,577	100,000	4,005,796	1,368,338	829,355	60,434	1,400,000	3,000,000
1887......	42,088,197	825,263	12,423,066	10,300,708	31,516,856	3,209,916	4,473,828	3,278,023	50,000	4,881,620	1,791,735	1,170,318	71,461	1,596,879	3,217,711
1888......	46,619,564	1,073,000	14,328,181	10,910,951	33,796,727	3,909,967	4,952,440	3,479,470	95,000	5,498,800	2,185,477	1,481,540	81,407	1,850,000	3,140,979
1889......	45,544,970	865,786	12,104,272	9,976,787	36,174,089	2,557,823	4,095,358	2,939,715	121,820	6,231,880	2,597,181	1,388,947	67,431	2,221,043	2,845,057
1890......	46,468,641	784,011	15,292,420	11,494,506	42,302,173	2,735,221	4,021,739	3,357,813	110,711	7,394,654	3,077,003	1,870,366	74,977	2,259,922	3,305,737
1891......	50,665,431	736,399	15,660,698	12,868,683	42,788,490	2,674,606	3,825,495	3,820,239	93,301	9,220,665	3,512,632	2,327,841	80,307	2,716,705	2,973,474
1892......	52,472,504	675,205	17,862,276	13,562,927	46,694,576	2,733,949	3,918,491	3,419,962	85,178	9,738,755	3,510,830	2,503,839	77,990	3,007,276	3,345,174
1893......	53,967,543	820,339	19,949,564	13,253,646	44,070,724	2,897,442	3,972,229	3,716,041	72,603	10,708,578	4,102,389	2,439,311	45,979	2,652,546	3,791,851
1894......	51,921,121	1,229,083	17,113,576	11,909,856	39,912,463	2,245,039	3,967,253	3,501,428	67,247	11,627,757	2,831,409	2,417,463	70,022	3,388,251	3,423,921
1895......	57,999,337	1,368,324	17,735,864	13,355,806	50,217,228	2,372,393	4,156,074	3,915,585	75,453	11,387,961	3,082,982	2,246,911	112,322	2,926,870	3,995,892
1896......	54,346,081	1,254,723	19,786,626	12,875,202	49,557,453	2,331,542	3,954,028	4,143,936	78,544	12,876,296	3,112,400	2,229,624	92,882	2,884,801	3,905,779
1897......	52,611,680	1,528,302	20,072,758	12,196,942	54,417,974	2,665,626	4,611,865	4,442,128	87,992	14,248,159	3,361,703	2,597,886	223,592	3,054,012	4,151,169
1898......	53,382,644	1,815,274	18,599,299	14,516,867	65,165,133	2,688,321	4,618,842	4,674,884	145,888	16,700,999	4,076,347	2,863,812	315,722	3,406,555	4,920,743
1899......	60,418,005	2,105,791	24,439,019	16,500,270	74,150,175	3,025,814	5,177,479	4,807,396	160,915	19,252,995	4,776,224	3,837,392	624,708	3,852,267	6,006,523
1900......	57,367,915	2,393,754	25,767,981	18,988,150	79,842,326	3,540,103	5,202,939	4,024,688	*a*172,908	22,647,207	5,244,364	4,014,602	849,475	4,467,870	6,484,086
1901......	67,471,667	2,725,873	27,331,552	20,943,807	82,305,946	3,802,088	5,617,499	5,113,127	*a*152,379	24,068,402	5,700,015	4,485,374	1,241,241	4,900,528	6,918,225
1902......	41,373,595	3,182,993	32,939,373	23,519,894	98,574,367	3,890,154	5,904,760	5,271,609	*a*87,196	24,570,826	7,401,343	4,429,491	964,718	5,266,065	9,446,424
Total ..	1,554,322,592	29,672,727	441,824,133	358,260,700	1,251,036,680	78,382,217	107,596,226	122,966,218	4,678,751	238,006,970	68,842,054	50,217,603	6,236,518	58,925,338	96,060,655

a Includes Alaska's production.

Production of coal, by States, from 1814 to 1902—Continued.

Year.	Kentucky.	Tennessee.	Washington.	Alabama.	Utah.	Arkansas.	New Mexico.	Montana.	Georgia.	Texas.	North Dakota.	Indian Territory.	Oregon.	North Carolina.	Miscellaneous.[a]	Total.
1814	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	22
1815	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	50
1816	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	75
1817	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	100
1818	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	200
1819	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	350
1820	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	450
1821	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,322
1822	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	58,583
1823	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	68,563
1824	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	80,725
1825	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	117,988
1826	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	147,914
1827	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	172,151
1828	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	195,580
1829	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	238,086
1830	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	318,072
1831	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	335,842
1832	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	579.550
1833	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	731,907
1834	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	595,515
1835	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	828,854
1836	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	979,332
1837	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,195,151
1838	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,138,026
1839	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,244,360
1840	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,785,574
1841	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,944,541
1842	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2,240,057

[a] From 1871 to 1888, inclusive, production reported in this column, is due principally to colliery consumption, which in some years was estimated and not included in the distribution by States. Since 1888, small, irregular production from several unimportant sources has been included in this column.

Production of coal, by States, from 1814 to 1902—Continued.

Year.	Kentucky.	Tennessee.	Washington.	Alabama.	Utah.	Arkansas.	New Mexico.	Montana.	Georgia.	Texas.	North Dakota.	Indian Territory.	Oregon.	North Carolina.	Miscellaneous.[a]	Total.
1843																2,670,174
1844																3,265,052
1845																3,855,404
1846																4,384,022
1847																4,789,067
1848																5,256,974
1849																5,898,331
1850																6,445,681
1851																8,141,525
1852																9,188,664
1853																9,926,288
1854																11,312,602
1855																12,240,673
1856																12,825,125
1857																12,582,189
1858																13,193,978
1859																14,804,175
1860																16,169,736
1861																15,508,512
1862																16,462,835
1863																20,302,062
1864																22,533,123
1865																22,743,173
1866																27,930,583
1867																29,511,922
1868																31,648,960
1869																31,660,160
1870	168,654	149,428	17,844	13,200												36,806,560

[a] From 1871 to 1888, inclusive, production reported in this column, is due principally to colliery consumption, which in some years was estimated and not included in the distribution by States. Since 1888, small, irregular production from several unimportant sources has been included in this column.

1871......	250,000	180,000	20,000	15,000	....	....	....	....	....	....	....	....	....	....	5,629,869	46,350,080
1872......	380,800	224,000	23,000	16,800	....	....	....	....	....	....	....	....	....	....	176,159	50,865,920
1873......	300,000	350,000	26,000	44,800	....	....	....	....	....	....	....	....	....	....	1,939,567	57,124,480
1874......	360,000	350,000	30,352	50,400	....	....	....	....	....	....	....	....	....	....	....	52,545,920
1875......	500,000	360,000	99,568	67,200	....	....	....	....	....	....	....	....	....	....	40,000	52,288,320
1876......	650,000	550,000	110,342	112,000	50,400	....	....	....	....	....	....	....	....	....	366,875	53,200,000
1877......	850,000	450,000	120,896	196,000	50,400	....	....	....	....	....	....	....	....	....	1,056,734	60,421,760
1878......	900,000	375,000	131,660	224,000	67,200	....	....	....	....	....	....	....	....	....	374,744	57,853,600
1879......	1,000,000	450,000	142,666	280,000	225,000	....	....	....	....	....	....	....	....	....	....	68,200,799
1880......	1,000,000	641,042	144,315	380,800	225,000	14,778	....	....	....	....	....	....	....	....	....	76,157,944
1881......	1,100,000	750,000	167,554	420,000	225,000	10,000	....	....	....	....	....	....	....	....	21,649	85,781,030
1882......	1,300,000	850,000	177,340	896,000	250,000	15,000	157,092	....	....	....	....	....	....	....	6,502,359	103,285,789
1883......	1,650,000	1,000,000	244,990	1,568,000	250,000	50,000	211,347	19,795	....	....	....	....	....	....	6,870,075	115,212,125
1884......	1,550,000	1,200,000	166,926	2,240,000	250,000	75,000	220,557	80,376	150,000	125,000	35,000	....	....	....	9,498,174	119,735,051
1885......	1,600,000	1,440,957	380,250	2,492,000	213,120	100,000	306,202	86,440	150,000	100,000	25,000	500,000	50,000	....	....	111,159,795
1886......	1,550,000	1,714,290	423,525	1,800,000	200,000	125,000	271,285	49,846	223,000	100,000	25,955	534,580	45,000	....	794,917	113,680,027
1887......	1,933,185	1,900,000	772,601	1,950,000	180,021	129,600	508,034	10,202	313,715	75,000	21,470	685,911	37,696	....	1,237,195	130,650,211
1888......	2,570,000	1,967,297	1,215,750	2,900,000	258,961	276,871	626,665	11,467	180,000	90,000	34,000	761,986	75,000	....	4,257,907	148,659,407
1889......	2,399,755	1,925,689	1,030,578	3,572,983	236,651	279,584	486,943	363,301	225,934	128,216	28,907	752,832	64,359	192	1,530	141,229,613
1890......	2,701,496	2,169,585	1,263,689	4,090,409	318,159	399,888	375,777	517,477	228,337	184,440	30,000	869,229	61,514	10,262	807	157,770,963
1891......	2,916,069	2,413,678	1,056,249	4,759,781	371,045	542,379	462,328	541,861	171,000	172,100	30,000	1,091,032	51,826	20,355	2,000	168,566,669
1892......	3,025,313	2,092,064	1,213,427	5,529,312	361,013	535,558	661,330	564,648	215,498	245,690	40,725	1,192,721	34,661	6,679	1,500	179,329,071
1893......	3,007,179	1,902,258	1,264,877	5,136,935	413,205	574,763	665,094	892,309	372,740	302,206	49,630	1,252,110	41,683	17,000	....	182,352,774
1894......	3,111,192	2,180,879	1,106,470	4,397,178	431,550	512,626	597,196	927,395	354,111	420,848	42,015	969,606	47,521	16,900	150	170,741,526
1895......	3,357,770	2,535,644	1,191,410	5,693,775	471,836	598,322	720,654	1,504,193	260,998	484,959	38,997	1,211,185	73,685	24,900	200	193,117,530
1896......	3,333,478	2,663,106	1,195,504	5,748,697	418,627	675,374	622,626	1,543,445	238,546	544,015	78,050	1,366,646	101,721	7,813	18,792	191,986,357
1897......	3,602,097	2,888,849	1,434,112	5,893,770	521,560	856,190	716,981	1,647,882	195,869	639,341	77,246	1,336,380	107,289	21,280	18,565	200,229,199
1898......	3,887,908	3,022,896	1,884,571	6,535,283	593,709	1,205,479	992,288	1,479,803	244,187	686,734	83,895	1,381,466	58,184	11,495	17,039	219,976,267
1899......	4,607,255	3,330,659	2,029,881	7,593,416	786,049	843,554	1,050,714	1,496,451	233,111	883,832	98,809	1,537,427	86,888	26,896	1,277	253,741,192
1900......	5,328,964	3,509,562	2,474,093	8,394,275	1,147,027	1,447,945	1,299,299	1,661,775	315,557	968,373	129,883	1,922,298	58,864	17,734	10	269,684,027
1901......	5,469,986	3,633,290	2,578,217	9,099,052	1,322,614	1,816,136	1,086,546	1,396,081	342,825	1,107,953	166,601	2,421,781	69,011	12,000	....	293,299,816
1902......	6,766,984	4,382,968	2,681,214	10,354,570	1,574,521	1,943,932	1,048,763	1,562,853	414,083	901,912	226,511	2,820,666	65,648	23,000	....	301,590,439
	73,128,085	53,553,141	26,847,747	102,465,636	11,412,668	13,027,979	13,087,721	16,387,600	4,829,511	8,160,619	1,262,694	22,607,856	1,130,550	216,506	38,828,094	4,853,844,191

RANK OF COAL-PRODUCING STATES.

In the following table the coal-producing States are arranged according to rank in 1901 and 1902, first in amount of production and then in the value of the product, with the percentage of both quantity and value contributed by each State. There are comparatively few changes in rank during the two years. The first seven States retain their relative positions. Kentucky succeeds Iowa in eighth place, and Tennessee changes places with Missouri. The Indian Territory displaces Washington, and Montana drops below Utah. In the rank according to value the most notable change is the drop of Wyoming from ninth to fourteenth place.

Rank of coal-producing States in 1901, with quantity and value of product, and percentage of each.

Production.				Value.			
Rank.	State or Territory.	Quantity.	Per cent of total production.	Rank.	State or Territory.	Value.	Per cent of total value.
	Pennsylvania:	*Short tons.*			Pennsylvania:		
1	Anthracite	67,471,667	23.0	1	Anthracite	$112,504,020	32.2
	Bituminous	82,305,946	28.1		Bituminous	81,397,586	23.3
2	Illinois	27,331,552	9.3	2	Illinois	28,163 937	8.1
3	West Virginia	24,068,402	8.2	3	Ohio	20,928,158	6.0
4	Ohio	20,943,807	7.1	4	West Virginia	20,848,184	6.0
5	Alabama	9,099,052	3.1	5	Alabama	10,000,892	2.9
6	Indiana	6,918,225	2.4	6	Iowa	7,822,805	2.2
7	Colorado	5,700,015	2.0	7	Indiana	7,017,143	2.0
8	Iowa	5,617,499	1.9	8	Colorado	6,441,891	1.8
9	Kentucky	5,469,986	1.9	9	Wyoming	6,060,462	1.7
10	Maryland	5,113,127	1.7	10	Kansas	5,991,599	1.7
11	Kansas	4,900,528	1.7	11	Kentucky	5,213,076	1.5
12	Wyoming	4,485,374	1.5	12	Maryland	5,046,491	1.5
13	Missouri	3,802,088	1.3	13	Missouri	4,707,164	1.4
14	Tennessee	3,633,290	1.2	14	Washington	4,271,076	1.2
15	Virginia	2,725,873	.9	15	Tennessee	4,067,389	1.2
16	Washington	2,578,217	.9	16	Indian Territory	3,915,268	1.1
17	Indian Territory	2,421,781	.8	17	Virginia	2,353,989	.7
18	Arkansas	1,816,136		18	Arkansas	2,068,613	
19	Montana	1,396,081		19	Montana	2,009,316	
20	Utah	1,322,614		20	Texas	1,907,024	
21	Michigan	1,241,241		21	Michigan	1,753,064	
22	Texas	1,107,953	3.0	22	Utah	1,666,082	3.5
23	New Mexico	1,086,546		23	New Mexico	1,546,652	
24	Georgia	354,825		24	Georgia	426,685	
25	North Dakota	166,601		25	California	409,706	
26	California	152,379		26	North Dakota	214,151	
27	Oregon	69,011		27	Oregon	173,646	
	Total	293,299,816	100.0		Total	348,926,069	100.0

Rank of coal-producing States in 1902, with quantity and value of product, and percentage of each.

Production.				Value.			
Rank.	State or Territory.	Quantity.	Per cent of total production.	Rank.	State or Territory.	Value.	Per cent of total value.
	Pennsylvania:	*Short tons.*			Pennsylvania:		
1	Anthracite	41,373,595	13.7	1	Anthracite	$76,173,586	21.8
	Bituminous	98,574,367	32.7		Bituminous	106,032,460	28.5
2	Illinois	32,939,373	10.9	2	Illinois	33,945,910	9.1
3	West Virginia	24,570,826	8.2	3	Ohio	26,953,789	7.2
4	Ohio	23,519,894	7.8	4	West Virginia	24,748,658	6.7
5	Alabama	10,354,570	3.4	5	Alabama	12,419,666	3.3
6	Indiana	9,446,424	3.1	6	Indiana	10,399,660	2.8
7	Colorado	7,401,343	2.5	7	Iowa	8,660,287	2.3
8	Kentucky	6,766,984	2.2	8	Colorado	8,397,812	2.3
9	Iowa	5,904,766	2.0	9	Kansas	6,862,787	1.8
10	Maryland	5,271,609	1.8	10	Kentucky	6,666,967	1.8
11	Kansas	5,266,065	1.7	11	Maryland	5,579,869	1.5
12	Wyoming	4,429,491	1.5	12	Tennessee	5,399,721	1.5
13	Tennessee	4,382,968	1.5	13	Missouri	5,374,642	1.4
14	Missouri	3,890,154	1.3	14	Wyoming	5,236,339	1.4
15	Virginia	3,182,993	1.1	15	Washington	4,572,295	1.2
16	Indian Territory	2,820,666	.9	16	Indian Territory	4,265,106	1.2
17	Washington	2,681,214	.9	17	Montana	2,443,447	.7
18	Arkansas	1,943,932	.6	18	Virginia	2,543,595	.7
19	Utah	1,574,521	.5	19	Arkansas	2,539,214	.7
20	Montana	1,560,823	.5	20	Utah	1,797,454	.5
21	New Mexico	1,048,763	.4	21	Michigan	1,653,192	.4
22	Michigan	964,718	.3	22	New Mexico	1,500,230	.4
23	Texas	901,912	.3	23	Texas	1,477,245	.4
24	Georgia and North Carolina.	437,083	.1	24	Georgia and North Carolina.	623,518	.2
25	North Dakota	226,511		25	North Dakota	325,967	
26	California and Alaska.	87,196	.1	26	California and Alaska.	273,398	.2
27	Oregon	65,648		27	Oregon	160,075	
28	Idaho	2,030		28	Idaho	5,180	
	Total	301,590,439	100.0		Total	367,032,069	100.0

KINDS OF COAL PRODUCED IN 1902.

In discussing elsewhere the coal production of the United States in 1902, only two general classes are considered—anthracite (in Pennsylvania) and bituminous coal, the latter including the small anthracite production of Colorado and New Mexico and comprehending lignites, semianthracite, and semibituminous coals, and the several subvarieties of bituminous coal. Inquiries are frequently received, however, for information as to the amount of these different varieties produced in each State. The following table has accordingly been prepared, classifying the total product in 1902 by varieties and States. It should be remembered that this classification makes no claim to technical exactness. It is simply made up from replies by operators to the inquiry "Kind of coal produced," and such replies are in some minor cases based on quite uncertain information. It is believed, however, that the classification indicates approximately the amount of each kind of coal produced and that it is sufficiently correct for practical purposes. The table is arranged to show the States and the kinds of coal according to their importance.

Classification of the coal product of the United States in 1902, by States and Territories.

State or Territory.	Bituminous.	Anthracite.	Semibituminous.	Lignite.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	94,525,584	41,373,595	4,017,878	
Illinois	32,716,677		222,696	
West Virginia	18,440,226		5,057,645	
Ohio	23,498,857			
Alabama	10,354,570			
Indiana	8,313,880			
Colorado	6,073,962	52,611	120,347	1,100,051
Kentucky	6,692,863			
Iowa	5,871,766			
Maryland	3,872,523		1,399,086	
Kansas	5,253,885		2,149	10,031
Wyoming	1,448,634		207,642	2,772,015
Tennessee	4,382,968			
Missouri	3,889,558			
Virginia	2,498,283		664,393	
Indian Territory	2,232,042			
Washington	2,055,203		438,675	187,336
Arkansas	511,676		123,763	
Utah	1,573,453		1,068	
Montana	1,550,876			9,947
New Mexico	837,389	41,326		170,048
Michigan	964,718			
Texas	696,005			205,907
Georgia	414,083			
North Dakota				226,511
California	2,920			82,064
Oregon				65,648
North Carolina	23,000			
Alaska				2,212
Idaho	2,030			
Total	238,697,631	41,467,532	12,255,342	4,831,770

Classification of the coal product of the United States in 1902, by States and Territories—Continued.

State or Territory.	Semianthracite.	Block.	Splint.	Cannel.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania				30,905	139,947,962
Illinois					32,939,373
West Virginia			938,254	[a] 134,701	24,570,826
Ohio		18,030		3,007	23,519,894
Alabama					10,354,570
Indiana		[b] 1,101,544	1,000	30,000	9,446,424
Colorado	54,372				7,401,343
Kentucky		8,804		[c] 65,317	6,766,984
Iowa		18,000		15,000	5,904,766
Maryland					5,271,609
Kansas					5,266,065
Wyoming	1,200				4,429,491
Tennessee					4,382,968
Missouri		150		446	3,890,154
Virginia	20,317				3,182,993
Indian Territory	588,624				2,820,666
Washington					2,681,214
Arkansas	1,308,493				1,943,932
Utah					1,574,521
Montana					1,560,823
New Mexico					1,048,763
Michigan					964,718
Texas					901,912
Georgia					414,083
North Dakota					226,511
California					84,984
Oregon					65,648
North Carolina					23,000
Alaska					2,212
Idaho					2,030
Total	1,973,006	1,146,528	939,254	279,376	301,590,439

[a] Includes 124,701 tons of semicannel coal.
[b] Includes 27,482 tons of semiblock coal.
[c] Includes 1,600 tons of semicannel coal.

LABOR STATISTICS.

The following tables show the number of men employed and the average number of days made by each during the last four years, by States, and the total number of men employed in the anthracite and bituminous fields of the United States, with the average time since 1899:

Statistics of labor employed in coal mines of the United States, 1899–1902.

State or Territory.	1899.		1900.		1901.		1902.	
	Number of days active.	Average number employed.	Number of days active.	Average number employed.	Number of days active.	Average number employed.	Number of days active.	Average number employed.
Alabama	238	13,481	257	13,967	236	17,370	256	16,439
Arkansas	156	2,313	219	2,800	221	3,144	188	3,595
California	a 287	369	309	378	289	428	a 302	a 217
Colorado	246	7,166	264	7,459	253	8,870	261	8,956
Georgia	b 291	637	b 262	681	b 291	791	b 312	b 795
Idaho	......	....	......	....	......	....	74	20
Illinois	228	36,756	226	39,101	220	41,880	226	47,411
Indiana	218	9,712	199	11,720	194	12,968	205	15,457
Indian Territory	212	4,084	228	4,525	208	6,706	232	5,574
Iowa	229	10,971	228	11,608	218	12,653	227	12,434
Kansas	226	8,000	232	8,459	224	9,928	220	9,461
Kentucky	224	7,461	227	9,680	213	10,307	209	13,727
Maryland	275	4,624	203	5,319	262	5,333	242	5,827
Michigan	232	1,291	261	1,704	247	2,276	171	2,344
Missouri	212	7,136	214	8,180	223	9,871	202	9,739
Montana	238	2,378	252	2,376	231	2,158	270	1,938
New Mexico	257	1,750	261	2,037	224	2,478	217	1,849
North Dakota	154	210	142	326	198	280	213	402
Ohio	200	26,038	215	27,628	198	32,111	200	38,965
Oregon	238	124	273	141	228	137	234	265
Pennsylvania bituminous	245	82,812	242	92,692	230	101,904	248	112,630
Tennessee	252	6,949	242	7,646	228	9,046	230	8,750
Texas	256	2,410	246	2,844	264	3,051	267	2,369
Utah	265	743	248	1,308	259	1,712	259	1,826
Virginia	252	1,960	239	3,631	279	4,152	293	3,912
Washington	259	3,330	289	3,670	276	4,545	275	4,404
West Virginia	242	23,625	231	29,163	219	30,935	205	35,500
Wyoming	261	4,697	266	5,332	248	5,151	248	5,250
Total	234	271,027	234	304,375	225	340,235	230	370,056
Pennsylvania anthracite	173	139,608	166	144,206	196	145,309	116	148,141
Grand total	214	410,635	212	448,581	216	485,544	197	518,197

a Includes Alaska. b Includes North Carolina.

Statistics of labor employed in coal mines of the United States, 1890–1902.

Year.	Pennsylvania anthracite.		Bituminous.	
	Number of days active.	Average number employed.	Number of days active.	Average number employed.
1890	200	126,000	226	192,204
1891	203	126,350	223	205,803
1892	198	129,050	219	212,893
1893	197	132,944	204	230,365
1894	190	131,603	171	244,603
1895	196	142,917	194	239,962
1896	174	148,991	192	244,171
1897	150	149,884	196	247,817
1898	152	145,504	211	255,717
1899	173	139,608	234	271,027
1900	166	144,206	234	304,375
1901	196	145,309	225	340,235
1902	116	148,141	230	370,056

From the preceding tables, showing the production and the statistics of labor employed, the following table, in which is shown the average daily and annual tonnage per man, has been compiled. It shows that in 1890 the annual production per man employed in the anthracite region was 369 short tons. The average tonnage per man per day was 1.845 short tons. In the bituminous region it was 579 short tons per man per year, and 2.56 short tons per man per day. In 1901 the anthracite employees produced an average of 464 short tons per man per year. The average production per day per man was 2.37 short tons. The average production of bituminous coal per man in 1901 was 664 short tons. The average tonnage per man per day in the bituminous fields was 2.94 short tons. The average efficiency, or daily tonnage per man, in the anthracite region has decreased from 2.50 in 1899 to 2.37 in 1901; the bituminous average has decreased from 3.05 to 2.94. On account of the long period of idleness in the anthracite region in 1902, that year does not form a fair basis for comparative statistics. It shows, however, the lowest tonnage per man for the year for the entire period since 1890. Compared with 1901 the yearly tonnage per man in 1902 shows a decrease of 40 per cent. The decrease in anthracite production was 38.8 per cent. On the other hand, an increased efficiency is shown in the labor performed during the time the mines were operated, from the fact that the daily tonnage per man increased from 2.37 to 2.4. The benefit secured by the average bituminous coal miner from the idleness of his competitors in the anthracite field is exhibited in an increased tonnage per day, from 2.94 in 1901 to 3.06 in 1902, and in an increase from 664 to 703 in the average tonnage per man for the year.

Production of coal according to number of persons employed, 1890–1902.

Year.	Anthracite.				Bituminous.			
	Men employed.	Days worked.	Average tonnage per man per day.	Average tonnage per man per year.	Men employed.	Days worked.	Average tonnage per man per day.	Average tonnage per man per year.
1890	126,000	200	1.85	369	192,204	226	2.56	579
1891	126,350	203	1.98	401	205,803	223	2.57	573
1892	129,050	198	2.06	407	212,893	219	2.72	596
1893	132,944	197	2.06	406	230,365	204	2.73	557
1894	131,603	190	2.08	395	244,603	171	2.84	486
1895	142,917	196	2.07	406	239,962	194	2.90	563
1896	148,991	174	2.10	365	244,171	192	2.94	564
1897	149,884	150	2.34	351	247,817	196	3.04	596
1898	145,504	152	2.41	367	255,717	211	3.09	651
1899	139,608	173	2.50	433	271,027	234	3.05	713
1900	144,206	166	2.40	398	304,375	234	2.98	697
1901	145,309	196	2.37	464	340,235	225	2.94	664
1902	148,141	116	2.40	279	370,056	230	3.06	703

On account of the peculiar conditions which existed in 1902 it is believed that the following table, showing the average tonnage per man, per year and per day, in each State during 1901 and 1902, will be of interest. As having a possible bearing upon such average capacity a statement of the machine-mined tonnage for each State in both years is also given. It should be remembered, however, that the extraordinary demand for soft coal in 1902 created a strenuousness for tonnage which to some extent overcame the influence exerted thereon by the use of mining machines. The following table shows that in addition to anthracite mining there were seven instances in which the yearly tonnage per man in 1902 was less than in 1901. In five of these instances the percentage of machine-mined coal to the total product for that State was larger in 1902 than in 1901. There were only four cases in which the average bituminous tonnage per man per day decreased, and in all but one of these the percentage of machine-mined coal was increased. The average tonnage per man per year varied from 361 in the Indian Territory to 958.8 in Maryland during 1901, and from 278.7 in Pennsylvania (anthracite) to 905 in Maryland for 1902. The daily tonnage per man was lowest in Texas for both years, namely, 1.38 and 1.43. It was highest in Maryland—3.66 in 1901 and 3.74 in 1902.

Average production per man compared with production by machines in 1901 and 1902 by States.

[Short tons.]

State.	Average tonnage.				Production by machines.			
	Per year.		Per day.		Total tonnage by machines.		Per cent of machine coal to total.	
	1901.	1902.	1901.	1902.	1901.	1902.	1901.	1902.
Alabama	524	630	2.22	2.46	289,051	300,670	3.17	2.90
Arkansas	577.7	540.7	2.59	2.88	102,220	8,989	5.62	.46
Colorado	642.6	826	2.54	3.16	319,678	857,279	5.60	11.58
Illinois	653	696	2.97	3.08	5,774,639	7,112,039	21.12	21.59
Indiana	533.5	611.1	2.75	2.98	1,852,058	2,421,342	26.77	25.63
Indian Territory	361	506	1.74	2.18	177,233	119,195	7.31	4.23
Iowa	444	475	2.04	2.09	110,980	110,489	1.97	1.87
Kansas	493.6	556.6	2.20	2.53	37,979	48,000	.77	.91
Kentucky	530.7	491.5	2.49	2.35	2,254,711	3,091,626	41.21	45.82
Maryland	958.8	904.6	3.66	3.74	177,724	252,753	3.47	4.28
Michigan	545.4	411.6	2.21	2.40	177,969	196,248	14.33	20.34
Missouri	395.3	399.5	1.73	1.98	153,879	223,969	4.04	5.76
Montana	647	805	2.80	2.98	748,981	691,669	53.64	44.31
New Mexico	438	567	1.96	2.61	2,700	71,744	.24	6.84
Ohio	652	604	3.29	3.02	9,908,316	12,094,641	47.30	51.42
Pennsylvania:								
Anthracite	464.3	278.7	2.37	2.04	....	....	....	....
Bituminous	808	875	3.53	3.52	29,591,368	35,058,038	35.95	35.57
Tennessee	401.7	501	1.76	2.18	220,573	303,995	6.07	6.92
Texas	363	381	1.375	1.43	22,420	25,500	2.02	2.83
Utah	772.6	862	2.98	3.33	14,738	74,502	1.11	4.81
Virginia	657	814	2.355	2.78	233,275	132,709	8.55	4.17
Washington	567	609	2.05	2.22	6,500	....	.25	....
West Virginia	778	692	3.55	3.38	4,817,943	5,738,045	20.01	23.35
Wyoming	871	843.7	3.51	3.40	804,826	588,302	17.94	13.10

COAL-MINING ACCIDENTS.

In the following table is presented a statement showing the number of fatal and nonfatal accidents occurring in the coal mines of the United States during 1901 and 1902, so far as it has been possible to obtain statistics of this kind. The statement shows also the number of men killed per thousand employed, and the total number of tons of coal mined in each State for each life lost. These statistics have not been collected directly by the Geological Survey, but have been obtained from the reports of State officials or by correspondence with the mine inspectors or other constituted authorities. The sources of the information included in the following tables have been as follows:

Alabama, the annual report of Mr. J. De B. Hooper, State mine inspector; Arkansas, Mr. Martin Rafter, State mine inspector; Colorado, Mr. John D. Jones, State coal mine inspector; Illinois, from the annual report of Mr. David Ross, secretary of the bureau of labor statistics; Indiana, from Mr. P. H. Penna, State coal mine inspector; Indian Territory, from the report of Mr. William Cameron, Territorial coal mine inspector; Iowa, from the annual report of the State mine inspectors; Kansas, Mr. D. R. Castleman, the State secretary of mine industries; Kentucky, from the report of Mr. C. J. Norwood, State inspector of mines; Maryland, Mr. James P. Carroll, State mine inspector; Michigan, from the report of the Bureau of Labor; Missouri, from Mr. Charles Evans, inspector of coal mines; New Mexico, from the annual report of the Territorial mine inspector; Ohio, from Mr. E. G. Biddison, State mine inspector; Pennsylvania, from the annual report of Mr. James E. Roderick, chief inspector of mines; Utah, from Mr. Gomer Thomas, State mine inspector; Washington, from Mr. C. F. Owen, State inspector of coal mines; West Virginia, from Mr. James W. Paul, chief mine inspector; Wyoming, from Mr. Noah Young, chief mine inspector.

To each of these officials the writer desires to express his sincere appreciation of the assistance rendered by them in the preparation of these statistics.

In the States and Territories included in the following tables the total number of lives lost in 1902 was 1,951, as compared with 1,467 in 1901; the total number of men injured was 3,643 in 1901 and 3,438 in 1902. The largest number of lives lost per 1,000 employees in 1902 was in Wyoming; the smallest number was in Missouri. The smallest production for each life lost in 1901 was in the Indian Territory, and the largest was in Maryland. In 1902 the smallest production for each life lost was in Tennessee and the largest was in Indiana. The largest number of men killed per thousand employed in 1902 was in Tennessee, where 200 men out of a total of 226 were killed by the explosions in the Nelson and Fraterville mines.

Fatal and nonfatal accidents in coal mines of United States in 1901.

State.	Number of men killed.	Number of men injured.	Number of lives lost per 1,000 employees.	Number of tons mined for each life lost.
Alabama	41	(a)	2.36	221,928
Arkansas	18	63	5.73	100,896
Colorado	55	81	6.20	103,637
Illinois[b]	99	422	2.24	263,716
Indiana	(a)	(a)	....	(a)
Indian Territory[b]	49	98	7.31	49,424
Iowa	29	59	2.29	193,707
Kansas	16	35	1.61	304,985
Kentucky	21	109	2.04	273,499
Maryland	12	110	2.25	426,094
Michigan	6	18	2.64	206,874
Missouri	15	16	1.52	253,333
Montana	(a)	(a)	....	(a)
New Mexico	9	11	3.63	135,281
Ohio	72	432	2.24	290,886

[a] Not reported.

[b] Fiscal year ending June 30, 1901.

Fatal and nonfatal accidents in coal mines of United States in 1901—Continued.

State.	Number of men killed.	Number of men injured.	Number of lives lost per 1,000 employees.	Number of tons mined for each life lost.
Pennsylvania:				
Anthracite	513	1,243	3.53	131,524
Bituminous	301	656	2.95	273,288
Tennessee	(a)	(a)	....	(a)
Utah	9	12	5.26	146,957
Washington	27	82	5.94	95,489
West Virginia	134	184	4.33	179,525
Wyoming	41	12	7.96	109,399
Total for 18 States and Territories	1,467	3,643	3.04	[b] 188,668

Fatal and nonfatal accidents in coal mines of United States in 1902.

State.	Number of men killed.	Number of men injured.	Number of lives lost per 1,000 employees.	Number of tons mined for each life lost.
Alabama	50	(a)	3.04	207,091
Arkansas	13	29	3.62	149,533
Colorado	73	105	8.15	101,384
Illinois [c]	154	[d] 406	3.35	194,944
Indiana	24	145	1.55	393,593
Indian Territory [c]	33	83	5.92	85,475
Iowa [c]	55	79	4.23	100,258
Kansas	30	71	3.17	175,536
Kentucky	19	129	1.39	355,120
Maryland	....	....	....	....
Michigan	7	19	3	137,817
Missouri	10	18	1.03	389,032
Montana	12	14	6.19	130,069
New Mexico [c]	17	27	10	66,644
Ohio	81	451	2.08	289,085
Pennsylvania:				
Anthracite	300	641	2.03	137,632
Bituminous	456	861	4.05	215,943
Tennessee	226	42	25.51	19,446
Utah	8	17	4.38	196,815
Washington	34	54	7.7	78,040
West Virginia	159	223	4.48	154,533
Wyoming	190	24	3	23,313
Total for 20 States and Territories	1,951	3,438	3.72	148,033

[a] Not reported.
[b] Averaged.
[c] Fiscal year ending June 30, 1902, taken from State report.
[d] Includes only men so injured as to lose one month of time.

PRICES.

The following tables show the fluctuations in the average prices prevailing in each State since 1898, and also the average prices for anthracite and bituminous coal in the United States since 1880. These averages are obtained by dividing the total product, including colliery consumption, into the total value.

Average prices for coal at the mines since 1898.

[Per short ton.]

State or Territory.	1898.	1899.	1900.	1901.	1902.
Alabama	$0.75	$1.09	$1.17	$1.10	$1.20
Arkansas	1.03	1.17	1.14	1.14	1.31
California	[a]2.65	[a]2.76	[a]3.12	[a]2.65	[a]3.14
Colorado	1.15	1.12	1.12	1.13	1.13
Georgia	.81	1.00	1.17	1.20	[b]1.42
Idaho	2.57	5.00	5.00	....	[c]2.50
Illinois	.78	.85	1.04	1.03	1.03
Indiana	.81	.88	1.03	1.01	1.10
Indian Territory	1.32	1.43	1.45	1.62	1.51
Iowa	1.14	1.24	1.38	1.39	1.47
Kansas	1.09	1.16	1.22	1.22	1.30
Kentucky	.79	.79	.92	.95	.99
Maryland	.76	.76	.98	.99	1.06
Michigan	1.47	1.39	1.48	1.41	1.71
Missouri	1.07	1.20	1.21	1.24	1.38
Montana	1.57	1.57	1.63	1.44	1.65
New Mexico	1.35	1.39	1.37	1.42	1.43
North Carolina	1.25	1.30	1.32	1.25	(*d*)
North Dakota	1.11	1.19	1.22	1.29	1.44
Ohio	.83	.87	1.02	1.00	1.14
Oregon	3.65	3.00	3.74	2.52	2.44
Pennsylvania bituminous	.67	.76	.97	.99	1.08
Tennessee	.77	.88	1.14	1.12	1.23
Texas	1.66	1.51	1.63	1.72	1.64
Utah	1.27	1.27	1.26	1.26	1.14
Virginia	.59	.62	.89	.86	.80
Washington	1.78	1.78	1.90	1.66	1.72
West Virginia	.61	.63	.81	.87	1.01
Wyoming	1.28	1.24	1.36	1.35	1.18
Total bituminous	.80	.87	1.04	1.04	1.12
Pennsylvania anthracite	1.41	1.46	1.49	1.67	1.84
General average	.95	1.01	1.14	1.19	1.22

[a] Includes Alaska.
[b] Includes North Carolina.
[c] Includes Nebraska.
[d] Included in Georgia.

Average price per short ton of coal in United States for 23 years.

Year.	Anthracite.	Bituminous.	Year.	Anthracite.	Bituminous.
1880	$1.47	$1.25	1892	$1.57	$0.99
1881	2.01	1.12	1893	1.59	.96
1882	2.01	1.12	1894	1.51	.91
1883	2.01	1.07	1895	1.41	.86
1884	1.79	.94	1896	1.50	.83
1885	2.00	1.13	1897	1.51	.81
1886	1.95	1.05	1898	1.41	.80
1887	2.01	1.11	1899	1.46	.87
1888	1.91	1.00	1900	1.49	1.04
1889	1.44	.99	1901	1.67	1.05
1890	1.43	.99	1902	1.84	1.12
1891	1.46	.99			

COAL MINED BY MACHINES.

Although there were a number of States in which there was a decided decrease in the use of mining machines in 1902 as compared with 1901, the total for the United States exhibits a marked increase in the number of machines used, in the machine-mined product, and in the percentage of machine-mined coal to the total output. The States in which the number of machines and the machine-mined tonnage decreased in 1902 were, with the exception of Wyoming, States in which comparatively little development in the mechanical production of coal had been made. All of the States where the use of machines had exerted any significant effect upon the production prior to 1902 showed substantial increases in that year. Ohio enjoys the distinction of the largest proportionate production by the use of machines, more than half the product of that State in 1902 having been machine mined. Ohio also stands second in the total of machine-mined coal, Pennsylvania being first. Illinois ranks third in the amount of coal produced by machines, West Virginia fourth, Kentucky fifth, and Indiana sixth. It will be noted that these six States comprise the well-known "competitive" coal fields. They produced 75 per cent of the total output of bituminous coal in the United States and 94 per cent of the total machine-mined tonnage in 1902.

The total machine-mined product reported for 1902 was 69,611,582 short tons, an increase, as compared with 57,843,335 short tons in 1901, of 11,768,247 short tons, or 20 per cent. As the total production of bituminous coal in the United States in 1902 was 15 per cent larger than in 1901, it will be seen that, on the whole, the production by the use of machines has more than kept pace with the increased output. In fact, as shown in the following table, the percentage of the machine-mined product to the total output has increased from 25.68 in 1901 to 27.09 in 1902.

The statistics for 1902 as compiled in the following tables have all been obtained from the reports of the coal-mine operators to the Geological Survey. It is possible that the falling off in machine production in some States has been due to the failure of operators to reply to this particular inquiry on the Survey schedules. Where no machines have been reported, it has been considered that none was in use, although the same mines may have reported the use of machines in 1901.

Of the 5,418 machines in use in 1902, 3,185 were of the "pick" or "puncher" type, 2,182 were chain-breast machines, and 51 were of the long-wall design.

The statistics in regard to the production of coal by machines in the last five years are presented in the following tables, which show the number of machines in use, the number of tons mined by machines, the total production of the States in which machines were used, and the percentage of the machine-mined product to the total:

Bituminous coal mined by machines in the United States in 1898, 1899, 1900, 1901, and 1902.

State.	Number of machines in use,				
	1898.	1899.	1900.	1901.	1902.
Alabama	37	53	54	82	66
Arkansas	21	16	20	20	7
Colorado	43	63	90	62	98
Illinois	392	440	430	464	508
Indiana	233	247	254	256	269
Indian Territory	75	74	58	47	23
Iowa	56	41	40	53	31
Kansas	2	3	3	4	6
Kentucky	158	189	239	237	318
Maryland	....	8	10	15	25
Michigan	7	25	33	31	58
Missouri	4	9	15	24	20
Montana	62	75	81	70	65
New Mexico	29	14	21	6	17
North Dakota	7	5	7	7	10
Ohio	245	278	341	376	559
Pennsylvania	1,085	1,343	1,786	2,058	2,620
Tennessee	19	22	18	21	38
Texas	5	....	....	8	8
Utah	....	....	....	13	13
Virginia	8	8	9	6	11
Washington	....	2	2	4	....
West Virginia	86	154	327	403	579
Wyoming	48	56	69	74	69
Total	2,622	3,125	3,907	4,341	5,418

State.	Number of tons mined by machines.				
	1898.	1899.	1900.	1901.	1902.
Alabama	298,170	260,444	370,150	289,051	300,670
Arkansas	152,192	146,899	219,085	102,220	8,989
Colorado	225,646	527,115	756,025	319,678	857,279
Illinois	3,415,635	6,085,312	5,083,594	5,774,639	7,112,039
Indiana	1,414,342	1,713,125	1,774,045	1,852,058	2,421,342
Indian Territory	274,370	276,180	239,424	177,233	119,195
Iowa	218,852	124,721	132,757	110,980	110,489
Kansas	11,722	40,271	46,164	37,979	48,000
Kentucky	1,366,676	1,625,809	2,339,944	2,254,711	3,091,626
Maryland	....	16,545	138,014	177,724	252,753
Michigan	1,456	64,055	191,577	177,969	196,248
Missouri	52,864	55,154	110,036	153,879	223,969
Montana	681,613	843,710	1,045,115	748,981	691,669
New Mexico	163,849	260,773	112,000	2,700	71,744
North Dakota	65,030	38,066	33,965	43,574	89,838
Ohio	5,191,375	6,822,524	8,835,743	9,908,316	12,094,641
Pennsylvania	16,512,480	22,000,722	26,867,053	29,591,368	35,058,038
Tennessee	152,002	208,033	176,872	220,573	303,995
Texas	15,340	....	....	22,420	25,500
Utah	....	....	....	14,738	74,502
Virginia	244,170	265,000	231,269	233,275	132,709
Washington	....	14,640	10,000	6,500	....
West Virginia	1,323,929	1,881,125	3,418,377	4,817,943	5,738,045
Wyoming	631,431	693,712	653,314	804,826	588,302
Total	32,413,144	43,963,935	52,784,523	57,843,335	69,611,582

Bituminous coal mined by machines in the United States in 1898, etc.—Continued.

State.	Total tonnage of States using mining machinery.				
	1898.	1899.	1900.	1901.	1902.
Alabama	6,535,283	7,593,416	8,394,275	9,099,052	10,354,570
Arkansas	1,205,479	843,554	1,477,945	1,816,136	1,943,932
Colorado	4,076,347	4,776,224	5,244,364	5,700,015	7,401,343
Illinois	18,599,299	24,439,019	25,767,981	27,331,552	32,939,373
Indiana	4,920,743	6,006,523	6,484,086	6,918,225	9,446,424
Indian Territory	1,381,466	1,537,427	1,922,298	2,421,781	2,820,666
Iowa	4,618,842	5,177,479	5,202,939	5,617,499	5,904,766
Kansas	3,406,555	3,852,267	4,467,870	4,900,528	5,266,065
Kentucky	3,887,908	4,607,255	5,328,964	5,469,986	6,766,984
Maryland	....	4,807,396	4,024,688	5,113,127	5,271,609
Michigan	315,722	624,708	849,475	1,241,241	964,718
Missouri	2,688,321	3,025,814	3,540,103	3,802,088	3,890,154
Montana	1,479,803	1,496,451	1,661,775	1,396,081	1,560,823
New Mexico	992,288	1,050,714	1,299,299	1,086,546	1,048,763
North Dakota	83,895	98,809	129,883	166,601	226,511
Ohio	14,516,867	16,500,270	18,988,150	20,943,807	23,519,894
Pennsylvania	65,165,133	74,150,175	79,842,326	82,305,946	98,574,367
Tennessee	3,022,896	3,330,659	3,708,562	3,633,290	4,382,968
Texas	686,734	....	....	1,107,953	901,912
Utah	....	....	....	1,322,614	1,574,521
Virginia	1,815,274	2,105,791	2,393,754	2,725,873	3,182,993
Washington	....	2,029,881	2,474,093	2,578,217	....
West Virginia	16,700,999	19,252,995	22,647,207	24,068,402	24,570,826
Wyoming	2,863,812	3,837,392	4,014,602	4,485,374	4,429,491
Total	158,963,666	191,144,219	209,864,639	225,251,934	256,927,491

State.	Percentage of total product mined by machines.				
	1898.	1899.	1900.	1901.	1902.
Alabama	4.56	3.43	4.41	3.17	2.90
Arkansas	12.63	17.41	14.82	5.62	.46
Colorado	5.54	11.03	14.42	5.60	11.58
Illinois	18.36	24.90	19.73	21.12	21.59
Indiana	28.74	28.52	27.36	26.77	25.63
Indian Territory	19.86	17.96	12.46	7.31	4.23
Iowa	4.74	2.21	2.55	1.97	1.87
Kansas	.34	1.04	1.03	.77	.91
Kentucky	35.15	35.29	43.91	41.21	45.66
Maryland	....	.34	3.43	3.47	4.28
Michigan	.46	10.20	22.55	14.33	20.34
Missouri	1.97	1.80	3.11	4.04	5.76
Montana	46.06	56.38	62.89	53.64	44.31
New Mexico	16.51	24.81	8.62	.24	6.84
North Dakota	77.51	38.52	26.15	26.15	39.66
Ohio	35.76	41.35	46.53	47.26	51.42
Pennsylvania	25.34	29.67	33.65	35.95	35.57
Tennessee	5.03	6.04	4.77	6.07	6.94
Texas	2.23	....	....	2.02	2.83
Utah	....	....	....	1.11	4.81
Virginia	13.45	23.06	9.66	8.55	4.17
Washington	....	.72	.40	.25	....
West Virginia	7.93	9.27	15.09	20.01	23.35
Wyoming	22.05	18.07	16.27	17.94	13.10
Average	20.39	23.00	25.15	25.68	27.09

ARTIFICIAL FUELS.

In this report for 1901 all the information obtainable on the manufacture of fuel briquettes was given in a brief paragraph, which stated that the manufacture of artificial fuel had made little or no progress in the United States, the chief reason being the cheapness and superiority of raw fuels. Since that paragraph was written the conditions have undergone several changes, some of which are of considerable importance. From one cause or another or from a combination of a number of causes the cost of coal to the consumer in 1902 was higher than for many years. Prices have been advancing steadily since 1898, and in 1902 the average selling value per ton at the mines for both anthracite and bituminous coal was 40 per cent higher than in 1898. The altered conditions affecting the consumption of anthracite are referred to elsewhere in this report, and statistics are given showing to what an extent the small sizes of anthracite coal formerly wasted are now being utilized and how these are being recovered by washeries from the old culm banks in the anthracite region. There is, however, a large amount of coal lost in the form of dust or finely pulverized material which may be utilized if it can be put into convenient shape for domestic consumption. The slack now wasted or sold for little or nothing at many of the bituminous mines in the United States can be utilized to advantage if compressed into briquettes; and results obtained in foreign countries in the use of lignite and peat in briquetted form should encourage the producers in this country to similar methods. And in fact there are many indications that the time is not far distant when these now neglected fuel resources will be utilized. This is particularly true in regard to the bituminous slack and lignites of the Middle West and Rocky Mountain States. Some of the more important producers in those sections have been making investigations of the subject with the idea of ascertaining the most practical and economical methods to apply to their particular products. It is understood that an important feature of the mining exhibit at the Louisiana Purchase Exposition will consist of a series of practical tests of ores and other minerals, and prominent among these will be tests for making briquettes with different fuels and binding materials.

LABOR TROUBLES.

The scenes of the principal labor difficulties in 1902 were laid in the anthracite regions of Pennsylvania, the New and Kanawha river districts of West Virginia, and in the State of Michigan. The anthracite troubles resulted in a decrease of nearly 40 per cent in production to the operators as compared with 1901; 145,000 men were made idle for 98 working days (based on an average of 4 working days for each man a week); and the public was put to greater inconvenience and annoyance for want of fuel than had ever been known before in the history of the country. The strike in the anthracite region of Pennsylvania in 1902 will be long remembered by operators, miners, and the public as one of the most stubbornly contested struggles between employers and employees that has ever taken place in the United States, and it was finally terminated through the friendly intervention of President Roosevelt, acting in the capacity of a private citizen. The total number of working days lost by this strike is estimated at 14,210,000, which, at an average of $2.50 a day, meant a loss of about $35,000,000 in wages.

The strikes in West Virginia were for the purpose of forcing a recognition of the union upon the operators. This was finally accomplished in the Kanawha River, but in the New River district the attempt failed of its purpose. The time lost in West Virginia in 1902 was nearly twice as much as that lost by strikes in all the United States in 1901. The estimated loss of tonnage for the State caused by the strike was about 4,500,000 tons, although on account of increased activity in other portions of the State there was no actual decrease in output as compared with 1901. The principal issue involved in the Michigan strike was the delivery of mine cars, the miners claiming that the companies should deliver the cars to and take them from the working places, instead of to and from the room entrances. The strike was lost. Michigan's production, which has only been developed to proportions of importance during the last three or four years, lost nearly 25 per cent in tonnage by the strike of 1902.

The statistics of labor troubles in the coal mines of the United States in 1901 and 1902 are shown in the following tables:

Statistics of labor strikes in the coal mines of the United States in 1901.

State or Territory.	Number of men on strike.	Total days lost.	Average number of days lost per man.
Alabama	1,170	14,071	12
Colorado	1,527	86,045	56
Illinois	3,740	79,245	21
Indiana	1,027	40,812	39
Iowa	401	16,171	40
Kansas	60	300	5
Kentucky	933	32,707	35
Missouri	1,042	31,318	30
Montana	285	14,175	49
New Mexico	766	32,949	43
North Dakota	32	224	7
Ohio	2,724	105,177	38
Pennsylvania	2,541	125,116	49
Tennessee	1,705	82,730	49
Texas	113	226	2
Utah	754	23,055	30
Virginia	175	3,200	18
West Virginia	1,438	45,161	31
Wyoming	160	1,120	7
Total	20,593	733,802	35

Statistics of labor strikes in the coal mines of the United States in 1902.

State or Territory.	Number of men on strike.	Total days lost.	Average number of days lost per man.
Alabama	6,059	139,783	23
Arkansas	14	140	10
Colorado	444	20,845	47
Illinois	3,916	65,231	17
Indiana	1,824	23,693	13
Indian Territory	150	9,000	60
Iowa	363	6,480	18
Kansas	334	17,256	52
Kentucky	1,248	22,184	18
Maryland	....	....	....
Michigan	1,935	239,146	124
Missouri	1,364	61,273	45
Montana	686	7,636	11
New Mexico	470	9,820	21
North Dakota	8	8	1
Ohio	3,769	70,534	19
Pennsylvania bituminous	12,580	264,862	21
Tennessee	1,904	136,347	72
Texas	50	50	1
Virginia	205	5,875	29
Washington	....	....	....
West Virginia	18,129	1,362,054	75
Total	55,452	2,462,217	44
Pennsylvania anthracite (approximate)	145,000	14,210,000	98

IMPORTS AND EXPORTS.

The following tables have been compiled from official returns to the Bureau of Statistics of the Department of Commerce and Labor, and show the imports and exports of coal from 1867 to 1902, inclusive. The values given in both cases are considerably higher than the average "spot" rates by which the values of the domestic production have been computed.

The tariff from 1824 to 1843 was 6 cents per bushel, or $1.68 per long ton; from 1843 to 1846, $1.75 per ton; 1846 to 1857, 30 per cent ad valorem; 1857 to 1861, 24 per cent ad valorem; 1861, bituminous and shale, $1 per ton; all other, 50 cents per ton; 1862 to 1864, bituminous and shale, $1.10 per ton; all other, 60 cents per ton; 1864 to 1872, bituminous and shale, $1.25 per ton; all other, 40 cents per ton. By the act of 1872 the tariff on bituminous coal and shale was made 75 cents per ton, and so continued until the act of August, 1894, changed it to 40 cents per ton. On slack or culm the tariff was made 40 cents per ton by the act of 1872; was changed to 30 cents per ton by the act of March, 1883, and so continued until the act of August, 1894, changed it to 15 cents per ton. The tariff act of 1897 provides that all coals which contain less than 92 per cent fixed carbon, and which will pass over a half-inch screen, shall pay a duty of 67 cents per ton. Slack or culm was not changed by the act of 1897. Tons are all 2,240 pounds. Anthracite coal has been free of duty since 1870. During the period from June, 1854, to March, 1866, the reciprocity treaty was in force, and coal from the British possessions in North America was admitted into the United States duty free. A special act of Congress placed all coal on the free list for one year from January 1, 1903, in order to relieve the shortage caused by the anthracite strike of 1902.

The exports consist both of anthracite and bituminous coal, the amount of bituminous being the greater in the last few years. They are made principally by rail over the international bridges and by lake and sea to the Canadian provinces. Exports are also made by sea to the West Indies, to Central and South America, and elsewhere.

The imports are principally from Australia and British Columbia to San Francisco, from Great Britain to the Atlantic and Pacific coasts, and from Nova Scotia to Atlantic coast points.

The statistics of the exports for 1902 show that the amount of anthracite exported decreased from 1,993,307 long tons in 1901 to 907,977 long tons in 1902, a loss of 1,085,330 tons, or nearly 57 per cent. The enormous home demand for bituminous coal in 1902, added to the almost constant shortage of cars, caused a slight decrease in the export trade of that commodity also. The amount of bituminous coal exported in 1902 was 5,218,969 long tons, a decrease of 171,117 long tons from the preceding year.

The imports of anthracite coal are comparatively insignificant. A considerable increase has been shown in the last two years in the imports of bituminous coal, due to the establishment of the plant of Otto-Hoffman coke ovens by the New England Gas and Coke Company at Everett, Mass., the fuel for which is brought from the mines of Cape Breton, Nova Scotia. The amount of this fuel brought to the port of Boston in 1902 was 1,001,520 long tons, about half of which was slack used in the coke ovens at Everett.

Coal imported and entered for consumption in the United States, 1867–1902.

Year ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
June 30, 1867			509,802	$1,412,597
1868			394,021	1,250,513
1869			437,228	1,222,119
1870			415,729	1,103,965
1871	973	$4,177	430,508	1,121,914
1872	390	1,322	485,063	1,279,686
1873	2,221	10,764	460,028	1,548,208
1874	471	3,224	492,063	1,937,274
1875	138	963	436,714	1,791,601
1876	1,428	8,560	400,632	1,592,846
1877	630	2,220	495,816	1,782,941
1878	158	518	572,846	1,929,660
1879	488	721	486,501	1,716,209
1880	8	40	471,818	1,588,312
1881	1,207	2,628	652,963	1,988,199
1882	36	148	795,722	2,141,373
1883	507	1,172	645,924	3,013,555
1884	1,448	4,404	748,995	2,494,228
1885	4,976	15,848	768,477	2,548,432
Dec. 31, 1886	2,039	4,920	811,657	2,501,153
1887	14,181	42,983	819,242	2,609,311
1888	24,093	68,710	1,085,647	3,728,060
1889	20,652	117,434	1,001,374	3,425,347
1890	15,145	46,695	819,971	2,822,216
1891	37,607	112,722	1,363,313	4,561,105
1892	65,058	197,583	1,143,304	3,744,862
1893	53,768	148,112	1,082,993	3,623,892
1894	90,068	234,024	1,242,714	3,785,513
1895	141,337	328,705	1,212,023	3,626,623
1896	101,689	237,717	1,211,448	3,453,742
1897	24,534	59,222	1,276,135	3,424,833
1898	3,149	8,609	1,277,070	3,569,743
1899	61	245	1,400,461	3,882,430
1900	118	549	1,909,258	5,019,553
1901	286	1,844	1,919,962	5,291,429
1902	[a] 170,211	792,469	[b] 2,470,902	6,984,668

[a] Includes 93,571 tons of anthracite containing less than 92 per cent fixed carbon, imported duty free under the special act of 1902.

[b] Includes 767,582 tons of slack or culm passing ½-inch screen.

Coal of domestic production exported from the United States, 1867–1902.

Year ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
June 30, 1867	192,912	$1,333,457	92,189	$512,742
1868	192,291	1,082,745	86,367	433,475
1869	283,783	1,553,115	....	....
1870	121,098	803,135	106,820	502,223
1871	134,571	805,169	133,380	564,067
1872	259,567	1,375,342	141,311	586,264
1873	342,180	1,827,822	242,453	1,086,253
1874	401,912	2,236,084	361,490	1,587,666
1875	316,157	1,791,626	203,189	828,943
1876	337,934	1,869,434	230,144	850,711
1877	418,791	1,891,351	321,665	1,024,711
1878	319,477	1,006,843	340,661	1,352,624
1879	386,916	1,427,886	276,000	891,512
1880	392,626	1,362,901	222,634	695,179
1881	462,208	2,091,928	191,038	739,532
1882	553,742	2,589,887	314,320	1,102,898
1883	557,813	2,648,033	463,051	1,593,214
1884	649,040	3,053,550	646,265	1,977,959
1885	588,461	2,586,421	683,481	1,989,541
Dec. 31, 1886	667,076	2,718,143	544,768	1,440,631
1887	825,486	3,469,166	706,364	2,001,966
1888	969,542	4,325,126	860,462	2,529,472
1889	857,632	3,636,347	935,151	2,783,592
1890	794,335	3,272,697	1,280,930	4,004,995
1891	861,251	3,577,610	1,615,869	5,104,850
1892	851,639	3,722,903	1,645,869	4,999,289
1893	1,333,287	6,241,007	2,324,591	6,009,801
1894	1,440,625	6,359,021	2,195,716	4,970,270
1895	1,470,710	5,937,130	2,211,983	4,816,847
1896	1,350,000	5,925,506	2,276,202	5,072,818
1897	1,298,768	5,836,730	2,399,263	5,326,761
1898	1,350,948	5,712,985	3,152,459	6,699,248
1899	1,707,796	7,140,100	4,044,354	8,573,276
1900	1,654,610	7,092,489	6,262,909	14,431,590
1901	1,993,307	8,937,147	5,390,086	13,085,763
1902	907,977	4,301,946	5,218,969	13,927,063

COAL PRODUCTION OF MEXICO.

Owing to the fact that the Mexican Government does not maintain any bureau for the collection of mining statistics, other than for the precious metals, there are no official records regarding the coal output of that country. Mr. Edwin Ludlow, general manager of the Mexican Coal and Coke Company, of Las Esperanzas, Coahuila, has, however, taken considerable trouble to obtain for this report all the information possible regarding the developments of the coal-mining industry in that country. Mr. Ludlow places the total production of coal in Mexico for the year ended December 31, 1902, at 709,654 metric tons (equivalent to 782,252 short tons), all of which was produced by three companies operating in the State of Coahuila.

The workable coal fields of Mexico from which any production has so far been obtained are found almost exclusively in the eastern part of the State of Coahuila, mining having commenced on the completion of the Mexican International Railroad in 1884. The first company to produce any coal in this region was known as the Sabinas Coal Mines. This company went out of existence in 1887, being succeeded by the Coahuila Coal Company in June of that year. The Sabinas Coal Mines produced in the three years of their existence a total of 101,000 metric tons. The next company to begin the production of coal was the Alamo Coal Company, whose operations began in March, 1888. It was followed by the Fuente Coal Company in 1894.

The controlling interest in all of these companies was owned by the late C. P. Huntington, and they were operated in connection with the Mexican International Railroad, of which Mr. Huntington was also the principal stockholder. The output of these mines has been as follows:

	Metric tons.
Sabinas Coal Mines, from 1884 to 1887	101,000
Coahuila Coal Company, from June, 1887, to December 31, 1902	1,943,000
Alamo Coal Company, from March, 1888, to December 31, 1902	1,017,000
Fuente Coal Company, from June, 1894, to December 31, 1902	793,000
Total	3,854,000

Included in the output of Coahuila Coal Company is the tonnage used in making 325,000 tons of coke.

The next company to begin operations was the Mexican Coal and Coke Company, which was organized under a charter from the State of New Jersey by New York capitalists in the fall of 1889. This company built 10 miles of railroad from the station of Barroteran on the Mexican International Railroad, about 90 miles south of Eagle Pass, to the Las Esperanzas coal fields of which it had secured control. Shipments began in June, 1900, and the total output of coal and coke from these mines from that date to the close of 1902 has been as follows:

Production of the Las Esperanzas coal mines from June, 1900, to December 31, 1902.

[Metric tons.]

Year.	Sold.	Coked.	Total.	Coke.
1900	56,201.31	....	56,201.31	....
1901	205,071.22	38,618.77	243,689.99	19,396.97
1902	310,279.72	84,774.58	395,054.30	53,010.39
Total	571,552.25	123,393.35	694,945.60	72,407.36

The total output of coal for the mines connected with the Mexican International Railroad and those of the Las Esperanzas district has therefore been 4,548,945.6 metric tons, or 5,014,302 short tons, to December 31, 1902. The Mexican Coal and Coke Company exported to the United States 2,271 metric tons of coke, most of which was sold to foundries in Texas and to smelters in Arizona.

The total production of the coal mines of Mexico for the year ending December 31, 1902, has been as follows:

Production of coal in Mexico, 1902.

[Metric tons.]

	Coal.	Coke.
Coahuila Coal and Coke Co	232,000	18,700
Fuente Coal Co	82,600	....
Mexican Coal and Coke Co	395,054	53,010
Total	709,654	71,710

The coal used in the manufacture of coke shown in the above table is included in the production of coal. The Coahuila Coal Company owns 120 ovens, 60 of which were in operation in 1902, and the Mexican Coal and Coke Company has 226 ovens, 200 of which were in active operation on December 31 of last year.

A Government report of the importation of coal and coke through the various custom-houses of the Republic during the fiscal year ending June 30, 1902, shows that the consumption exceeded the production by 761,938 tons of coal and 175,395 tons of coke.

The detail of importation of coal and coke through the various custom-houses for the fiscal year 1902 was as follows:

Imports of coal and coke into Mexico in 1902.

[Metric tons.]

Custom-house.	Coal.	Coke.
Ciudad Juarez	50,264	6,077
Ciudad Porfirio Diaz	9,890	22,200
Laredo	143,631	11,249
Tampico	358,699	131,282
Veracruz	199,454	4,587
Total	761,938	175,395
Production of mines in Mexico	709,654	71,710
Total consumption of Mexico	1,471,592	247,105

These figures are complete, with the exception of the coal and coke imported into the State of Sonora for the mines and smelters of the Cananea Consolidated Copper Company and for those of Phelps, Dodge & Co., as it was impossible to obtain the figures from the custom-houses through which the imports were made.

WORLD'S PRODUCTION OF COAL.

In the following table is given the coal production of the principal countries for the years nearest the one under review for which figures could be obtained. For the sake of convenience the quantities are expressed in the unit of measurement adopted in each country and reduced for comparison to short tons of 2,000 pounds. In each case the year is named for which the production is given:

The world's production of coal.

Country.		Usual unit in producing country.	Equivalent in short tons.
United States (1902)	long tons	269,277,178	301,590,439
Great Britain (1902)	do	227,095,042	254,346,447
Germany (1902)	metric tons	150,436,810	165,826,496
Austria-Hungary (1901)	do	41,202,902	45,417,959
France (1902)	do	30,196,994	33,286,146
Belgium (1901)	do	22,213,410	24,485,842
Russia (1901)	do	16,269,800	17,934,201
Canada (1902)	short tons	7,639,225	7,639,225
Mexico (1902)	metric tons	709,654	782,251
Japan (1900)	do	7,429,457	8,187,262
India (1902)	long tons	7,433,972	8,326,049
New South Wales (1902)	do	5,942,011	6,655,052
Spain (1901)	metric tons	2,747,721	3,027,992
New Zealand (1901)	long tons	1,227,638	1,374,955
Sweden (1902)	metric tons	304,733	335,907
Italy (1901)	do	425,614	469,154
Holland (1900)	do	320,225	352,888
South African Republic (1901)	long tons	671,532	752,116
Queensland (1901)	do	539,472	604,209
Victoria (1901)	do	209,329	234,448
Natal (1902)	do	592,821	663,960
Cape Colony (1900)	do	198,451	222,265
Tasmania (1900)	do	43,010	48,171
Other countries[a]	do	2,000,000	2,240,000
Total			884,803,434
Percentage of the United States			34

[a] Includes China, Turkey, Servia, Portugal, United States of Colombia, Chile, Borneo and Labuan, Peru, Greece, etc.

It will be seen from this table that the United States is now producing a little more than one-third of the entire coal supply of the world and stands well in the lead of all the coal-producing countries. This country passed Great Britain in 1899, that country having until that year led the world in the production of coal. Since that time the United States has annually increased its lead and in 1902 exceeded its former rival by 47,000,000 short tons. If to the production of Great Britain in 1902 is added that of Canada, India, New South Wales, and all her other dependencies for the latest years for which the statistics are available, the production of the British Empire is found to have been 280,866,897 short tons, an amount exceeded by the United States in 1902 by 20,723,542 short tons, or nearly 8 per cent.

The steps by which the United States has attained its present rank among the coal producing countries of the world are exhibited in the following table, which shows the production of each country for each year for which the figures are obtainable since 1868. At the beginning of that period the United States held third place, with Great Britain first and Germany second. The latter country was permanently displaced in 1877, although in four years previous to that date, in 1871, 1872, 1873, and 1874, our production had exceeded that of Germany. In 1902 the United States produced more than 80 per cent more coal than Germany.

In 1868 Great Britain produced 3.6 times as much coal as the United States. In 1880 Great Britain's product was 2.3 times that of the United States. In 1890 it was a little more than 1.4 times as much as ours, but in 1900 the United States produced about 7 per cent more coal than Great Britain. In the thirty-five years from 1868 to 1902, inclusive, the coal production of the United States increased 852 per cent, while that of Great Britain increased only 120 per cent. In 1868 the United States produced 14.35 per cent of the total world's supply of coal, and Great Britain produced a little over 50 per cent. In 1902 the United States produced 34 per cent of the total world's supply and Great Britain not quite 29 per cent.

World's production of coal, by countries, 1868–1902.

Year.	United States.		Great Britain.		Germany.	
	Long tons.	Short tons.	Long tons.	Short tons.	Metric tons.	Short tons.
1868	28,258,000	31,648,960	103,141,157	115,518,096	32,879,123	36,249,233
1869	28,268,000	31,660,160	107,427,557	120,318,864	34,343,913	37,864,164
1870	32,863,000	36,806,560	110,431,192	123,682,935	34,003,004	37,488,312
1871	41,384,000	46,350,080	117,352,028	131,434,271	37,856,110	41,736,361
1872	45,416,000	50,865,920	123,497,316	138,316,994	42,324,467	46,662,725
1873	51,004,000	57,124,480	128,680,131	144,121,747	46,145,194	50,875,076
1874	46,916,000	52,545,920	126,590,108	141,780,921	46,658,145	51,440,605
1875	46,686,000	52,288,320	133,306,485	149,303,263	47,804,054	52,703,970
1876	47,500,000	53,200,000	134,125,166	150,220,186	49,550,461	54,629,383
1877	53,948,000	60,421,760	134,179,968	150,281,564	48,229,882	53,173,445
1878	51,655,000	57,853,600	132,612,063	148,525,511	50,519,899	55,698,188
1879	60,893,570	68,200,799	133,720,393	149,766,840	53,470,716	58,951,464
1880	67,998,164	76,157,944	146,969,409	164,605,738	59,118,035	65,177,634
1881	76,865,357	85,881,030	154,184,300	172,686,416	61,540,485	67,848,385
1882	92,219,454	103,285,789	156,499,977	175,279,974	65,378,211	72,079,478
1883	102,867,969	115,212,125	163,737,327	183,385,806	70,442,648	77,663,019
1884	106,906,295	119,735,051	160,757,779	180,048,712	72,113,820	79,505,487
1885	99,249,817	111,159,795	159,351,418	178,473,588	73,675,515	81,227,255
1886	101,500,024	113,680,027	157,518,482	176,420,700	73,682,584	81,235,049
1887	116,651,974	130,650,211	162,119,812	181,574,189	76,232,618	84,046,461
1888	132,731,613	148,659,407	169,935,219	190,327,445	81,960,083	90,360,992
1889	126,097,869	141,229,613	176,916,724	198,146,731	84,973,230	93,640,500
1890	140,866,931	157,770,963	181,614,288	203,408,003	89,290,834	98,398,500
1891	150,505,954	168,566,668	185,479,126	207,736,621	94,252,278	103,913,136
1892	160,115,242	179,329,071	181,786,871	203,601,296	92,544,050	102,029,815

World's production of coal, by countries, 1868-1902—Continued.

Year.	United States.		Great Britain.		Germany.	
	Long tons.	Short tons.	Long tons.	Short tons.	Metric tons.	Short tons.
1893	162,814,977	182,352,774	167,325,795	184,044,890	95,426,153	105,207,334
1894	152,447,791	170,741,526	188,277,525	210,870,828	98,805,702	108,883,884
1895	172,426,366	193,117,530	189,661,362	212,320,725	103,957,639	114,561,318
1896	171,416,390	191,986,357	195,361,260	218,804,611	112,471,106	123,943,159
1897	178,766,071	200,229,199	202,129,931	226,385,523	120,474,485	132,762,882
1898	196,407,382	219,976,267	202,054,516	226,301.058	130,928,490	144,283,196
1899	226,554,635	253,741,192	220,094,781	246,506,155	135,824,427	149,719,766
1900	240,789,309	269,684,027	225,181,300	252,203,056	149,551,000	164,805,202
1901	261,874,836	293,299,816	219,046,945	245,332,578	152,628,931	168,217,082
1902	269,277,178	301,590,439	227,095,042	254,346,447	150,436,810	165,826,496

Year.	Austria-Hungary.		France.		Belgium.	
	Metric tons.	Short tons.	Metric tons.	Short tons.	Metric tons.	Short tons.
1868	7,021,756	7,741,486	13,330,826	14,697,236	12,298,589	13,559,194
1869	7,663,043	8,448,505	13,509,745	14,894,494	12,943,994	14,270,753
1870	8,355,945	9,212,429	13,179,788	14,530,716	13,697,118	15,101,073
1871	8,437,401	9,302,235	13,240,135	14,597,249	13,733,176	15,140,827
1872	8,825,896	9,730,550	16,100,773	17,751,102	15,658,948	17,263,990
1873	10,104,769	11,140,508	17,479,341	19,270,973	15,778,401	17,395,687
1874	12,631,364	13,926,079	16,907,913	18,640,974	14,669,029	16,172,604
1875	13,062,738	14,395,137	16,956,840	18,694,916	15,011,331	16,549,992
1876	13,000,000	14,327,300	17,101,448	18,854,346	14,329,578	15,798,360
1877	13,500,000	14,883,750	16,804,529	18,526,993	13,669,077	15,070,157
1878	13,900,000	15,324,750	16,960,916	18,699,410	14,899,175	16,426,340
1879	14,500,000	15,986,250	17,110,979	18.864,854	15,447,292	17,030,640
1880	14,800,000	16,317,000	19,361,564	21,346,124	16,886,698	18,617,585
1881	15,304,813	16,873,556	19,765,983	21,791,996	16,873,951	18,603,531
1882	15,555,292	17,149,709	20,603,704	22,715,584	17,590,989	19,394,065
1883	17,047,961	18,795,377	21,333,884	23,520,607	18,177,754	20,040,974
1884	18,000,000	19,845,000	20,023,514	22,075,924	18,051,499	19,901,778
1885	20,435,463	22,530,098	19,510,530	21,510,359	17,437,603	19,224,957
1886	20,779,441	22,909,334	19,909,894	21,950,658	17,285,543	19,057,311
1887	21,879,172	24,121,787	21,287,589	23,469,567	18,378,624	20,262,433
1888	23,859,608	26,305,218	22,602,894	24,919,691	19,218,481	21,188,375
1889	25,328,417	27,924,580	24,303,509	26,794,619	19,869,980	21,906,653
1890	27,504,032	30,323,195	26,083,118	28,756,638	20,365,960	22,453,471
1891	28,823,240	31,777,622	26,024,893	28,692,444	19,675,644	21,692,398
1892	29,037,978	32,014,371	26,178,701	28,862,018	19,583,173	21,590,448
1893	30,449,304	33,570,358	25,650,981	28,280,207	19,410,519	21,400,097
1894	31,492,000	34,704,184	27,459,137	30,273,699	20,458,827	22,555,857
1895	32,654,777	35,985,564	28,019,893	30,877,922	20,450,604	22,536,566
1896	33,676,411	37,111,405	29,189,900	32,167,270	21,252,370	23,420,112
1897	35,858,000	39,515,516	30,797,629	33,938,987	21,534,629	23,731,161
1898	37,786,963	41,652,569	32,356,104	35,656,426	22,075,093	24,326,752
1899	38,739,000	42,690,378	32,863,000	36,215,026	21,917,740	24,159,925
1900	39,029,729	43,010,761	33,404,298	36,811,536	23,462,817	25,856,024
1901	41,202,902	45,417,959	32,301,757	35,596,536	22,213,410	24,485,842
1902	....	....	30,196,994	33,286,146	....	....

World's production of coal, by countries, 1868–1902.—Continued.

Year.	Russia.		Japan.		Other countries.	Total.	Per cent of United States.
	Metric tons.	Short tons.	Metric tons.	Short tons.	Short tons.	Short tons.	
1868....	430,032	473,895	....	....	1,147,330	221,035,430	14.32
1869....	579,419	638,510	....	....	1,104,563	229,200,013	13.81
1870....	667,806	735,922	....	....	1,063,121	238,621,068	15.42
1871....	772,371	851,153	....	....	1,114,248	260,526,424	17.79
1872....	1,037,611	1,143,447	....	....	1,268,115	283,002,843	17.97
1873....	1,154,618	1,272,389	....	....	1,502,516	302,703,376	18.87
1874....	1,270,889	1,400,520	....	....	2,708,756	298,616,379	17.60
1875....	1,673,753	1,844,475	....	....	2,639,104	308,419,177	16.95
1876....	1,795,146	1,968,251	....	....	2,597,143	311,594,969	17.07
1877....	1,760,276	1,939,824	....	....	2,821,155	317,118,648	19.05
1878....	2,483,575	2,738,141	....	....	3,176,050	318,441,990	18.17
1879....	2,874,790	3,169,456	....	....	3,362,605	335,332,908	20.34
1880....	3,238,470	3,570,413	....	....	3,621,342	369,413,780	20.62
1881....	3,439,787	3,792,365	....	....	5,185,974	392,663,253	21.87
1882....	3,672,782	4,049,242	....	....	6,128,631	420,082,472	24.58
1883....	3,916,105	4,317,506	1,021,000	1,125,142	6,929,841	450,990,397	25.55
1884....	3,869,689	4,266,332	1,159,000	1,277,218	7,367,309	454,022,811	26.37
1885....	4,207,905	4,639,215	1,314,000	1,448,028	7,570,507	447,783,802	24.82
1886....	4,506,027	4,967,895	1,402,000	1,545,004	9,082,815	450,848,793	25.22
1887....	4,464,174	4,921,752	1,785,000	1,967,070	10,399,273	481,412,743	27.14
1888....	5,187,312	5,719,011	2,044,000	2,252,488	11,493,176	521,225,803	28.52
1889....	6,215,577	6,852,674	2,435,000	2,683,370	12,618,299	531,797,039	26.56
1890....	6,016,525	6,633,219	2,653,000	2,923,606	13,025,637	563,693,232	27.99
1891....	6,233,020	6,871,905	3,230,000	3,559,460	14,744,329	587,554,583	28.69
1892....	6,816,323	7,514,996	3,228,000	3,557,256	14,998,633	593,497,904	30.22
1893....	7,535,000	8,307,337	3,350,000	3,691,700	15,783,599	582,638,296	31.30
1894....	8,629,000	9,509,158	4,311,000	4,750,722	18,197,510	610,487,368	27.97
1895....	9,079,138	10,005,210	4,849,000	5,343,598	19,428,643	644,177,076	29.98
1896....	9,229,000	10,170,358	5,019,690	5,531,698	20,866,748	664,001,718	28.92
1897....	11,207,475	12,350,638	5,647,751	6,225,516	22,074,093	697,213,515	28.72
1898....	12,307,450	13,562,810	6,761,301	7,572,657	24,797,873	738,129,608	29.80
1899....	13,562,810	15,730,346	6,716,831	7,401,948	25,811,285	801,976,021	31.63
1900....	16,151,557	17,799,016	7,429,457	8,187,262	27,684,964	846,041,848	31.88
1901....	16,269,800	17,934,201	....	(a)	b 30,565,923	869,037,199	33.76
1902....	....	....	....	....	....	....	....

a Latest available figures are used in making up totals for 1901.

b This includes, in addition to the countries named on the following pages, the output of Holland, 352,888 tons; Natal, 637,504 tons (1901), 663,960 tons (1902); Cape Colony, 222,265 tons; Tasmania, 48,171 tons; China, Turkey, Servia, Portugal, etc. (estimated), 2,240,000 tons; total, 3,500,828 tons (1901).

Production of minor coal-producing countries, 1868–1902.

Year.	New South Wales.		Queensland.		New Zealand.	
	Long tons.	Short tons.	Long tons.	Short tons.	Long tons.	Short tons.
1868	954,231	1,068,739	19,611	21,964		
1869	919,774	1,030,147	11,120	12,454		
1870	868,564	972,791	22,639	25,356		
1871	898,784	1,006,638	17,000	19,040		
1872	1,012,426	1,133,917	27,727	31,054		
1873	1,192,862	1,336,005	33,613	37,647		
1874	1,304,567	1,461,115	43,443	48,656		
1875	1,329,729	1,489,296	32,107	35,960		
1876	1,319,918	1,478,308	50,627	56,702		
1877	1,444,271	1,617,584	60,918	68,228		
1878	1,575,497	1,764,556	52,580	58,890	162,218	181,684
1879	1,583,381	1,773,387	55,012	61,613	231,218	258,964
1880	1,466,180	1,642,122	58,052	65,018	299,623	335,913
1881	1,769,597	1,981,949	65,612	73,485	337,262	377,733
1882	2,109,282	2,362,396	74,436	83,368	378,272	423,665
1883	2,521,457	2,824,032	104,750	117,320	421,764	472,376
1884	2,749,109	3,079,002	120,727	135,214	480,831	538,531
1885	2,878,863	3,224,327	209,698	234,862	511,063	572,390
1886	2,830,175	3,169,796	228,656	256,094	534,353	598,475
1887	2,922,497	3,273,197	238,813	267,470	558,620	625,654
1888	3,203,444	3,587,857	311,412	348,781	613,895	687,562
1889	3,655,632	4,094,308	265,507	297,368	586,445	656,818
1890	3,060,876	3,428,181	338,344	378,945	637,397	713,885
1891	4,037,929	4,522,480	271,603	304,195	668,794	749,049
1892	3,780,968	4,234,684	265,086	296,896	673,315	754,113
1893	3,278,328	3,671,727	264,403	296,131	691,548	774,534
1894	3,672,076	4,112,725	270,705	303,190	719,546	805,892
1895	3,737,536	4,186,040	322,977	361,734	727,000	814,240
1896	3,909,517	4,378,659	371,000	415,520	793,000	888,160
1897	4,383,591	4,909,622	358,407	401,416	840,713	941,600
1898	4,736,000	5,304,320	407,819	456,757	906,778	1,015,591
1899	4,597,028	5,148,671	494,009	553,290	975,234	1,092,262
1900	5,507,497	6,168,397	497,132	556,788	1,093,990	1,225,269
1901	5,968,426	6,684,637	539,472	604,209	1,227,638	1,374,955
1902	5,942,011	6,655,052				

Production of minor coal-producing countries, 1868–1902—Continued.

Year.	Victoria.		Canada.	India.		Spain.	
	Long tons.	Short tons.	Short tons.	Long tons.	Short tons.	Metric tons.	Short tons.
1868							
1869							
1870							
1871							
1872							
1873							
1874			1,058,446				
1875			984,905				
1876			933,803				
1877			1,002,395				
1878			1,034,081				
1879			1,123,863				
1880			1,424,635				
1881			1,487,182	997,543	1,117,248		
1882			1,811,708	1,130,242	1,265,871		
1883			1,806,259	1,315,976	1,473,893		
1884			1,950,080	1,266,312	1,418,269		
1885			1,879,470	1,294,221	1,449,528		
1886			2,091,976	1,401,295	1,569,450	1,001,432	1,104,079
1887			2,418,494	1,560,393	1,747,640	1,038,305	1,144,731
1888			2,658,134	1,802,876	2,019,221	1,036,565	1,142,813
1889	14,421	16,152	2,719,478	2,045,359	2,290,802	1,153,755	1,272,015
1890	20,750	23,240	3,117,661	2,168,521	2,438,744	1,212,089	1,336,328
1891	22,834	25,574	3,623,076	2,328,577	2,608,006	1,287,988	1,420,007
1892	23,363	26,166	3,292,547	2,537,696	2,842,220	1,461,196	1,610,969
1893	91,726	102,733	3,201,742	2,529,855	2,833,438	1,484,794	1,636,986
1894	175,175	196,196	3,903,913	2,810,929	3,158,240	1,657,010	1,830,853
1895	194,171	217,472	3,512,504	3,538,000	3,962,560	1,783,783	1,965,729
1896	227,000	255,240	3,743,234	3,848,000	4,309,760	1,878,399	2,069,996
1897	236,277	264,630	3,786,107	4,063,127	4,550,702	1,939,400	2,137,219
1898	245,659	275,138	4,172,655	4,203,199	4,707,582	2,526,600	2,784,313
1899	262,380	293,866	4,925,051	5,093,260	5,704,451	2,742,389	3,022,113
1900	211,596	236,988	5,322,197	6,118,692	6,852,935	2,674,105	2,946,864
1901	209,329	234,448	6,186,286	6,635,727	7,432,014	2,747,724	3,027,992
1902			7,639,225	7,433,972	8,326,049		

Production of minor coal-producing countries, 1868-1902—Continued.

Year.	Italy.		Sweden.		South African Republic.	
	Metric tons.	Short tons.	Metric tons.	Short tons	Long tons.	Short tons.
1868	51,386	56,627				
1869	56,201	61,962				
1870	58,770	64,794				
1871	80,336	88,570				
1872	93,555	103,144				
1873	116,884	128,864				
1874	127,473	140,539				
1875	116,955	128,943				
1876	116,399	128,330				
1877	120,588	132,948				
1878	124,117	136,839				
1879	131,318	144,778				
1880	139,369	153,654				
1881	134,582	148,377				
1882	164,737	181,623				
1883	214,121	235,961				
1884	223,322	246,213				
1885	190,413	209,930				
1886	243,325	268,266				
1887	327,665	361,251				
1888	366,794	404,390				
1889	390,320	432,533				
1890	376,326	415,500	187,512	206,132		
1891	289,286	318,938	198,033	218,331		
1892	295,713	326,024	199,380	219,816		
1893	317,249	349,767	199,933	220,426	548,534	614,358
1894	271,395	299,103	213,633	235,532	791,358	886,321
1895	305,321	336,563	223,652	246,464	1,133,466	1,269,482
1896	276,197	304,369	226,000	249,052	1,437,297	1,609,772
1897	314,222	346,273	224,343	251,264	1,600,212	1,792,237
1898	341,327	376,245	236,277	260,448	1,907,271	2,136,143
1899	388,534	428,164	239,344	263,757	1,464,317	1,640,035
1900	480,859	529,907	252,320	278,057	433,948	486,022
1901	425,614	469,154	271,509	299,284	671,532	752,116
1902			304,733	335,907		

COAL TRADE REVIEW.

The strike in the anthracite region was the overshadowing factor connected with the coal trade of the United States in 1902. Its influence was felt not only throughout the States of the Atlantic seaboard, where anthracite is the chief domestic fuel, but beyond the Mississippi River. The elimination of over 25,000,000 tons of anthracite coal from the fuel supply of the eastern States naturally created a demand upon the bituminous fields nearest to those markets. Attracted by the high prices obtainable in the eastern cities, a large amount of soft coal mined in Pennsylvania, Maryland, Virginia, and West Virginia was diverted from its customary channels, which in turn had to be supplied from the mines of Ohio, Indiana, Illinois, and Kentucky. To further complicate matters and render conditions even more serious, there was, throughout almost the entire year, an inadequate supply of transportation facilities. The phenomenal industrial activity since 1897 had outstripped the capacity of the railroad companies in both motive power and rolling stock, the builders of which were unable in turn to meet the demands put upon them by the railroad companies.

An interesting feature of the development of our coal-mining industry during the last two decades has been the comparative decline in the production of anthracite. The output has increased, it is true, and in somewhat greater proportion than the increase of population, but as compared with the production of bituminous coal anthracite mining has shown a decreasing tendency. In order to illustrate this the following table has been prepared in which the output of anthracite and bituminous coal is shown in 1880, the average by five-year periods from 1881 to 1900, and the total production in 1901 and 1902. This table shows that the average production in the five years from 1881 to 1885 was about 7,500,000 tons more than that of 1880. The average annual production from 1886 to 1890 was 6,000,000 tons more than that for the five years previous. The average for the next five years shows an increase of over 11,250,000 tons, but in the period from 1896 to 1900 the increase is only a little more than 2,200,000 tons. Comparing this with increase in bituminous production shows that in 1880 the total amount of bituminous coal mined was about one and one-half times that of the anthracite. The average production from 1881 to 1885 was nearly double that of anthracite, and from 1886 to 1890 it was two and one-fourth times the anthracite production. In the period from 1896 to 1900 the bituminous production was more than three times that of anthracite, and in 1901 the production of bituminous coal was about three and one-third times that of anthracite. On account of the great loss to the anthracite trade by the strike of 1902 the comparison with bituminous production in that year is not a fair indication of the average conditions. Bituminous production last year was more than six times that of anthracite.

Comparative increases in the production of anthracite and bituminous coal.

[Short tons.]

Period.	Anthracite.	Bituminous.
1880	28,649,811	47,508,133
1881–85	36,194,188	70,856,570
1886–90	42,151,364	94,488,681
1891–95	53,405,189	125,216,327
1896–1900	55,625,165	171,498,143
1901	67,471,667	225,828,149
1902	41,373,595	260,216,844

In the following table is shown a statement of the coal receipts in some of the principal cities of the United States since 1898:

Coal receipts at important centers, 1898–1902.

	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Philadelphia (long tons):							
Anthracite	4,981,697	5,423,045	5,179,438	6,091,907	3,298,474	....	2,793,433
Bituminous	5,156,602	5,314,460	6,807,634	6,337,542	6,617,196	279,654	....
Boston (long tons): [a]							
Anthracite	1,866,877	2,226,094	2,005,879	2,163,558	1,057,170	....	1,106,388
Bituminous	1,786,194	2,043,065	2,702,368	2,648,861	3,226,028	577,167	....
Pittsburg (short tons) [b]	18,467,086	20,075,066	20,718,537	23,001,126	28,898,931	5,897,805	....
Cleveland (short tons):							
Anthracite	179,891	202,782	138,614	326,741	158,405	....	168,336
Bituminous	4,533,721	4,857,295	4,136,696	3,996,493	4,949,027	952,534	....
Chicago (short tons):							
Anthracite	1,840,858	2,146,554	1,572,019	2,192,545	674,908	....	1,517,637
Bituminous	4,976,779	6,463,506	6,956,622	6,687,132	7,497,719	810,587	....
Milwaukee (short tons):							
Anthracite	768,150	922,321	639,100	845,687	172,676	....	673,011
Bituminous	920,911	997,543	1,169,493	1,107,802	1,468,419	360,617	....
St. Louis (short tons):							
Anthracite	225,616	292,118	180,550	200,797	60,944	....	139,853
Bituminous	3,342,498	4,124,629	4,172,706	4,754,431	5,205,814	451,383	....
Cincinnati (short tons):							
Anthracite	37,925	51,650	17,500	25,300	11,750	....	13,550
Bituminous	3,319,793	3,100,011	2,727,521	3,177,275	3,508,122	330,847	....

[a] Including foreign (mostly Nova Scotian) coal imported, which amounted to 1,001,520 long tons in 1902, 538,031 long tons in 1901, 551,817 tons in 1900, and 201,671 in 1898. Prior to 1898 such receipts were insignificant.

[b] Anthracite and bituminous.

PRODUCTION OF COAL BY STATES.

Including Alaska, where a small amount of coal was mined, there were 30 States and Territories which contributed to the total coal production of the United States in 1902. Of these there were only 9 in which the output was less than 1,000,000 tons. Four States—Pennsylvania, Illinois, West Virginia, and Ohio—each produced over 20,000,000 short tons, Pennsylvania's output being nearly seven times that amount. Alabama reached a total of 10,000,000 tons for the first time in her history, and Indiana passed 9,000,000 tons for the first time. Colorado exceeded 7,000,000 tons, and 4 other States—Iowa, Kansas, Kentucky, and Maryland—each produced over 5,000,000 tons. The 6 most important producers are all east of the Mississippi, and all but 2 of them—Illinois and Indiana—belong to the Appalachian system. There are 13 coal-producing States east of the Mississippi River and 17 coal-producing States and Territories west of it. The 13 States east of the river produced in 1902, 261,785,404 short tons, or 86.8 per cent of the total product, and the 17 States west of the river produced 39,805,035 short tons, or 13.2 per cent of the total.

In the following tables are shown the statistics of production in the Eastern States divided by the Ohio and Potomac rivers, and in the States west of the Mississippi River. The figures are given for the years 1880, 1890, 1900, and 1902. An interesting feature of this statement is the percentage of increase shown between 1880 and 1902 in these different sections. The States east of the Mississippi River and north of the Ohio and Potomac rivers have a little more than trebled their production. The States west of the Mississippi have increased their production eight and one-half, and in the States east of the Mississippi and south of the Ohio and Potomac rivers the production in 1902 was thirteen times that of 1880.

Coal production in States north of Ohio and Potomac rivers in 1880, 1890, 1900, and 1902.

State.	1880.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Illinois	6,115,377	$8,779,832	15,292,420	$14,171,230
Indiana	1,454,327	2,150,258	3,305,737	3,259,233
Maryland	2,228,917	2,585,537	3,357,813	2,899,572
Michigan	100,800	224,500	74,977	149,195
Ohio	6,008,595	7,719,667	11,494,506	10,783,171
Pennsylvania:				
Anthracite	28,711,379	42,282,948	46,468,641	66,383,772
Bituminous	18,425,163	18,567,129	42,302,173	35,376,916
Total	63,044,558	82,309,871	122,296,267	133,023,089

State.	1900.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Illinois	25,767,981	$26,927,185	32,939,373	$33,945,910
Indiana	6,484,086	6,687,137	9,446,424	10,399,660
Maryland	4,024,688	3,927,381	5,271,609	5,579,869
Michigan	849,475	1,259,683	964,718	1,653,192
Ohio	18,988,150	19,292,246	23,519,894	26,953,789
Pennsylvania:				
Anthracite	57,367,915	85,757,851	11,373,595	74,708,081
Bituminous	79,842,326	77,438,545	98,574,367	106,032,460
Total	193,324,621	221,290,028	212,089,980	259,272,961

Coal production in States south of Ohio and Potomac rivers, 1880, 1890, 1900, and 1902.

State.	1880.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Alabama	323,972	$476,911	4,090,409	$4,202,469
Georgia	154,644	231,605	228,337	238,315
Kentucky	946,288	1,134,960	2,701,496	2,472,119
North Carolina	350	400	10,262	17,864
Tennessee	495,131	629,724	2,169,585	2,395,746
Virginia	43,079	99,802	784,011	589,925
West Virginia	1,829,844	2,013,671	7,394,654	6,208,128
Total	3,793,308	4,587,073	17,378,754	16,124,566

State.	1900.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Alabama	8,394,275	$9,793,785	10,354,570	$12,419,666
Georgia	315,557	370,022	414,083	589,018
Kentucky	5,328,964	4,881,577	6,766,984	6,666,967
North Carolina	17,734	23,447	23,000	34,500
Tennessee	3,509,562	4,003,082	4,382,968	5,399,721
Virginia	2,393,754	2,123,222	3,182,993	2,543,595
West Virginia	22,647,207	18,416,871	24,570,826	24,748,658
Total	42,607,053	39,612,006	49,679,102	52,402,125

Coal production in States west of Mississippi River, 1880, 1890, 1900, and 1902.

State.	1880.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Arkansas	14,778	$33,535	399,888	$514,595
California	236,950	663,013	110,711	283,019
Colorado	462,747	1,041,350	3,094,003	4,344,196
Idaho	....	....	....	....
Indian Territory	....	....	869,229	1,579,188
Iowa	1,461,116	2,507 453	4,021,739	4,995,739
Kansas	771,442	1,517,444	2,259,922	2,947,517
Missouri	884,304	1,464,425	2,735,221	3,382,858
Montana	224	800	517,477	1,252,492
Nebraska	200	750	1,500	4,500
New Mexico	....	....	375,777	504,390
North Dakota	....	....	30,000	42,000
Oregon	43,205	97,810	61,514	177,875
Texas	....	....	184,440	465,900
Utah	14,748	33,645	318,159	552,390
Washington	145,015	389,046	1,263,689	3,426,590
Wyoming	589,595	1,080,451	1,870,366	3,183,669
Total	4,624,324	8,829,722	18,113,635	27,656,918

State.	1900.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Arkansas	1,447,945	$1,653,618	1,943,932	$2,539,214
California	172,908	540,031	[a] 87,196	273,398
Colorado	5,244,364	5,858,036	7,401,343	8,397,812
Idaho	10	50	2,030	5,180
Indian Territory	1,922,298	2,788,124	2,820,666	4,265,106
Iowa	5,202,939	7,155,341	5,904,766	8,660,287
Kansas	4,467,870	5,454,691	5,266,065	6,862,787
Missouri	3,540,103	4,280,328	3,890,154	5,374,642
Montana	1,661,775	2,713,707	1,560,823	2,443,447
Nebraska	....	....	....	....
New Mexico	1,299,299	1,776,170	1,048,763	1,500,230
North Dakota	129,883	158,348	226,511	325,967
Oregon	58,864	220,001	65,648	160,075
Texas	968,373	1,581,914	901,912	1,477,245
Utah	1,147,027	1,447,750	1,574,521	1,797,454
Washington	2,474,093	4,700,068	2,681,214	4,572,295
Wyoming	4,014,602	5,457,953	4,429,491	5,236,339
Total	33,752,353	45,786,130	39,805,035	54,029,958

[a] Includes Alaska.

The production of coal in the several States and Territories in 1902 and preceding years is discussed with more detail in the following pages.

ALABAMA.

Total production in 1902, 10,354,570 short tons; spot value, $12,419,666.

For the first time in the history of the State the output of coal in Alabama in 1902 reached a total exceeding 10,000,000 short tons. The rise of Alabama as a coal-producing State forms one of the interesting chapters of our industrial development. Prior to the civil war little, if any, coal was mined in any of the Southern States. Some coal was probably produced in Alabama during the war, but there are no official records of the amount mined. The coal-mining industry in the State may be said to have had its birth in 1870, when, according to the Ninth United States Census, the production amounted to 13,200 short tons. In the first decade following that date the production gradually increased, until in 1881 it had reached a total of 420,000 tons. Discoveries, about this time, of rich iron-ore deposits created a boom in the coal-mining industry and stimulated development and production, until, in 1885, the output of coal amounted to nearly 2,500,000 tons. Then followed the inevitable reaction, the boom collapsed, and the coal production in 1886 fell off to 1,800,000 tons.

With a return to normal conditions the coal-mining industry revived upon a conservative and rational basis, and production has increased with the healthful industrial development of the State until in less than a third of a century the output has grown to a total of 10,354,570 short tons. For several years Alabama has ranked fifth among the coal-producing States, being preceded by Pennsylvania, Illinois, West Virginia, and Ohio. In the manufacture of pig iron Alabama ranks fourth, being exceeded only by Pennsylvania, Illinois, and Ohio.

Compared with 1901 the production of coal in Alabama for 1902 shows an increase of 1,255,518 short tons, or 13.8 per cent. The output of 1901 exceeded by 704,777 short tons, or 8.4 per cent, that of 1900, which in turn exceeded that of 1899 by 800,859 short tons, or 10.5 per cent. The tonnage of 1902 shows a gain of over 36 per cent as compared with 1899. In each of the last eight years the coal production of Alabama has been the maximum up to that time.

Notable as was the amount of production in 1902, it was surpassed by the increase in value which, influenced partly by the extraordinary demand for fuel and partly by increased cost of mining, advanced from $10,000,892 in 1901 to $12,419,666 in 1902, a gain of $2,418,774, or 24 per cent, as compared with the increase of 13.8 per cent in quantity produced. The average price per ton in 1902 ($1.20) was the highest obtained since 1887, a period of fifteen years.

Including the number of men employed in the small local banks there were 16,439 men engaged in coal mining in 1902, against 17,370 in 1901, when men working at country banks were not considered.

The average number of working days for each employee was 256 in 1902, against 236 in 1901. From these data it is deduced that the average tonnage per each employee was 630 in 1902 and 524 in 1901. The average tonnage per day per man was 2.46 in 1902 and 2.22 in 1901, an increase in daily productiveness per man of a little more than 10 per cent.

This increase in productive capacity per employee was apparently due to a greater "intensity of labor" on the part of the men. The statistics relating to the use of machines show that the total tonnage mechanically undercut in 1902 was only slightly greater than that of 1901, the figures being, respectively, 289,051 in 1901 and 300,670 in 1902. The number of machines in use in 1902 was 66, against 82 reported for the preceding year. The latter figure, however, was evidently erroneous, as the returns for 1902 indicate that some machines were moved from one mine to another belonging to the same company in 1901, and were reported separately from each mine, having been in use at several different mines during the year. This is also shown by the fact that only 54 machines were used in 1900.

There were two periods of labor disturbances worthy of note in the coal mines of Alabama during 1902. The first one was caused by the demand of the miners' union for an 8-hour day, a semimonthly pay day, and an advance from 55 to 60 cents per ton in the maximum rate to be paid for mining coal. The rates for mining are fixed by fluctuations in the price of pig iron, with a minimum and maximum limit. As the operators refused the demands of the union, a strike was called, to go into effect July 1. The strike was settled on July 11 by mutual concessions and work was resumed July 14. The other notable strike was one ordered against the Tennessee Coal, Iron and Railway Company because of the refusal of that corporation to withhold from the pay of its men, unless instructed to do so by the men themselves, an assessment of $1 each, levied against them by the United Mine Workers for the benefit of the men on strike in the anthracite fields of Pennsylvania. Other strikes of minor importance due to local causes occurred during the year. The total number of men idle by reason of strikes during the year was 6,059 and the aggregate time lost amounted to 139,783 working days. Except for this lost time, the production of coal in the State in 1902 would have been further increased by about 340,000 tons, bringing the total up to nearly 10,700,000 short tons.

In the following tables is presented a statement of the production of coal in Alabama during 1901 and 1902, by counties, showing the distribution of the product for consumption, the value, and the statistics of labor employed in the State. This table shows that in 1902 there were 2,760,298 short tons made into coke. The actual amount of coal made into coke in this State last year was 4,237,491 short tons. This difference is due to the fact that a large amount of coal is shipped from the mines to ovens at a distance. Many of the ovens are located in the vicinity of Birmingham, and the coal is shipped to them from the mines, some distance away. In these cases the coal is reported on the coal schedules as shipped from the mines. In 1901 the amount of coal made into coke in Alabama was 3,849,908 short tons, though it appears in this report as 2,182,477 short tons.

Coal production of Alabama in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bibb	1,213,620	2,881	40,914	1,438	1,258,853	$1,512,562	$1.20	235	1,824
Blount and Cullman	142,047	1,650			143,697	173,127	1.20	148	328
Etowah	86,941	6,050	600		93,591	119,244	1.27	210	186
Jefferson	3,436,757	25,255	139,665	1,948,038	5,549,715	5,965,291	1.07	259	9,492
Marion and Winston	69,335	170			69,505	86,169	1.24	151	209
St. Clair	136,935	624	3,257		140,816	164,742	1.17	198	293
Shelby	139,405	1,382	8,345		149,132	226,826	1.52	256	396
Tuscaloosa	130,803	2,821	8,093	233,001	374,718	399,440	1.07	247	1,069
Walker	1,260,751	9,196	14,078		1,284,025	1,318,491	1.02	186	3,573
Small mines		35,000			35,000	35,000			
Total	6,616,594	85,029	214,952	2,182,477	9,099,052	10,000,892	1.10	236	17,370

Coal production of Alabama in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bibb	1,372,745	1,922	38,174	74,566	1,487,407	$1,842,163	$1.24	245	1,924
Etowah	100,290	1,280	220		101,790	125,190	1.23	264	208
Jefferson	3,410,698	56,050	160,873	2,227,915	5,855,536	6,975,929	1.19	280	8,400
St. Clair	119,618	550	7,500	28,575	156,243	208,162	1.33	246	374
Shelby	131,241	130	4,672		136,043	218,971	1.61	206	417
Tuscaloosa	108,617	924	1,848	320,322	431,711	527,504	1.22	236	989
Walker	1,748,073	16,047	30,936	108,920	1,903,976	2,147,894	1.13	228	3,388
Winston	26,686	2,000			28,686	41,250	1.44	134	174
Blount, Cullman, and Marion	253,178				253,178	332,603	1.31	233	565
Total	7,271,146	78,903	244,223	2,760,298	10,354,570	12,419,666	1.20	256	16,439

In the following table is presented a statement of the distribution of the coal product of Alabama for a period of fourteen years. As previously stated, the amount reported as loaded at mines for shipment includes considerable quantities of coal shipped to other points in the State and there made into coke. About one-third the amount of coal that finally goes into coke is reported in the coal shipped from the mines.

Distribution of the coal product of Alabama, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2,327,209	59,945	79,515	1,106,314	3,572,983	$3,961,491	$1.10	248	6,975
1890	2,487,983	84,578	88,952	1,428,896	4,090,409	4,202,469	1.03	217	10,961
1891	2,822,813	91,456	100,160	1,745,352	4,759,781	5,087,596	1.07	268	9,302
1892	3,122,075	37,843	135,627	2,233,767	5,529,312	5,788,898	1.05	271	10,075
1893	3,536,935	59,599	96,412	1,443,989	5,136,935	5,096,792	.99	237	11,294
1894	3,269,548	43,911	130,404	953,315	4,397,178	4,085,535	.93	238	10,859
1895	3,610,433	272,551	137,021	1,673,770	5,693,775	5,126,822	.90	244	10,346
1896	3,555,493	285,416	138,268	1,769,520	5,748,697	5,174,135	.90	248	9,894
1897	4,543,597	86,790	126,187	1,137,196	5,893,770	5,192,085	.88	233	10,597
1898	4,926,828	107,576	145,808	1,355,071	6,535,283	4,932,776	.75	250	10,733
1899	4,701,612	79,994	155,514	2,656,296	7,593,416	8,256,462	1.09	238	13,481
1900	6,108,011	146,591	189,474	1,950,199	8,394,275	9,793,785	1.17	257	13,967
1901	6,616,594	85,029	214,952	2,182,477	9,099,052	10,000,892	1.10	236	17,370
1902	7,271,146	78,903	244,223	2,760,298	10,354,570	12,419,666	1.20	256	16,439

In the following table is shown the total production, by counties, for the last five years, with the increases and decreases in 1902 as compared with 1901. The most notable increase in 1902 was in Walker County, where the gain in output amounted to 619,951 short tons, or nearly 50 per cent. Other important increases were in Jefferson County, 305,821 tons, and Bibb County, 228,554 tons. Production increased in every county of the State except Shelby and Winston. The apparent decrease in the production from small mines is due to the distribution of this factor among the several counties in 1902.

Coal production of Alabama, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase in 1902.	Decrease in 1902.
Bibb	810,891	912,263	964,785	1,258,853	1,487,407	228,554	
Blount, Cullman	18,300	15,724	18,572	143,697	[a] 253,178	109,481	
Etowah	5,884	9,578	20,855	93,591	101,790	8,199	
Jefferson	4,204,590	4,878,696	5,255,296	5,549,715	5,855,536	305,821	
St. Clair	72,808	52,252	156,270	140,816	156,243	15,427	
Shelby	68,987	86,928	135,832	149,132	136,043		13,089
Tuscaloosa	238,954	325,461	268,422	374,718	431,711	56,993	
Walker	1,071,334	1,249,294	1,489,380	1,284,025	1,903,976	619,951	
Winston	8,535	[a] 28,220	[a] 49,863	69,505	28,686		40,819
Small mines	35,000	35,000	35,000	35,000	([b])	([b])	35,000
Total	6,535,283	7,593,416	8,394,275	9,099,052	10,354,570	[c] 1,255,518	

[a] Includes production of Marion County.
[b] Small-mine production included in county distribution.
[c] Net increase.

In the following table is shown the total production of Alabama since 1870:

Annual coal production of Alabama, 1870–1902.

Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*
1870	13,200	1888	2,900,000
1873	44,800	1889	3,572,983
1874	50,400	1890	4,090,409
1875	67,200	1891	4,759,781
1876	112,000	1892	5,529,312
1877	196,000	1893	5,136,935
1878	224,000	1894	4,397,178
1879	280,000	1895	5,693,775
1880	380,800	1896	5,748,697
1881	420,000	1897	5,893,770
1882	896,000	1898	6,535,283
1883	1,568,000	1899	7,593,416
1884	2,240,000	1900	8,394,275
1885	2,492,000	1901	9,099,052
1886	1,800,000	1902	10,354,570
1887	1,950,000		

ALASKA.

There are a number of localities in the Territory of Alaska where coal seams of workable thickness and quality have been located, but it has been impossible to secure exact statistics in regard to the production. Mr. Alfred H. Brooks, of the United States Geological Survey, in his report entitled "The Coal Resources of Alaska,"[a] states that the coal mines of Alaska which have produced some coal in the past may be divided naturally into three separate provinces or districts. These are the Pacific coast district, which includes all the mines located on Pacific coast waters and one deposit at Kootznahoo Bay; one at Controller Bay, one at Homer (on Cook Inlet), and three on the Alaskan Peninsula—at Chignik River, Herendeen, and Unga Island. The second, which may be designated as the Yukon district, includes all the mines tributary to the Yukon River. Of these there are six, three of which—known, respectively, as No. 1, Williams, and Blatchford—are on the Yukon River between Anvik and Nulato. The Pickart mine is located a short distance northeast of Nulato, on the Yukon River; the Drew mine near Rampart and Nation River, between Fort Yukon and Fortymile. The Arctic coast district includes two mines, the Corwin and the Thetis, located on the Arctic Ocean near the seventieth degree of north latitude. Mr. Brooks states that at the time of his visit to the region, in 1902, the mine on Kootznahoo Bay, the only one in

[a] Twenty-second Ann. Rept. U. S. Geol. Survey, Part III.

southeastern Alaska, had been shut down. He also reports that at Controller Bay, 30 miles east of the mouth of the Copper River, an excellent coal has been discovered, and extensive preparations are under way for developing the field. It is probable that this mine will become a producer within a short time.

The only mines in American territory from which any production was reported for 1902 were the Williams mine, on the Yukon River below Kaltag, and the Homer property, on Cook Inlet. The first-mentioned property produced, in 1902, 1,700 tons of coal, which was used principally on the steamers plying on the Yukon River. The Pickart mine, also on the Yukon River, was operated for a short time during 1902, but was closed down in July. No exact information as to the amount of coal obtained during this time has been secured. The Homer mine, on Cook Inlet, produced 512 tons, most of which was obtained in the course of the development of the property. At this point a railway about 7 miles in length connects the mine with the navigable waters of Cook Inlet, where docks and coal bunkers have been established. The three mines on the Alaskan Peninsula have been operated at different times during the last two decades, but no production was reported from them in 1902, although the one on Chignik River is known to have produced some coal to supply the local steamers, and the same is true of the one on Unga Island. A company was organized during 1902 to extend the developments of the mines on Herendeen Bay, but no production was reported from it during the year. The two mines in the Arctic coast district have been worked from time to time during the last twenty years to supply whalers and revenue cutters, but the operations have never reached the dignity of an industry, and no record of their actual production has been secured. Some attempt, however, at systematic development has been recently made, and a small amount of coal was shipped to Nome, where it was said to have brought a good price.

Mr. Arthur J. Collier, assistant geologist, United States Geological Survey, who made a special investigation of the coal resources of the Yukon, has published his results in Bulletin No. 218.

During the field season of 1902 Mr. Collier was able to secure more definite data in regard to the production of the different mines along the Yukon River than have heretofore been obtained. He states that the Williams mine, on the Yukon River, 50 miles below Kaltag, which was first known as the Thein mine, was the only mine in American territory on the Yukon which was worked continuously during the season of 1902. This mine was opened in 1900 and produced some coal in that year.

The Pickart mine, 10 miles above Nulato, was opened in 1898, and produced some coal each year from that time until 1902, when it was abandoned. No definite statement as to the amount of coal produced during this time has been obtained, but the output was probably between 2,000 and 3,000 tons. The first mine to be opened on the Yukon River was what is known as the Nation River mine, 52 miles below the international boundary. About 2,000 tons of coal are said to have been produced from this mine in 1897; the mine has since been shut down and is not now operated. The next mine to be opened was what is known as the Drew mine, about 25 miles above Rampart. This mine was worked from 1897 to 1900, during which time the entire production is estimated to have amounted to about 1,200 tons. The Blatchford mine, 9 miles below Nulato, was opened in 1898 and produced some coal in 1899, 1900, and 1901. It is estimated that about 300 tons were produced at this mine during these years. What is known as Mine No. 1, about 25 miles below the Williams mine, was worked during the winter of 1898, and producd about 900 tons. Since that time it has been shut down. Mr. Collier estimates that the total amount of coal produced in American territory on the Yukon from 1897 to 1902, inclusive, is about 9,000 tons—this total being distributed annually approximately as follows:

Production of coal on the Yukon River, 1897–1902.

Year.	Name of mine.	Quantity.	Value.
		Short tons.	
1897	Nation River	2,000	$28,000
1898	No. 1, Drew, and Pickart	1,600	22,400
1899	Drew, Pickart, and Blatchford	1,200	16,800
1900	Drew, Pickart, Blatchford, and Thein	1,200	16,800
1901	Pickart, Blatchford, and Thein	1,300	15,600
1902	Williams	1,700	17,000

All of these mines are located immediately on the Yukon River. The coal from them has been used principally on the river steamers, though a smaller amount has been used for domestic purposes at Dawson and other points along the river. At Dawson the coal sells at from $15 to $20 per ton. Coal delivered at the river banks from the Yukon mines sells for from $10 to $12 per ton at present, though in years past prices have been higher, and in 1900 coal was selling for $15 per ton at the Drew mine. Adding the production of the Cook Inlet mine to that of the Williams mine in 1902, the total production reported for the Territory is found to be 2,212 tons, valued at $19,048. It is known, however, that some coal was also produced at the Corwin mine, at Chignik, and at Herendeen Bay, but since no definite reports have been obtained from these localities they are not included in the above statement. The actual production in the Territory for 1902 was, therefore, probably somewhat larger than that reported.

ARKANSAS.

Total production in 1902, 1,943,932 short tons; spot value, $2,539,214.

Compared with 1901, the production of coal in Arkansas in 1902 shows an increase of 127,796 short tons, or 7 per cent, while the value of the product increased $470,601, a gain of 22.7 per cent. Aside from the increase in production the principal items of interest connected with the coal-mining industry of the State were (1) the practical exemption from labor troubles and (2) the decided decrease in the use of mining machines. There was only one instance reported of a suspension of work because of strike, and this was of short duration, affecting only 14 men who were idle ten days. The mechanical production of coal in Arkansas has almost disappeared. In 1900 the amount of coal undercut by machines was 219,085 short tons. In 1901 this had decreased to 102,220 short tons, and in 1902 only 8,989 tons were reported as machine mined.

A large part of the coal product of Arkansas consists of a semianthracite quality, which is highly prized, particularly as a domestic fuel. Its use is growing steadily, and it has largely superseded anthracite in Memphis, and in St. Louis and other large cities in the Mississippi Valley west of the river. This coal is practically smokeless, burns with a short, hot flame, and leaves a comparatively small amount of ash. Of the total product in 1902, 1,432,266 short tons, or nearly three-fourths, consisted of this semianthracite coal. As an indication of the present prosperous condition of the coal-mining industry in Arkansas it may be stated that there were 13 new firms or corporations which contributed to the product of 1902. These 13 firms had a total initial production of 150,521 short tons. Three more new operations were reported which had not reached the productive stage at the close of 1902. Of additional interest in connection with the new developments was the taking over of all the coal-mining interests of the Kansas and Texas Coal Company by the Central Coal and Coke Company, of Kansas City.

As in the case of Alabama, an increase in the intensity of labor is shown in the statistics for Arkansas in 1902 as compared with 1901, although the total tonnage per each employee for the year shows a decrease. The total number of tons mined for each man employed in 1901 was 577.7, while in 1902 it was only 540.7 tons. The average tonnage per man per day, however, increased from 2.59 in 1901 to 2.88 in 1902.

In the following tables are presented the statistics of production in 1901 and 1902, with the distribution of the product, by counties, and according to consumption:

Coal production of Arkansas in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Johnson	140,147	1,140	4,938	146,225	$203,461	$1.39	232	302
Sebastian	1,271,039	2,796	31,355	1,305,190	1,390,995	1.06	214	2,297
Franklin, Logan, and Pope	343,341	1,990	13,390	358,721	462,157	1.29	248	545
Small mines		6,000		6,000	12,000			
Total	1,754,527	11,926	49,683	1,816,136	2,068,613	1.14	223	3,144

Coal production of Arkansas in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Franklin	327,418	1,199	9,396	338,013	$377,794	$1.12	154	509
Johnson	186,812	1,072	5,374	193,258	404,822	2.09	167	519
Logan	19,286	1,215	1,250	21,751	36,000	1.66	196	71
Pope	29,389	500	5,077	34,966	101,474	2.90	188	126
Sebastian	1,275,324	6,053	43,804	1,325,181	1,583,209	1.19	199	2,304
Ouachita and Scott	26,683	3,600	480	30,763	35,915	1.17	245	66
Total	1,864,912	13,639	65,381	1,943,932	2,539,214	1.31	188	3,595

Since 1889, the distribution of the coal product of Arkansas has been as follows:

Distribution of the coal product of Arkansas, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	268,518	6,820	4,246	279,584	$395,836	$1.42		677
1890	374,969	9,240	15,679	399,888	514,595	1.29	214	938
1891	518,120	8,909	15,350	542,379	647,560	1.19	214	1,317
1892	513,908	7,450	14,200	535,558	666,230	1.24	199	1,128
1893	549,504	11,778	13,481	574,763	773,347	1.34	151	1,559
1894	488,077	7,870	16,679	512,626	631,988	1.22	134	1,493
1895	576,112	14,935	7,275	598,322	751,156	1.25	176	1,218
1896	647,240	8,640	19,494	675,374	755,577	1.12	168	1,507
1897	827,518	11,588	18,084	856,190	903,993	1.06	156	1,990
1898	1,167,103	13,256	25,120	1,205,479	1,238,778	1.03	163	2,555
1899	811,366	10,296	21,892	843,554	989,383	1.17	156	2,313
1900	1,396,674	10,950	40,321	1,447,945	1,653,618	1.14	219	2,800
1901	1,754,527	11,926	49,683	1,816,136	2,068,613	1.14	223	3,144
1902	1,864,912	13,639	65,381	1,943,932	2,539,214	1.31	188	3,595

The production by counties during the last five years has been as follows:

Coal production of Arkansas, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.
Franklin	328,412	a 257,196	a 442,466	504,946	338,013
Johnson					193,258
Logan					21,751
Pope					34,966
Sebastian	871,067	580,358	999,479	1,305,190	1,325,181
Ouachita and Scott					30,763
Small mines	6,000	6,000	6,000	6,000	(b)
Total	1,205,479	843,554	1,447,945	1,816,136	1,943,932

a Includes also production of Logan County.
b Small mine production included with county distribution.

The earliest production of coal in Arkansas, of which there is official record, was in 1880, when the Tenth United States Census reported a total output of 14,778 short tons. Since that date the production of the State has grown to large proportions, as is shown in the following table:

Annual production of coal in Arkansas, 1880–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880	14,778	1892	535,558
1881	10,000	1893	574,763
1882	15,000	1894	512,626
1883	50,000	1895	598,322
1884	75,000	1896	675,374
1885	100,000	1897	856,190
1886	125,000	1898	1,205,479
1887	129,600	1899	843,554
1888	276,871	1900	1,447,945
1889	279,584	1901	1,816,136
1890	399,888	1902	1,943,932
1891	542,379		

CALIFORNIA.

Total production in 1902, 84,984 short tons; spot value, $254,350.

The increased production and consumption of petroleum in California is reflected in the decreased production of coal in the State. The coal developments in Kern County, mention of which was made in the report for 1901, had not reached a productive stage up to the close of 1902. The larger part of the production of the State continues to come from Alameda County, about 80 per cent of the output in 1902 being from that county.

The statistics of production in the State since 1889 have been as follows:

Distribution of the coal product of California, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	111,128	3,146	7,546	121,820	$288,232	$2.37	......	....
1890	103,436	2,121	5,154	110,711	283,019	2.56	301	364
1891	86,783	3,424	3,094	93,301	204,902	2.20	222	256
1892	73,269	9,679	2,230	85,178	209,711	2.46	204	187
1893	64,733	5,336	2,534	72,603	167,555	2.31	208	158
1894	52,736	8,143	6,368	67,247	155,620	2.31	232	125
1895	60,440	12,171	2,842	75,453	175,778	2.33	262	190
1896	69,608	4,537	4,399	78,544	166,123	2.12	297	157
1897	74,762	6,869	4,361	85,992	201,236	2.34	150	363
1898	123,568	15,996	4,724	144,288	349,915	2.43	265	284
1899	151,041	5,242	4,432	160,715	428,333	2.67	291	363
1900	160,508	4,550	6,650	171,708	523,231	3.05	309	378
1901	132,566	597	17,916	151,079	394,106	2.60	289	428
1902	79,485	1,721	3,778	84,984	254,350	2.99	312	207

The annual production since 1883 is exhibited in the following table:

Coal production of California, 1883–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1883	76,162	1893	72,603
1884	77,485	1894	67,247
1885	71,615	1895	75,453
1886	100,000	1896	78,544
1887	50,000	1897	85,992
1888	95,000	1898	144,288
1889	121,820	1899	160,715
1890	110,711	1900	171,708
1891	93,301	1901	151,079
1892	85,178	1902	84,984

COLORADO.

Total production in 1902, 7,401,343 short tons; spot value, $8,397,812.

Colorado is one of the States which experienced in her coal production the full benefit of the remarkable industrial activity which prevailed throughout 1902. As compared with 1901 the production of coal in 1902 increased 1,701,328 short tons, or 29.8 per cent. In this report for 1901 it was stated that the building of the extensive iron works at Pueblo would probably augment the production of coal in 1902, a prediction which has been abundantly realized. In fact, the industrial development of the State as reflected in its coal production has been without interruption since 1894, the output having increased each year since that date, and the production in 1902 being more than two and one-half times that of eight years before.

In comparing the statistics for 1902 with those for 1901 a decided increase is shown in the quantity of coal produced per employee. In 1901, 8,870 men worked for an average of 253 days and produced 5,700,015 tons of coal, or at the rate of 642.6 tons per man for the year. In 1902, 8,956 men worked an average of 261 days and produced 7,401,343 tons, equivalent to 826 tons per man. The daily average shows even more striking comparisons, the average production per day per man increasing from 2.54 tons in 1901 to 3.16 tons in 1902. A good portion of this increased capacity was due to the increased production by coal-cutting machinery. The production, by counties, in 1901 and 1902, is shown in the following tables:

Coal production of Colorado in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Boulder	432,942	18,896	31,137	....	482,975	$611,151	$1.27	221	1,133
Delta	2,410	3,284	150	....	5,844	8,036	1.38	183	11
El Paso	170,979	700	4,300	....	175,979	252,245	1.43	301	196
Fremont	508,170	4,591	17,226	6,326	536,313	890,155	1.66	234	1,046
Garfield	165,163	2,294	6,250	....	173,707	190,547	1.10	238	247
Gunnison	273,666	3,288	7,826	112,263	397,043	608,230	1.53	251	547
Huerfano	888,288	5,128	25,193	....	918,609	1,063,403	1.16	250	1,319
La Plata	133,214	9,513	512	1,653	144,892	219,021	1.51	255	222
Las Animas	1,594,414	20,986	59,630	801,108	2,476,138	2,197,567	.89	272	3,598
Pitkin	143,632	1,258	2,485	178,497	325,872	304,692	.93	233	436
Routt	140	1,418	....	....	1,558	2,562	1.64	55	13
Weld	11,667	18,857	2,850	....	33,374	53,616	1.61	263	48
Arapahoe and Larimer	....	608	....	....	608	760	1.25	100	4
Jefferson, Rio Blanco, Mesa, Montezuma, and Montrose	25,600	1,483	20	....	27,103	39,906	1.47	141	50
Total	4,350,285	92,304	157,579	1,099,847	5,700,015	6,441,891	1.13	253	8,870

Coal production of Colorado in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Boulder	719,554	48,454	38,363	....	806,371	$1,019,072	$1.26	268	941
Delta	410	8,790	150	....	9,350	12,450	1.33	235	16
El Paso	74,135	140,714	3,700	....	218,549	286,270	1.31	282	302
Fremont	661,804	2,559	31,636	....	695,999	1,146,416	1.65	262	979
Garfield	200,821	2,351	4,090	....	207,262	228,935	1.10	261	202
Gunnison	252,861	1,519	8,614	101,880	364,874	563,593	1.54	251	435
Huerfano	1,156,555	4,891	27,867	....	1,189,313	1,446,866	1.22	241	1,406
La Plata	143,412	10,178	607	832	155,029	230,901	1.49	220	229
Las Animas	1,929,116	26,250	55,435	1,234,470	3,245,271	2,919,146	.90	268	3,925
Routt	600	2,535	45	....	3,180	4,698	1.48	106	20
Weld	38,652	30,402	4,627	....	73,681	106,574	1.45	252	160
Other counties[a]	197,295	3,384	6,412	225,373	432,464	432,891	1.00	269	341
Total	5,375,215	282,027	181,546	1,562,555	7,401,343	8,397,812	1.13	261	8,956

[a] Arapahoe, Larimer, Mesa, Montezuma, Ouray, Pitkin, and Rio Blanco.

The influence exerted by the growth of the iron industry upon the production of coal in Colorado is shown in the following table, which exhibits the distribution of the product during a period of fourteen years. The statement shows that while the coal shipped in 1902 was about two and one-half times that of 1889, the amount of coal made into coke for blast-furnace use in 1902 was more than five times that of 1889.

Distribution of the coal product of Colorado, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2,109,335	91,248	88,537	308,061	2,597,181	$3,993,768	$1.54	....	4,904
1890	2,636,939	65,432	48,451	343,181	3,094,003	4,344,196	1.40	....	5,827
1891	2,934,332	70,000	50,000	458,300	3,512,632	4,800,000	1.37	....	6,000
1892	2,938,980	126,748	55,721	389,381	3,510,830	5,685,112	1.62	229	5,747
1893	3,345,951	65,386	178,993	512,059	4,102,389	5,104,602	1.24	188	7,202
1894	2,181,048	56,688	112,414	481,259	2,831,409	3,516,340	1.24	155	6,507
1895	2,445,578	49,088	99,055	489,261	3,082,982	3,675,185	1.20	182	6,125
1896	2,424,027	65,755	93,128	529,490	3,112,400	3,606,642	1.16	172	6,704
1897	2,649,042	76,699	93,782	542,180	3,361,703	3,947,186	1.17	180	5,852
1898	3,132,676	130,305	117,820	695,546	4,076,347	4,686,081	1.15	220	6,440
1899	3,681,341	118,153	106,988	869,742	4,776,224	5,363,667	1.12	246	7,166
1900	4,027,872	106,917	139,085	970,490	5,244,364	5,858,036	1.12	264	7,459
1901	4,350,285	92,304	157,579	1,099,847	5,700,015	6,441,891	1.13	253	8,870
1902	5,375,215	282,027	181,546	1,562,555	7,401,343	8,397,812	1.13	261	8,956

All the coal-producing counties of any importance participated in the increased production in 1902 with the single exception of Gunnison County. The greatest gain was made by Las Animas County, whose output increased 769,133 short tons, or 31 per cent over 1901. The production of Boulder County increased 319,396 short tons, or 66 per cent, from 482,975 tons in 1901 to 802,371 tons in 1902. The other notable increases were in Huerfano County, 270,704 short tons, and Fremont County, 159,686 tons. Practically all of the increased production in Colorado during 1902 was due to the greater activity at the older mines rather than to the opening of new properties. Thirteen new mines contributed to the production in 1902, but the aggregate output of these new operations amounted to only 53,989 short tons, scarcely 3 per cent of the total increase of production.

The production of the State, by counties, since 1898, with the increases and decreases in 1902 as compared with 1901, is presented in the following table:

Coal production of Colorado, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Boulder	451,539	540,475	574,334	482,975	806,371	323,396	
Delta					9,350	9,350	
El Paso			94,334	175,979	218,549	42,570	
Fremont	426,553	620,609	619,413	536,313	695,999	159,686	
Garfield	222,480	134,354	141,159	173,707	207,262	33,555	
Gunnison	323,321	319,434	432,555	397,043	364,874		32,169
Huerfano	1,075,881	632,577	854,944	918,609	1,189,313	270,704	
Jefferson	12,366	9,900	3,000				
Las Animas	1,211,340	2,125,143	2,123,411	2,476,138	3,245,271	769,133	
La Plata	100,650	116,500	123,524	144,892	155,029	10,137	
Pitkin	195,496	172,917	175,942	325,872	414,244	88,372	
Routt				1,558	3,180	1,622	
Weld	24,085	47,573	80,015	33,374	73,681	40,307	
Other counties	32,636	56,742	21,733	33,555	18,220		15,335
Total	4,076,347	4,776,224	5,244,364	5,700,015	7,401,343	[a] 1,701,328	

[a] Net increase.

Colorado entered the list of coal-producing States in 1864, with an output for that year of 500 short tons. The growth of the industry since that date is exhibited in the following table:

Coal production of Colorado, 1864–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1864	500	1884	1,130,024
1865	1,200	1885	1,356,062
1866	6,400	1886	1,368,338
1867	17,000	1887	1,791,735
1868	10,500	1888	2,185,477
1869	8,000	1889	2,597,181
1870	13,500	1890	3,077,003
1871	15,600	1891	3,512,632
1872	68,540	1892	3,510,830
1873	69,997	1893	4,102,289
1874	77,372	1894	2,831,409
1875	98,838	1895	3,082,982
1876	117,666	1896	3,112,400
1877	160,000	1897	3,361,703
1878	200,630	1898	4,076,347
1879	322,732	1899	4,776,224
1880	437,005	1900	5,244,364
1881	706,744	1901	5,700,015
1882	1,061,479	1902	7,401,343
1883	1,229,593		

GEORGIA.

Total production in 1902, 414,083 short tons; spot value, $589,018.

All of the coal produced in Georgia comes from two counties, Dade and Walker, in the northwestern corner of the State. The coal found in this section of the State is in reality the eastern limit of the Warrior coal fields of Alabama. The coal as found here is of excellent quality and enjoys a high reputation as a steam-raising fuel. It is in good demand for bunker coal at South Atlantic ports. It also makes a good grade of coke, which finds a market among the iron furnaces in the vicinity of Chattanooga. Coal production in the State has increased steadily since 1899, and in 1902 reached the maximum production for any one year. The largest previous production was obtained in 1893, when a total of 372,740 tons was mined. Compared with 1901, the production in 1902 shows an increase of 71,258 short tons in quantity, and of $177,333 in value. The average price per ton obtained was the highest since 1901, and was a little more than double that obtained in 1896.

As stated in the previous reports, a considerable number of the miners employed in the production of coal in Georgia are convicts leased from the State authorities. The efficiency of this class of labor varies materially from year to year, and the labor statistics of Georgia, therefore, are hardly comparable with those of other States.

The statistics of production during the last fourteen years are presented in the following table:

Coal production of Georgia since 1889.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	46,131	158	15,000	164,645	225,934	$338,901	$1.50		
1890	57,949			170,388	228,337	238,315	1.04	313	425
1891	15,000	1,000	5,000	150,000	171,000	256,500	1.50	312	850
1892	52,614	250	3,756	158,878	215,498	212,761	.99	277	467
1893	196,227		4,869	171,644	372,740	365,972	.98	342	736
1894	178,610		8,978	166,523	354,111	299,290	.85	304	729
1895	135,692	150	6,256	118,900	260,998	215,863	.83	312	848
1896	120,496	875	7,520	109,655	238,546	168,050	.70	303	713
1897	120,398	1,481	5,500	68,490	195,869	140,466	.72	304	469
1898	135,926	890	5,650	101,721	244,187	198,169	.81	298	504
1899	149,954	440	6,150	76,567	233,111	233,344	1.00	302	567
1900	160,889	1,305	6,895	146,468	315,557	370,022	1.17	278	597
1901	249,581	550	1,930	90,764	342,825	411,685	1.20	291	766
1902	278,847	1,700	3,080	130,456	414,083	589,018	1.42	312	755

Coal mining in Georgia, so far as the records of production show, began in 1884, with a production of 150,000 tons. Since that date the total output of the State has been as follows:

Coal production of Georgia, 1884–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1884	150,000	1894	354,111
1885	150,000	1895	260,998
1886	223,000	1896	238,546
1887	313,715	1897	195,869
1888	180,000	1898	244,187
1889	225,934	1899	233,111
1890	228,337	1900	315,557
1891	171,000	1901	342,825
1892	215,498	1902	414,083
1893	372,740		

IDAHO.

Idaho once more enters the list of coal-producing States in 1902, this time with a production of 2,030 tons, the output being obtained from the counties of Boise, Lemhi, and Fremont. The market for the product is limited to the demands of ranchmen in the vicinity of the mines. The entire product is lignite, of rather inferior quality.

ILLINOIS.

Total production in 1902, 32,939,373 short tons; spot value, $33,-945,910.

Illinois, like many other States of the Union, eclipsed in 1902 all previous records in coal production. Compared with the preceding year the output in 1902 shows a gain of 5,607,821 short tons, or 20.5 per cent. The value increased in exactly the same proportion, the amount of gain being $5,781,973. Once before, in 1899, the production of coal in this State showed an increase over the preceding year as remarkable as the one in 1902, but the output in 1898 had been considerably reduced by strikes among the mine workers, whereas in 1901 the production was larger than in any previous year in the history of the State.

Illinois continues to hold second place among the coal-producing States, the rivalry of West Virginia for this honor having been greatly lessened in 1902 by the protracted strikes in the Pocahontas, New River, and Kanawha districts of the latter State, while Illinois enjoyed comparative peace in this particular. In fact, since 1898 labor troubles have given little disturbance to the coal-mining industry of Illinois. In 1900 there were 34 mines in which strikes occurred, the total number of men on strike being 3,909, who lost an average of 34 days. In 1901 strikes occurred in 74 mines, 3,740 men being idle for an average of 21 days. In 1902, 26 mines were affected by short-lived strikes, the total number of men made idle thereby being 3,916, and the average time lost 16.6 days. In none of these cases was the total loss of time sufficient to materially affect the production of the State. As the miners' union has had its greatest strength developed in this State, and as the system of collective wage-scale settlements between the Illinois Coal Operators' Association and the United Mine Workers has been carried on for several years, this statement contains special interest. At the same time, however, it should be stated that the average price of coal at the mines has advanced from 78 cents in 1898 to $1.04 in 1900, and $1.03 in 1901 and 1902.

It is also interesting to note in this connection that the tonnage per employee in 1902 shows a decided gain over 1901. The total average production per man increased from 653 in 1901 to 695 in 1902, and the average production per man per day increased from 2.97 tons to 3.08 tons. Part if not all of this increased efficiency was due to the increased use of mining machines. The reports for 1901 show that 464 machines were in use and that 5,774,639 tons of coal were machine-mined; in 1902, 508 machines were used in the production of 7,112,039 tons.

The statistics of production, by counties, during 1901 and 1902 are shown in the following tables:

Coal production of Illinois in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Bond	151,000	500	250	151,750	$136,750	$0.90	284	259
Bureau	1,487,358	58,141	49,304	1,594,803	1,854,306	1.16	252	3,303
Calhoun	....	4,985	938	5,923	7,699	1.30	286	21
Christian	510,248	73,275	32,850	616,373	583,573	.95	161	971
Clinton	689,301	50,848	24,911	765,060	602,066	.79	220	902
Fulton	617,912	22,625	13,879	654,416	723,644	1.11	210	1,082
Gallatin	....	4,800	....	4,800	5,200	1.08	186	9
Greene	1,120	2,660	28	3,808	5,208	1.37	232	15
Grundy	1,192,231	44,350	33,160	1,269,741	1,950,703	1.52	222	3,276
Hancock	5,200	906	....	6,106	9,350	1.54	207	16
Henry	13,565	71,714	4,186	89,465	153,202	1.71	202	231
Jackson	753,780	69,349	46,964	870,093	907,879	1.04	189	1,099
Jefferson	50,000	....	....	50,000	65,000	1.30	250	60
Johnson	....	1,000	10	1,010	1,010	1.00	150	5
Kankakee	56,067	3,605	7,523	67,195	93,325	1.39	233	178
Knox	33,611	44,533	492	78,636	107,171	1.36	202	189
Lasalle	1,503,515	193,739	54,504	1,751,758	2,451,927	1.40	248	3,370
Livingston	231,041	65,103	11,123	307,267	383,257	1.25	224	576
Logan	107,046	36,910	17,655	161,611	205,494	1.27	196	285
McDonough	25,835	5,427	75	31,337	46,319	1.48	164	127
McLean	57,239	74,340	13,380	144,959	202,939	1.40	287	333
Macon	38,429	48,039	....	86,468	153,602	1.78	291	305
Macoupin	1,815,414	63,076	81,548	1,960,038	1,695,878	.87	207	2,406
Madison	1,776,785	65,394	69,202	1,911,381	1,537,813	.80	244	2,132
Marion	765,889	40,476	38,451	844,816	736,424	.87	236	1,042
Marshall	388,943	15,487	13,014	417,444	544,631	1.30	244	825
Menard	327,997	43,560	19,374	390,931	425,511	1.09	215	525
Mercer	523,741	28,276	11,333	563,350	750,196	1.33	235	843
Montgomery	313,000	41,972	12,354	367,326	332,185	.90	224	510
Morgan	....	3,000	....	3,000	4,500	1.50	100	10
Peoria	603,839	42,815	13,047	659,701	706,765	1.07	206	1,001
Perry	598,753	23,700	9,586	632,039	575,142	.90	177	1,151
Randolph	336,337	19,904	12,710	368,951	284,295	.77	170	617
Rock Island	19,059	48,179	1,118	68,356	100,660	1.47	157	179
St. Clair	2,049,812	174,524	74,507	2,298,843	1,872,575	.81	223	2,613
Saline	152,671	9,913	1,000	163,584	161,607	.99	197	222
Sangamon	3,013,193	166,062	98,684	3,277,939	3,100,868	.95	231	4,083
Schuyler	....	5,400	152	5,552	6,494	1.17	212	13
Scott	18,500	4,580	600	23,680	33,775	1.43	267	61
Shelby	90,150	20,542	3,500	114,192	138,944	1.22	240	180
Stark	....	13,100	300	13,400	21,250	1.59	197	43
Tazewell	64,639	77,992	2,938	145,569	161,782	1.11	198	283
Vermilion	2,074,258	144,160	42,546	2,260,964	2,294,690	1.01	215	3,106
Warren	1,088	9,112	100	10,300	15,428	1.50	174	39
Washington	20,000	4,600	1,100	25,700	21,200	.82	190	54
Will	41,981	13,205	1,460	56,646	83,413	1.47	229	164
Williamson	1,652,800	37,808	52,444	1,743,052	1,553,740	.89	187	2,729
Woodford	122,514	12,658	7,047	142,219	204,547	1.44	193	437
Small mines	....	150,000	....	150,000	150,000	.....	....	....
Total	24,295,861	2,156,344	879,347	27,331,552	28,163,937	1.03	220	41,880

Coal production of Illinois in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Brown	....	1,230	....	....	1,230	$1,705	$1.39	104	11
Bureau	1,653,131	55,132	61,379	....	1,769,642	2,401,435	1.36	243	3,811
Christian	815,601	77,157	43,278	....	936,036	890,512	.95	196	1,333
Clinton	795,793	13,092	25,433	....	834,318	771,246	.92	246	938
Fulton	871,108	58,374	24,125	....	953,607	1,104,963	1.16	212	1,706
Gallatin	18,325	11,971	615	....	30,911	35,080	1.13	136	89
Greene	....	6,000	....	....	6,000	9,265	1.54	199	23
Grundy	1,328,815	47,962	37,702	....	1,414,479	1,880,231	1.33	219	3,976
Hancock	1,570	11,800	30	....	13,400	22,800	1.70	172	31
Henry	44,888	89,859	3,565	....	138,312	229,509	1.66	226	324
Jackson	857,193	27,700	45,594	....	930,487	1,023,853	1.10	214	1,238
Jersey	....	3,520	....	....	3,520	5,480	1.56	160	20
Johnson	200	3,650	....	....	3,850	4,195	1.09	93	10
Knox	36,540	48,481	830	....	85,851	128,067	1.49	190	246
Lasalle	1,487,507	304,862	53,867	....	1,846,236	2,369,359	1.28	257	3,434
Livingston	299,012	85,618	10,453	....	395,083	544,581	1.38	257	583
Logan	218,500	35,132	15,075	....	268,707	302,894	1.13	222	336
McDonough	20,353	14,133	150	....	34,636	57,997	1.67	159	171
McLean	77,000	90,200	7,800	....	175,000	254,775	1.46	289	408
Macoupin	2,033,159	66,419	85,747	....	2,185,325	1,911,377	.87	226	2,424
Madison	2,232,236	58,119	84,329	....	2,374,684	1,941,599	.82	223	2,863
Marion	841,127	37,553	43,976	....	922,656	787,737	.85	256	954
Marshall	421,457	19,313	17,416	....	458,186	611,491	1.33	278	852
Menard	419,067	29,516	23,375	....	471,958	473,369	1.00	239	587
Mercer	577,148	38,837	24,156	....	640,141	766,725	1.20	249	945
Montgomery	558,590	46,113	14,745	....	619,448	641,042	1.03	217	598
Morgan	....	4,775	5	....	4,780	7,170	1.50	201	15
Peoria	723,411	113,554	15,325	85	852,375	963,519	1.13	222	1,197
Perry	931,406	34,078	25,860	....	991,344	925,131	.93	166	1,820
Randolph	431,131	18,663	7,190	....	456,984	377,318	.83	213	455
Rock Island	50,253	31,490	1,675	....	83,418	120,589	1.45	202	131
St. Clair	2,537,147	188,451	96,650	....	2,822,248	2,425,846	.86	222	3,014
Saline	278,662	13,279	5,630	....	297,571	277,308	.93	226	286
Sangamon	3,669,213	379,192	124,317	....	4,172,722	3,865,742	.92	230	4,713
Schuyler	2,520	15,877	60	....	18,457	23,661	1.28	163	59
Scott	15,990	10,945	500	....	27,435	42,168	1.54	235	82
Shelby	58,866	19,310	8,936	....	87,112	178,039	2.04	190	218
Stark	6,640	21,833	570	....	29,043	48,162	1.66	153	107
Tazewell	97,089	72,174	3,755	....	173,018	198,891	1.15	210	311
Vermilion	2,330,705	210,043	44,543	....	2,585,291	2,546,608	.99	230	3,445
Warren	2,200	13,577	300	....	16,077	27,935	1.74	140	57
Washington	38,754	14,951	3,130	....	56,835	55,405	.97	219	83
Will	25,125	14,357	1,310	....	40,792	73,012	1.79	209	146
Williamson	2,229,073	31,682	65,187	....	2,325,942	2,116,280	.91	206	2,369
Other counties[a]	262,632	101,796	19,798	....	384,226	501,839	1.31	220	992
Total	29,299,137	2,591,770	1,048,381	85	32,939,373	33,945,910	1.03	226	47,411

[a] Bond, Calhoun, Cass, Edwards, Hamilton, Jefferson, Kankakee, Macon, Wabash, and Woodford.

The distribution of the coal product of Illinois since 1889 has been as follows:

Distribution of the coal product of Illinois, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	9,884,883	1,810,702	395,787	12,900	12,104,272	$11,755,203	$0.97	....	....
1890	12,539,784	2,130,539	606,497	15,600	15,292,420	14,171,230	.93	204	28,574
1891	12,787,993	2,246,705	610,000	16,000	15,660,698	14,237,074	.91	216	32,951
1892	14,557,655	2,624,821	675,000	4,800	17,862,276	16,243,645	.91	220	34,585
1893	16,260,463	2,931,846	753,955	3,300	19,949,564	17,827,595	.89	229	35,390
1894	13,948,910	2,590,414	570,452	3,800	17,113,576	15,282,111	.89	183	38,477
1895	14,456,524	2,684,607	591,133	3,600	17,735,864	14,239,157	.80	182	38,630
1896	16,128,103	2,995,022	659,601	3,900	19,786,626	15,809,736	.80	186	33,054
1897	16,358,221	3,041,712	669,012	3,813	20,072,758	14,472,529	.72	185	33,788
1898	15,596,888	2,149,808	852,603	....	18,599,299	14,567,598	.78	175	35,026
1899	21,871,930	1,936,515	630,574	....	24,439,019	20,744,553	.85	228	36,756
1900	22,955,737	2,002,884	809,360	....	25,767,981	26,927,185	1.04	226	39,101
1901	24,295,861	2,156,344	879,347	....	27,331,552	28,163,937	1.03	220	41,880
1902	29,299,137	2,591,770	1,048,381	85	32,939,373	33,945,910	1.03	226	47,411

To what an extent the prosperous condition was distributed throughout the coal-mining districts of Illinois is shown by the fact that out of 50 counties from which a production was reported in 1902 there were 43 in which the output showed an increase over the preceding year, only 7 showing a loss. In 1901 there were 27 out of a total of 48 counties in which the output exceeded that of 1900. It should be stated, however, that in 1902 the production from the small mines is included in the county distribution and was not so included in 1901. This accounts for the increase of 2 in the number of coal-producing counties in 1902, and affects also in some degree the output of some of the smaller producing counties.

In the following table is shown the total output, by counties, during the last five years, with the increases and decreases in 1902 as compared with 1901:

Coal production of Illinois in 1898, 1899, 1900, 1901, and 1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase 1902.	Decrease 1902.
Bond	96,314	100,955	150,000	151,750	100,000	....	51,750
Brown	1,940	2,630	....	....	1,230	1,230	....
Bureau	865,892	1,400,908	1,318,784	1,594,803	1,769,642	174,839	....
Calhoun	4,893	6,113	6,300	5,923	3,000	....	2,923
Cass	2,900	3,430	....	....	....	....	....
Christian	495,616	617,027	622,183	616,373	936,036	319,663	....
Clinton	417,584	577,454	531,457	765,060	834,318	69,258	....
Fulton	563,397	651,694	602,645	654,416	953,607	299,191	....
Gallatin	16,812	16,836	5,969	4,800	30,911	26,111	....
Greene	8,520	15,420	5,220	3,808	6,000	2,192	....
Grundy	796,249	1,257,092	1,315,688	1,269,741	1,414,479	144,738	....
Hamilton	4,882	640	....	....	....	....	....
Hancock	5,600	5,498	1,267	6,106	13,400	7,294	....
Henry	159,049	92,429	72,046	89,465	138,312	48,847	....
Jackson	911,194	808,340	985,998	870,093	930,487	60,394	....
Jefferson	46,060	63,010	48,648	50,000	25,090	....	24,910
Jersey	1,680	4,050	....	....	3,520	3,520	....
Johnson	2,030	3,541	1,760	1,010	3,850	2,840	....
Kankakee	84,632	129,262	109,129	67,195	48,439	....	18,756
Knox	49,819	55,924	62,423	78,636	85,851	7,215	....
Lasalle	1,165,490	2,015,304	2,022,462	1,751,758	1,846,236	94,478	....
Livingston	122,087	129,484	236,872	307,267	395,083	87,816	....
Logan	177,935	185,480	156,901	161,611	268,707	107,096	....
McDonough	77,696	42,269	30,293	31,337	34,636	3,299	....
McLean	171,594	186,487	207,304	144,959	175,000	30,041	....
Macon	300,264	150,403	58,025	86,468	100,000	13,532	....
Macoupin	1,264,926	1,727,102	2,012,540	1,960,038	2,185,325	225,287	....
Madison	630,769	1,538,049	1,510,394	1,911,381	2,374,684	463,303	....
Marion	714,513	710,487	805,859	844,816	922,656	77,840	....
Marshall	286,365	350,732	396,087	417,444	458,186	40,742	....
Menard	314,160	432,948	397,077	390,931	471,958	81,027	....
Mercer	384,345	503,474	564,247	563,350	640,141	76,791	....
Montgomery	294,667	301,424	304,200	367,326	619,448	252,122	....
Morgan	1,800	4,506	4,500	3,000	4,780	1,780	....
Peoria	640,193	792,239	717,939	659,701	852,375	192,674	....
Perry	845,329	809,425	561,091	632,039	991,344	359,305	....
Randolph	274,072	437,034	466,547	368,951	456,984	88,033	....
Rock Island	47,490	44,005	44,078	68,356	83,418	15,062	....
St. Clair	1,600,752	2,079,353	2,232,786	2,298,843	2,822,248	523,405	....
Saline	100,005	95,736	116,650	163,584	297,571	133,987	....
Sangamon	1,763,863	2,289,708	2,738,402	3,277,939	4,172,722	894,783	....
Schuyler	11,149	15,874	4,992	5,552	18,457	12,905	....
Scott	21,337	22,227	27,097	23,680	27,435	3,755	....
Shelby	68,388	105,409	109,392	114,192	87,112	....	27,080
Stark	21,936	25,430	15,191	13,400	29,043	15,643	....
Tazewell	84,507	98,092	92,843	145,569	173,018	27,449	....
Vermilion	1,520,699	2,191,067	2,139,474	2,260,964	2,585,291	324,327	....
Warren	12,245	16,992	12,019	10,300	16,077	5,777	....
Washington	43,808	32,360	37,291	25,700	56,835	31,135	....
Will	40,904	42,275	55,323	56,646	40,792	....	15,854
Williamson	915,108	1,072,367	1,508,453	1,743,052	2,325,942	582,890	....
Woodford	145,840	179,024	192,135	142,219	101,567	....	40,652
Small mines	....	....	150,000	150,000	6,130	....	143,870
Total	18,599,299	24,439,019	25,767,981	27,331,552	32,939,373	[a]5,607,821	....

[a] Net increase.

The census of 1870 reports the coal production of Illinois at 2,624,163 tons. The report for 1880 gives the output for that year at 6,115,377 tons. Since that date the annual production has been as follows:

Coal production of Illinois, 1870–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1870	2,624,163	1891	15,660,698
1880	6,115,377	1892	17,862,276
1881	7,500,000	1893	19,949,564
1882	9,115,653	1894	17,113,576
1883	12,123,456	1895	17,735,864
1884	12,208,075	1896	19,786,626
1885	11,834,459	1897	20,072,758
1886	11,175,241	1898	18,599,299
1887	12,423,066	1899	24,439,019
1888	14,328,181	1900	25,767,981
1889	12,104,272	1901	27,331,552
1890	15,292,420	1902	32,939,373

INDIANA.

Total production in 1902, 9,446,424 short tons; spot value, $10,399,660.

Following a period of five years of uninterrupted increase in its output of coal, Indiana in 1902 exceeded all previous records and added 2,528,199 short tons, or 36.5 per cent, to the production of 1901. Accompanying this increase in production was a gain in value of even greater ratio, for the average price per ton advanced from $1.01 in 1901 to $1.10 in 1902, and the total value increased $3,382,517, or 48 per cent. The production in 1902 was 2¼ times in quantity and three times in value the output of 1897.

The statistics of the labor employed in the coal mines of the State show that in 1901 there were 533.5 tons produced during the year for each employee, and that the average tonnage per day per man was 2.75. In 1902 the total production per man was 611.1 tons, and the tonnage per day per man was 2.98. In connection with this increased efficiency of the labor employed in the coal mines of the State it is necessary to note the increasing production by the use of undercutting machines. The amount of machine-mined coal in 1902 was 2,421,342, against 1,852,058 in 1901. The number of machines in use increased from 256 to 269.

Indiana, like her neighboring State of Illinois, was comparatively free from strikes during 1902. In all, 1,824 men were on strike for short periods, the total number of working days lost being 23,693, or an average of 12.9 days for each man on strike.

The statistics of production by counties in 1901 and 1902, with the distribution of the product for consumption, are presented in the following tables:

Coal production of Indiana in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Clay	1,041,630	10,447	25,087	1,080,164	$1,445,964	$1.34	179	2,981
Daviess and Martin	212,001	24,480	2,218	238,699	274,241	1.15	184	637
Fountain	34,126	....	700	34,826	34,826	1.00	300	60
Gibson	97,822	14,891	3,813	116,526	90,150	.77	232	197
Greene	913,895	12,089	18,637	944,621	873,447	.92	226	1,550
Knox	57,684	30,645	6,250	94,579	99,890	1.06	145	170
Parke	586,919	12,497	31,616	631,032	696,053	1.10	198	1,403
Perry	15,522	1,000	300	16,822	21,027	1.25	106	60
Pike	258,434	3,734	7,100	269,268	251,815	.94	167	577
Spencer	1,600	17,285	....	18,885	23,299	1.23	170	31
Sullivan	868,328	20,607	21,790	910,725	820,664	.90	210	1,451
Vanderburg	72,701	109,775	11,240	193,716	218,109	1.13	206	363
Vermilion	669,882	2,472	11,899	684,253	590,265	.86	151	1,019
Vigo	1,301,463	22,682	37,896	1,362,041	1,244,794	.91	202	2,100
Warrick	238,076	34,507	13,485	286,068	296,599	1.04	214	369
Small mines	....	36,000	....	36,000	36,000	......	....	....
Total	6,373,083	353,111	192,031	6,918,225	7,017,143	1.01	194	12,968

Coal production of Indiana in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Clay	1,241,950	28,850	44,246	....	1,315,046	$1,799,839	$1.37	219	2,639
Daviess	178,368	33,193	5,765	....	217,326	272,995	1.26	210	465
Dubois	....	9,991	103	....	10,094	14,951	1.48	147	39
Fountain	13,781	2,820	498	....	17,099	19,894	1.16	148	57
Gibson	87,761	13,307	4,400	....	105,468	105,059	1.00	199	166
Greene	1,596,594	34,568	32,623	....	1,663,785	1,745,601	1.05	181	2,705
Knox	79,635	33,873	5,717	....	119,225	134,970	1.13	185	265
Martin	14,370	3,107	180	....	17,657	29,987	1.70	155	59
Parke	1,090,162	21,693	43,602	....	1,155,457	1,481,315	1.28	210	1,991
Perry	10,425	10,792	360	....	21,577	27,914	1.29	197	48
Pike	466,130	34,741	9,146	....	510,017	532,551	1.04	200	938
Spencer	1,340	14,884	50	....	16,274	19,886	1.24	130	62
Sullivan	1,177,158	50,579	41,208	....	1,268,945	1,298,903	1.02	191	1,737
Vanderburg	97,763	112,889	7,460	....	218,112	250,395	1.15	213	429
Vermilion	698,719	3,343	16,040	....	718,102	652,597	.91	201	1,019
Vigo	1,551,849	59,808	40,441	700	1,652,798	1,570,796	.95	227	2,319
Warren	....	3,280	100	....	3,380	7,460	2.21	209	16
Warrick	343,139	65,181	7,742	....	416,062	434,547	1.04	228	503
Total	8,649,144	536,899	259,681	700	9,446,424	10,399,660	1.10	205	15,457

The distribution of the product for the last fourteen years has been as follows:

Distribution of the coal product of Indiana, 1889-1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2,527,112	237,935	67,210	12,800	2,845,057	$2,887,852	$1.02	....	6,448
1890	3,036,737	225,167	34,703	9,130	3,305,737	3,259,233	.91	220	5,489
1891	2,689,780	211,854	63,152	8,688	2,973,474	3,070,918	1.03	190	5,879
1892	3,088,911	208,220	42,621	5,422	3,345,174	3,620,582	1.08	225	6,436
1893	3,461,830	252,879	69,797	7,345	3,791,851	4,055,372	1.07	201	7,644
1894	3,085,664	248,398	67,545	22,314	3,423,921	3,295,034	.96	149	8,603
1895	3,488,876	392,423	104,695	9,898	3,995,892	3,642,623	.91	189	8,530
1896	3,471,470	311,911	113,442	8,956	3,905,779	3,261,737	.84	163	8,806
1897	3,639,758	393,012	111,376	7,023	4,151,169	3,472,348	.84	176	8,886
1898	4,398,078	387,790	130,810	4,065	4,920,743	3,994,918	.81	199	8,971
1899	5,465,609	376,574	160,621	3,719	6,006,523	5,285,018	.88	218	9,712
1900	5,947,462	372,948	161,071	2,605	6,484,086	6,687,137	1.03	199	11,720
1901	6,373,083	353,111	192,031	....	6,918,225	7,017,143	1.01	194	12,968
1902	8,649,144	536,899	259,681	700	9,446,424	10,399,660	1.10	205	15,457

As shown in the following table, the production increased in all but four counties in the State, and in these counties the decreases were insignificant. The most notable increases were those made by Parke and Greene counties, the former recording a gain of 524,425 tons, a little over 83 per cent, and the latter 719,164 tons, or nearly 76 per cent. Pike County increased nearly 90 per cent, though the amount of gain was only 240,749 tons. Sullivan County gained 358,220 tons, Vigo County 290,757 tons, Clay County 234,882 tons, and Warrick County 129,994 tons.

Coal production of Indiana, 1898-1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase 1902.	Decrease 1902.
Clay	928,607	1,253,948	1,165,302	1,080,164	1,315,046	234,882	....
Daviess	202,693	[a]266,029	[a]276,625	[a]238,699	234,983	....	3,716
Dubois	....	....	....	....	10,094	10,094	....
Fountain	139,200	55,750	44,232	34,826	17,099	....	17,727
Gibson	63,006	75,420	66,889	116,526	105,468	....	11,058
Greene	526,800	681,799	723,255	944,621	1,663,785	719,164	....
Knox	56,532	49,684	60,749	94,579	119,225	24,646	....
Owen	7,808	....	....	....	....	....	....
Parke	551,137	638,181	649,665	631,032	1,155,457	524,425	....
Perry	27,162	28,700	24,077	16,822	21,577	4,755	....
Pike	248,478	191,589	245,433	269,268	510,017	240,749	....
Spencer	6,633	13,946	9,106	18,885	16,274	....	2,611
Sullivan	637,849	752,734	939,989	910,725	1,268,945	358,220	....

[a] Includes Martin County.

Coal production of Indiana, 1898-1902, by counties—Continued.

County.	1898.	1899.	1900.	1901.	1902.	Increase 1902.	Decrease 1902.
Vanderburg	197,072	152,430	192,532	193,716	218,112	24,396	....
Vermilion	261,738	609,876	649,525	684,253	718,102	33,849	....
Vigo	884,109	1,029,699	1,151,643	1,362,041	1,652,798	290,757	....
Warren	....	....	....	....	3,380	3,380	....
Warrick	145,919	170,738	249,064	286,068	416,062	129,994	....
Small mines	36,000	36,000	36,000	36,000	(a)	....	36,000
Total	4,920,743	6,006,523	6,484,086	6,918,225	9,446,424	[b]2,528,199	....

[a] Small mines production included in county distribution. [b] Net increase.

The total production of the State since 1873 has been as follows:

Production of coal in Indiana, 1873-1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	1,000,000	1888	3,140,979
1874	812,000	1889	2,845,057
1875	800,000	1890	3,305,737
1876	950,000	1891	2,973,474
1877	1,000,000	1892	3,345,174
1878	1,000,000	1893	3,791,851
1879	1,196,490	1894	3,423,921
1880	1,500,000	1895	3,995,892
1881	1,771,536	1896	3,905,779
1882	1,976,470	1897	4,151,169
1883	2,560,000	1898	4,920,743
1884	2,260,000	1899	6,006,523
1885	2,375,000	1900	6,484,086
1886	3,000,000	1901	6,918,225
1887	3,217,711	1902	9,446,424

INDIAN TERRITORY.

Total production in 1902, 2,820,666 short tons; spot value, $4,265,106.

Compared with 1901 the coal production of Indian Territory in 1902 shows an increase of 398,885 short tons, or 16.5 per cent in quantity, and of $349,838, or 8.9 per cent in value. Production has increased steadily since 1897 and has more than doubled in the last four years. An interesting feature in connection with the production of coal in Indian Territory in 1902 is that the production per man for the year, and for each day, increased considerably over 1901, although the use of mining machines perceptibly decreased. In 1901, 6,706 men, working for an average of 208 days, produced 2,421,781 short tons, an average of 361 tons per man for the year and of 1.74 tons per man per day; in 1902, 5,574 men were employed for an average of 232 days in the production of 2,820,666 tons, an average of 506 tons per man for the year and of 2.18 tons per man per day.

The following table shows the production of coal in the Territory, the distribution of the product for consumption, and the statistics of labor employed for the last 12 years.

Distribution of the coal product of Indian Territory, 1891–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1891	1,026,932	9,405	22,163	32,532	1,091,032	$1,897,037	$1.74	222	2,891
1892	1,156,603	10,840	18,089	7,189	1,192,721	2,043,479	1.71	211	3,257
1893	1,197,468	9,234	21,663	23,745	1,252,110	2,235,209	1.79	171	3,446
1894	923,581	4,632	30,878	10,515	969,606	1,541,293	1.59	157	3,101
1895	1,173,399	3,070	21,935	12,781	1,211,185	1,737,254	1.43	164	3,212
1896	1,295,742	12,648	45,560	12,696	1,366,646	1,918,115	1.40	170	3,549
1897	1,250,066	9,068	47,501	29,745	1,336,380	1,787,358	1.34	176	3,168
1898	1,310,178	16,632	34,055	20,601	1,381,466	1,827,638	1.32	198	3,216
1899	1,444,063	12,280	54,222	26,862	1,537,427	2,199,785	1.43	212	4,084
1900	1,796,422	14,786	54,137	56,953	1,922,298	2,788,124	1.45	228	4,525
1901	2,249,100	31,370	83,183	58,128	2,421,781	3,915,268	1.62	208	6,706
1902	2,587,100	25,998	96,017	111,551	2,820,666	4,265,106	1.51	232	5,574

The first production of coal reported for Indian Territory was in 1885. Since that date the annual output has been as follows:

Production of coal in Indian Territory, 1885–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1885	500,000	1894	969,606
1886	534,580	1895	1,211,185
1887	685,911	1896	1,366,646
1888	761,986	1897	1,336,380
1889	752,832	1898	1,381,466
1890	869,229	1899	1,537,427
1891	1,091,032	1900	1,922,298
1892	1,192,721	1901	2,421,781
1893	1,252,110	1902	2,820,666

IOWA.

Total production in 1902, 5,904,766 short tons; spot value, $8,660,287.

The principal features connected with the production of coal in Iowa during 1902 were an increase of 287,267 short tons, or 5 per cent in the quantity of coal mined, a gain of 837,432, or 10.7 per cent in its value, a decrease in the number of employees, and an increase in the production per employee, both for the year and for each day the mines were operated. The production in 1902 was the largest in the history of the State, as was the amount for which it sold. The average price per ton was the highest recorded since 1886. The annual tonnage per man employed increased from 444 in 1901 to 475 in 1902, and the production per man per day increased from 2.04 to 2.09. The few strikes which occurred during the year were unimportant, involving only a total of 363 men for an average of 18 days. The use of machines was slightly less than in 1901, the machine-mined product being, respectively, 110,980 tons in 1901, and 110,489 tons in 1902. Reports were received from 46 new operators in 1902, whose aggregate output amounted to 219,776 short tons. About 25 of these did not exceed an output of 2,000 tons each.

The statistics of production, by counties, during the last two years, with distribution of the product for consumption, are shown in the following tables:

Coal production of Iowa in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Adams	4,000	14,035	56	18,091	$36,395	$2.01	166	84
Appanoose	698,291	17,904	5,802	721,997	1,121,265	1.55	167	2,533
Boone	235,020	17,607	1,427	254,054	423,827	1.67	212	809
Dallas	5,220	10,622	1,145	16,987	31,072	1.83	202	56
Davis	....	1,986	....	1,986	3,913	1.97	82	18
Greene	6,700	11,381	729	18,810	31,652	1.68	169	59
Jasper	173,029	8,821	2,820	184,670	270,369	1.46	236	382
Jefferson	1,500	2,375	....	3,875	7,568	1.95	126	17
Keokuk	268,032	18,755	21,406	308,193	425,876	1.38	231	585
Lucas	207,721	4,675	8,662	221,058	274,416	1.24	208	432
Mahaska	874,019	34,299	20,792	929,110	1,161,242	1.25	228	1,601
Marion	117,167	23,243	5,571	145,981	173,882	1.19	196	257
Monroe	1,003,339	14,448	20,545	1,038,332	1,292,503	1.24	265	2,319
Page and Story	....	6,740	....	6,740	16,850	2.50	285	17
Polk	732,412	250,353	42,249	1,025,014	1,492,060	1.46	221	2,165
Scott	1,320	15,631	146	17,097	27,378	1.60	161	82
Taylor	19,409	4,075	15	23,499	49,570	2.11	242	80
Van Buren	9,272	3,290	10	12,572	18,997	1.51	189	27
Wapello	282,250	24,974	4,950	312,174	407,136	1.30	234	609
Warren	3,120	11,541	....	14,661	27,847	1.90	133	63
Wayne	44,140	11,541	897	56,578	88,486	1.56	192	130
Webster	124,992	18,586	2,442	146,020	265,501	1.82	243	328
Small mines	....	140,000	....	140,000	175,000	....	....	....
Total	4,810,953	666,882	139,664	5,617,499	7,822,805	1.39	218	12,653

Coal production of Iowa in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Adams	....	19,707	44	19,751	$46,693	$2.36	127	203
Appanoose	848,553	35,187	16,597	900,337	1,530,002	1.70	202	2,428
Boone	229,062	20,790	4,472	254,324	486,624	1.91	221	702
Dallas	7,831	8,609	2,405	18,845	37,557	1.99	204	69
Davis	....	3,953	....	3,953	6,573	1.66	150	24
Greene	....	11,501	72	11,573	24,404	2.11	132	51
Jasper	181,630	45,805	6,005	233,440	331,283	1.42	223	377
Jefferson	6,000	4,410	200	10,610	19,651	1.85	210	34
Keokuk	91,976	10,779	3,348	106,103	143,169	1.35	212	257
Mahaska	649,032	59,470	15,065	723,567	1,031,554	1.43	205	1,598
Marion	275,287	31,753	8,385	315,425	347,207	1.10	223	565
Monroe	1,355,464	23,637	27,804	1,406,905	1,806,365	1.28	268	2,402
Page	....	10,022	48	10,070	25,277	2.51	222	45
Polk	763,345	231,975	28,540	1,023,860	1,541,406	1.51	236	1,833
Scott	....	10,176	182	10,358	19,858	1.92	148	41
Taylor	8,357	5,785	65	14,207	32,186	2.27	209	61
Van Buren	10,836	3,967	13	14,816	24,499	1.65	244	32
Wapello	257,937	77,409	5,416	340,762	460,331	1.35	252	690
Warren	10,227	9,900	....	20,127	38,888	1.93	178	83
Wayne	56,782	7,794	798	65,374	128,135	1.96	220	237
Webster	109,735	36,030	3,850	149,615	265,308	1.77	239	252
Guthrie, Lucas, and Story	227,484	10,081	13,179	250,744	313,317	1.25	252	450
Total	5,089,538	678,740	136,488	5,904,766	8,660,287	1.47	227	12,434

The distribution of the product during the last 14 years has been as follows:

Distribution of the coal product of Iowa, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	3,530,373	464,735	100,213	37	4,095,358	$5,426,509	$1.33	....	9,247
1890	3,560,738	397,503	63,498	....	4,021,739	4,995,739	1.24	213	8,130
1891	3,263,347	373,025	88,966	157	3,725,495	4,867,999	1.27	224	8,124
1892	3,459,025	401,855	57,611	....	3,918,491	5,175,060	1.32	236	8,170
1893	3,442,584	449,639	80,006	....	3,972,229	5,110,460	1.30	204	8,863
1894	3,390,751	511,683	64,819	....	3,967,253	4,997,939	1.26	170	9,995
1895	3,630,867	460,820	64,387	....	4,156,074	4,982,102	1.20	189	10,066
1896	3,367,819	494,443	91,766	....	3,954,028	4,628,022	1.17	178	9,672
1897	4,023,944	516,427	71,494	....	4,611,865	5,219,503	1.13	201	10,703
1898	3,981,361	572,063	65,417	....	4,618,842	5,260,716	1.14	219	10,262
1899	4,479,743	622,401	75,335	....	5,177,479	6,397,338	1.24	229	10,971
1900	4,389,344	696,472	117,123	....	5,202,939	7,155,341	1.38	228	11,608
1901	4,810,953	666,882	139,664	....	5,617,499	7,822,805	1.39	218	12,653
1902	5,089,538	678,740	136,488	....	5,904,766	8,660,287	1.47	227	12,434

The production by counties for the last five years, with the increases and decreases in 1902 as compared with 1901, is shown in the following table:

Coal production of Iowa, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Adams	....	....	....	....	19,751	19,751	....
Appanoose	608,165	636,421	680,094	721,997	900,337	178,340	....
Boone	331,543	290,525	266,542	254,054	254,324	270	....
Dallas	7,907	10,804	16,737	16,987	18,845	1,858	....
Davis	....	....	....	....	3,953	3,953	....
Greene	12,920	17,568	17,044	18,810	11,573	....	7,237
Jasper	143,935	191,928	99,948	184,670	233,440	48,770	....
Jefferson	....	....	....	....	10,610	10,610	....
Keokuk	251,145	314,900	258,933	308,193	106,103	....	202,090
Lucas	6,600	32,419	227,921	221,058	246,400	25,342	....
Mahaska	1,292,787	1,273,473	1,142,017	929,110	723,567	....	205,543
Marion	127,293	231,668	186,446	145,981	315,425	169,444	....
Monroe	584,578	689,004	755,286	1,038,332	1,406,905	368,573	....
Page	....	....	....	....	10,070	10,070	....
Polk	635,606	749,708	827,4[illegible]2	1,025,014	1,023,860	....	1,154
Scott	....	....	....	....	10,358	10,358	....
Taylor	6,555	10,965	17,159	23,499	14,207	....	9,292
Van Buren	6,600	9,385	12,108	12,572	14,816	2,244	....
Wapello	249,624	325,029	276,360	312,174	340,762	28,588	....
Warren	7,120	34,815	24,724	14,661	20,127	5,466	....
Wayne	51,550	62,818	65,140	56,578	65,374	8,796	....
Webster	137,548	124,841	123,660	146,020	149,615	3,595	....
Other counties and small mines	157,366	171,208	205,338	187,789	4,344	....	183,445
Total	4,618,842	5,177,479	5,202,939	5,617,499	5,904,766	[a] 287,267	....

[a] Net increase.

The census for 1860 reported the coal production of Iowa at 48,263 tons. The production since that date so far as records are obtainable has been as follows:

Production of coal in Iowa, 1860–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1860	48,263	1889	4,095,358
1865	69,574	1890	4,021,739
1866	99,320	1891	3,825,495
1868	241,453	1892	3,918,491
1870	283,467	1893	3,972,229
1875	1,231,547	1894	3,967,253
1880	1,461,166	1895	4,156,074
1882	3,920,000	1896	3,954,028
1883	4,457,540	1897	4,611,865
1884	4,370,566	1898	4,618,842
1885	4,012,575	1899	5,177,479
1886	4,315,779	1900	5,202,939
1887	4,473,828	1901	5,617,499
1888	4,952,440	1902	5,904,766

KANSAS.

Total production in 1902, 5,266,065 short tons; spot value, $6,862,787.

Kansas is included among the States whose coal production has shown an uninterrupted increase since the period of prosperity began in 1897. In 1892 the State's production reached for the first time a total of 3,000,000 tons, and it was not until eight years later in 1900 that the 4,000,000-ton mark was passed. The output in 1901 was within less than 100,000 tons of attaining a 5,000,000-ton record, which was reached and passed in 1902. Compared with 1901, the production in 1902 shows an increase of 365,537 short tons, or 7.5 per cent, in quantity, and of $871,188, or 14.5 per cent, in value. The use of mining machines in Kansas had little to do with the increase of production, as only 48,000 tons of the product in 1902 were reported as machine mined, as compared with 37,979 tons in 1901. The increase, in fact, appears to have been due to greater efficiency on the part of the mine workers, as there was a decrease both in the total number of men employed and in the average number of days worked. In 1901, 9,928 men produced 4,900,528 tons, an average of 493.6 tons per man, and as the average days worked was 224 the average tonnage per day per man was 2.2. In 1902, 9,461 men were employed in the production of 5,266,065 tons, an average of 556.6 tons per man. The average number of working days in 1902 was 220, showing an average output per man per day of 2.53 tons. There was little interruption to work on account of strikes in 1902, there being only 334 men idle for an average of 51.6 days. The details of production in the last 2 years are shown in the following tables:

Coal production of Kansas in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Cherokee	1,504,162	23,063	22,973	1,550,198	$1,772,252	$1.14	214	2,821
Cloud	....	7,870	....	7,870	19,575	2.49	123	43
Crawford	2,640,850	27,570	40,281	2,708,701	3,124,164	1.15	239	5,038
Franklin	2,182	9,278	....	11,460	21,838	1.90	219	56
Leavenworth	180,372	59,230	8,874	248,476	460,008	1.85	208	983
Linn	24,000	2,080	300	26,380	34,650	1.31	228	63
Osage	188,424	33,668	201	222,293	429,562	1.93	190	893
Atchison, Coffey, and Lyon	....	4,600	....	4,600	7,900	1.72	268	21
Ellsworth, Labette, and Lincoln	....	550	....	550	1,650	3.00	142	10
Small mines	....	120,000	....	120,000	120,000	......	......	......
Total	4,539,990	287,909	72,629	4,900,528	5,991,599	1.22	224	9,928

Coal production of Kansas in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Cherokee	1,792,092	26,094	29,944	1,766	1,849,896	$2,305,112	$1.25	221	2,861
Cloud	....	7,524	....	....	7,524	19,909	2.65	172	35
Crawford	2,765,898	67,895	47,481	....	2,881,274	3,489,528	1.21	221	4,671
Franklin	1,795	3,204	....	....	4,999	12,117	2.42	178	28
Leavenworth	195,023	80,372	16,286	....	291,681	555,969	1.91	245	941
Linn	24,000	5,480	300	....	29,780	41,770	1.40	154	87
Osage	161,982	30,573	226	....	192,781	416,746	2.16	199	781
Other counties[a]	446	6,684	1,000	....	8,130	21,636	2.66	91	57
Total	4,941,236	227,826	95,237	1,766	5,266,065	6,862,787	1.30	220	9,461

[a] Atchison, Bourbon, Coffey, Jewell, Labette, and Republic.

The distribution of the product for consumption, the total value, and the statistics of labor employed, for the last 14 years, have been as follows:

Distribution of the coal product of Kansas, 1899–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons,*	*Short tons.*	*Short tons.*				
1889	1,891,090	300,207	29,246	500	2,221,043	$3,296,888	$1.48	....	5,956
1890	2,028,100	224,839	6,983	....	2,259,922	2,947,517	1.30	210	4,523
1891	2,428,787	255,839	31,946	133	2,716,705	3,557,305	1.31	222	6,201
1892	2,756,812	206,038	44,325	101	3,007,276	3,955,595	1.32	208	6,559
1893	2,364,810	227,321	60,412	3	2,652,546	3,375,740	1.27	147	7,310
1894	3,066,398	275,565	45,523	765	3,388,251	4,178,998	1.23	164	7,339
1895	2,587,602	279,739	59,142	387	2,926,870	3,481,981	1.20	159	7,482
1896	2,562,779	256,906	63,901	1,215	2,884,801	3,295,032	1.15	168	7,127
1897	2,745,101	253,933	54,730	248	3,054,012	3,602,326	1.18	194	6,639
1898	3,079,601	277,022	49,932	....	3,406,555	3,703,014	1.09	194	7,197
1899	3,524,497	276,918	50,852	....	3,852,267	4,478,112	1.16	226	8,000
1900	4,128,892	286,080	52,898	....	4,467,870	5,454,691	1.22	232	8,459
1901	4,539,990	287,909	72,629	....	4,900,528	5,991,599	1.22	224	9,928
1902	4,941,236	227,826	95,237	1,766	5,266,065	6,862,787	1.30	220	9,461

The production, by counties, during the last five years, with the increases and decreases in 1902 as compared with 1901, is shown below:

Coal production of Kansas, 1898–1902.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Atchison	3,000	3,000	2,000	3,000	(a)	....	3,000
Cherokee	1,110,527	1,162,142	1,547,471	1,550,198	1,849,896	299,698	....
Cloud	....	....	....	....	7,524	7,524	....
Crawford	1,654,493	1,951,504	2,307,130	2,708,701	2,881,274	172,573	....
Franklin	6,433	14,050	4,420	11,460	4,999	....	6,461
Leavenworth	305,576	312,845	250,229	248,476	291,681	43,205	....
Linn	20,542	17,260	26,640	26,380	29,780	3,400	....
Osage	182,156	262,331	196,998	222,293	192,781	....	29,512
Other counties and small mines	123,828	129,135	132,982	130,020	8,130	....	121,890
Total	3,406,555	3,852,267	4,467,870	4,900,528	5,266,065	b 365,537	....

a Included in other counties. b Net increase.

The earliest production of coal in Kansas of which we have any record was made in 1880, since which date the output annually has been as exhibited in the following table:

Coal production of Kansas, 1880–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880	550,000	1892	3,007,276
1881	750,000	1893	2,652,546
1882	750,000	1894	3,388,351
1883	900,000	1895	2,926,870
1884	1,100,000	1896	2,884,801
1885	1,212,057	1897	3,054,012
1886	1,400,000	1898	3,406,555
1887	1,596,879	1899	3,852,267
1888	1,850,000	1900	4,467,870
1889	2,221,043	1901	4,900,528
1890	2,259,922	1902	5,206,065
1891	2,716,705		

KENTUCKY.

Total production in 1902, 6,766,984 short tons; spot value, $6,666,967.

Kentucky, like many other of the coal-producing States, reached its maximum output in 1902. Compared with 1901, the production in 1902 shows a gain of 1,296,798 short tons, the largest increase ever made in the history of the State. The average price per ton obtained in 1902, 99 cents, was the highest recorded in 14 years, and the total value exceeded that of the preceding year by $1,453,891. Much of the increased production in this State was due to the use of coal-cutting machinery, the total amount mined by machines in 1902 being 3,091,626 short tons, against 2,254,711 tons in 1901. The number of machines in use increased from 237 to 318.

The details of production during the last two years are snown in the following tables:

Coal production of Kentucky in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bell	257,765	5,420	3,850	66,200	333,235	$336,874	$1.01	205	1,113
Boyd	172,030	680	1,220	....	173,930	138,902	.80	282	381
Butler	14,960	3,842	....	....	18,802	16,851	.90	95	80
Carter	234,335	8,072	3,119	....	245,526	314,020	1.28	239	468
Henderson	139,849	27,133	2,383	....	169,365	156,314	.92	212	332
Hopkins	1,216,132	24,093	31,435	90,639	1,362,299	1,069,258	.78	254	1,818
Johnson and Morgan	36,782	710	200	....	37,692	57,897	1.54	201	232
Knox	277,003	2,260	4,443	....	283,706	282,520	1.00	226	487
Laurel	310,986	2,296	2,416	....	315,698	282,642	.90	198	781
Lawrence	36,449	2,615	7,860	....	46,924	48,861	1.04	236	95
McLean	17,226	340	150	....	17,716	13,993	.79	79	77
Muhlenberg	520,067	6,277	6,192	304	532,840	472,866	.89	176	957
Ohio	493,787	5,347	3,840	....	502,974	445,622	.89	197	801
Pulaski	128,348	7,710	2,729	....	138,787	168,764	1.22	222	326
Rockcastle	12,000	3,000	....	....	15,000	15,000	1.00	250	30
Union	251,283	14,045	7,875	4,134	277,337	251,629	.91	195	470
Webster	113,261	3,092	5,763	....	122,116	103,824	.85	220	234
Whitley	581,622	5,494	3,952	....	591,068	725,515	1.23	195	1,352
Breathitt and Lee	37,126	200	....	....	37,326	44,682	1.20	206	92
Christian, Daviess, and Hancock	96,705	420	520	....	97,645	79,542	.81	236	181
Small mines	....	150,000	....	....	150,000	187,500	....	....	....
Total	4,947,716	273,046	87,947	161,277	5,469,986	5,213,076	.95	213	10,307

Coal production of Kentucky in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bell	352,942	5,369	7,210	96,247	461,768	$478,801	$1.04	255	940
Boyd	241,127	844	50		242,021	193,494	.80	246	341
Breathitt	22,919	954			23,873	31,487	1.32	192	91
Butler	9,600	3,268			12,868	15,915	1.24	123	46
Carter	268,056	8,350	4,995		281,401	285,271	1.01	225	659
Clay		7,093			7,093	6,007	.85	73	70
Daviess	9,973	10,195	350		20,518	19,558	.95	178	76
Floyd		2,728			2,728	2,872	1.05	38	50
Hancock	10,297	6,640	900		17,837	17,252	.97	82	124
Harlan		1,628			1,628	1,701	1.04	41	22
Henderson	113,689	41,459	3,323		158,471	149,895	.95	223	292
Hopkins and Christian	1,499,872	38,249	44,539	59,777	1,642,437	1,340,020	.82	241	2,519
Johnson	67,000	4,537	600		72,137	85,296	1.19	177	259
Knott		2,790			2,790	2,706	.97	35	36
Knox	466,357	4,150	11,312		481,819	471,754	.98	241	758
Laurel	353,433	44,478	5,086		402,997	394,883	.98	228	906
Lawrence	37,527	12,539	7,321		57,387	55,069	.96	142	173
Lee	36,275	376			36,651	41,052	1.12	263	77
Leslie		4,699			4,699	6,617	1.41	146	29
Letcher		1,941			1,941	2,385	1.23	20	63
McLean	47,788	6,620	160		54,568	50,108	.94	141	148
Magoffin		6,663			6,663	8,021	1.20	76	71
Morgan	49,410	3,926	1,000		54,336	113,746	2.09	263	211
Muhlenberg	680,730	9,637	10,333		700,700	621,841	.89	212	1,085
Ohio	513,583	17,943	9,700		541,226	489,518	.90	167	1,121
Owsley		13,494			13,494	18,035	1.34	109	74
Pike		5,092			5,092	5,219	1.02	88	37
Pulaski	152,307	3,370	3,820		159,497	204,537	1.28	204	409
Union	279,241	23,909	9,958	2,678	315,786	338,794	1.07	219	557
Webster	257,835	13,137	7,070		278,042	238,786	.86	230	365
Whitley	668,096	15,325	4,410		687,831	952,608	1.38	192	1,842
Other counties [a]	3,829	11,155	675		15,659	22,507	1.44	119	275
Total	6,141,886	333,584	132,812	158,702	6,766,984	6,666,967	.99	209	13,727

[a] Crittenden, Edmonson, Elliott, Grayson, Greenup, Jackson, Madison, Martin, Menifee, Perry, Rockcastle, Trigg, Warren, Wayne, and Wolfe.

According to the reports made to the Geological Survey, the total number of working days lost in Kentucky in 1902 by reason of labor disaffections was 22,184, which, compared with a total of nearly 3,000,000 working days made by the 13,727 mine employees, was insignificant, and, as shown by the large increase in tonnage, had no appreciable effect on the production. The most protracted strike was in Johnston County, where 75 men were idle for ninety days. Bell County reported the largest number of men on strike, 500 altogether, who were idle, however, only 12 days. These two instances were responsible for more than half the total time lost. These figures, nevertheless, do not represent all the labor troubles in the State during the year. In 1901 an effort was made by the United Mine Workers to "unionize" the mine employees in Hopkins County, and particularly those employed by the St. Bernard Mining Company, of Earlington, which has been well known as a strictly nonunion organization. The struggle was continued well into 1902, but the efforts either to get the men of this company to strike or to associate themselves as members of the Union Mine Workers of the State were alike unsuccessful. The men employed by the St. Bernard Company continued to work, the mines suffered comparatively little, and the production for the county, of which this particular company contributes over 60 per cent, increased its output 192,785 short tons, or about 15 per cent, over 1901. The United Mine Workers of Kentucky, in spite of the struggle in Hopkins County, kept their contracts with the operators, which action met with general commendation, a report to the Coal Trade Journal stating that "their honorable conduct will make the annual adjustment of wage scales much easier in future. Kentucky miners have had more work, better pay, and better treatment this year and last than ever before, and they are too sensible to give up their understanding with the operators to join in a sympathetic strike."

The statistics for 1902, as presented in the accompanying tables, include the labor employed at all the small local banks from which reports were received. It has been customary to estimate the output of these small mines and disregard the labor employed. In connection with the Census work, however, a canvass of these small mines has been made, and the production is distributed among the several counties. This will in part account for the apparent fact that the labor efficiency in the State exhibited a decided falling off in 1902. In 1901 the tonnage per man for the year amounted to 530.7, but in 1902 it was only 493. The average production per man per day declined from 2.49 tons to 2.36 tons.

Part of this decrease in individual productiveness was also due to the large number of new mines opened in the State. Sixty-four new names were added to the list of producers in 1902, many of which, however, will not become important contributors. Probably not more than 20 should be considered as commercial propositions. The total production from these 64 new mines in 1902 was 339,232 short tons.

The distribution of Kentucky's coal product for consumption since 1889 has been as follows:

Distribution of the coal product of Kentucky, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2,111,010	246,306	23,981	18,458	2,399,755	$2,374,339	$0.98	....	....
1890	2,357,989	291,666	29,568	22,273	2,701,496	2,472,119	.92	219	5,259
1891	2,559,263	285,281	21,363	50,162	2,916,069	2,715,600	.93	225	6,355
1892	2,620,556	327,985	33,856	42,916	3,025,313	2,771,238	.92	217	6,724
1893	2,613,645	281,115	30,969	81,450	3,007,179	2,613,569	.86	202	6,581
1894	2,734,847	281,235	47,344	47,766	3,111,192	2,749,932	.88	145	8,083
1895	3,012,610	254,028	50,294	40,838	3,357,770	2,890,247	.86	153	7,799
1896	2,980,355	251,897	55,447	45,779	3,333,478	2,684,306	.78	165	7,549
1897	3,088,132	404,099	55,033	54,833	3,602,097	2,828,329	.79	178	7,983
1898	3,537,429	253,629	55,206	41,644	3,887,908	3,084,551	.79	187	7,614
1899	4,139,199	282,736	67,136	118,184	4,607,255	3,618,222	.79	224	7,461
1900	4,783,062	286,518	92,123	167,261	5,328,964	4,881,577	.92	227	9,680
1901	4,947,716	273,046	87,947	161,277	5,469,986	5,213,076	.95	213	10,307
1902	6,141,886	333,584	132,812	158,702	6,766,984	6,666,967	.99	209	13,727

As shown in the following table, there were only 3 counties in the State whose whose production in 1902 was less than that of 1901. The apparent decrease of 90,847 short tons in the last item of the table is due to the fact that the production of the small mines is included in the county distribution in 1902.

Coal production of Kentucky, 1898–1902, by counties.
[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Bell	85,544	152,934	224,500	333,235	461,768	128,533	....
Boyd	208,762	171,438	170,931	173,930	242,021	68,091	....
Breathitt and Lee	44,236	21,000	33,416	37,326	60,524	23,198	....
Butler	34,114	35,174	32,482	18,802	12,868	....	5,934
Carter	63,745	184,784	248,756	245,526	281,401	35,875	....
Christian, Daviess, and Hancock	93,087	12,484	114,253	97,645	125,708	28,063	....
Greenup	2,500	4,225	....	....	....	....	....
Henderson	86,395	136,628	135,775	169,365	158,471	....	10,894
Hopkins	974,959	1,204,683	1,371,826	1,362,299	1,555,084	192,785	....
Johnson	12,216	12,464	19,164	*a* 37,692	126,473	88,781	....
Knox	281,575	235,682	303,969	283,706	481,819	198,113	....
Laurel	288,478	349,719	351,786	315,698	402,997	87,299	....
Lawrence	59,600	49,418	46,316	46,924	57,387	10,463	....
McLean	21,725	29,795	20,454	17,716	54,568	36,852	....
Muhlenberg	317,392	414,332	399,944	532,840	700,700	167,860	....
Ohio	440,011	505,913	552,665	502,974	541,226	38,252	....
Pulaski	86,770	103,469	92,960	138,787	159,497	20,710	....
Rockcastle	....	....	8,000	15,000	3,660	....	11,340
Union	193,665	185,405	268,133	277,337	315,786	38,449	....
Webster	55,850	122,391	110,565	122,116	278,042	155,926	....
Whitley	387,284	525,317	673,069	591,068	687,831	96,763	....
Other counties and small mines	150,000	150,000	150,000	150,000	59,153	....	90,847
Total	2,887,908	4,607,255	5,328,964	5,469,986	6,766,984	*b* 1,296,998	....

a Includes Morgan County. *b* Net increase.

Kentucky is the only one of the United States whose coal product is drawn from any two of the great coal fields. The coal-producing counties in the eastern portion of the State are included in the Coal Measures of the Appalachian system, while those in the western portion belong to the Central coal field. The latter furnishes considerably more than half of the total output. The counties included in the two districts, and their production for the last 5 years, are shown in the following tables:

Coal production of the eastern district of Kentucky, 1898–1902.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Bell	85,544	152,934	224,500	333,235	461,768	128,533	....
Boyd	208,762	171,438	170,931	173,930	242,021	68,091	....
Breathitt	18,440	15,700	16,416	18,540	23,873	5,333	....
Carter	63,745	184,784	248,756	245,526	281,401	35,875	....
Greenup	2,500	4,225	....	....	....	....	....
Johnson	12,216	12,464	19,164	a 37,692	126,473	88,781	....
Knox	281,575	235,682	303,969	283,706	481,819	198,113	....
Laurel	288,478	349,719	351,786	315,698	402,997	87,299	....
Lawrence	59,600	49,418	46,316	46,924	57,387	10,463	....
Lee	25,796	5,300	17,000	18,786	36,651	17,865	....
Pulaski	86,770	103,469	92,960	138,787	159,497	20,710	....
Rockcastle	....	....	8,000	15,000	3,660	....	11,340
Whitley	387,284	525,317	673,069	591,068	687,831	96,763	....
Other counties and small mines	....	....	....	90,000	40,000	....	50,000
Total	1,520,710	1,810,450	2,172,867	2,308,892	3,005,378	b 696,486	....

a Includes Morgan County. b Net increase.

Coal production of the western district of Kentucky, 1898–1902.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Butler	34,114	35,174	32,482	18,802	12,868	....	5,934
Christian	66,496	....	93,931	73,220	87,353	14,133	....
Daviess	17,141	2,464	13,272	16,205	20,518	4,313	....
Hancock	9,450	10,020	7,050	8,220	17,837	9,617	....
Henderson	86,395	136,628	135,775	169,365	158,471	....	10,894
Hopkins	974,959	1,204,683	1,371,826	1,362,299	1,555,084	192,785	....
McLean	21,725	29,795	20,454	17,716	54,568	36,852	....
Muhlenberg	317,392	414,332	399,944	532,840	700,700	167,860	....
Ohio	440,011	505,913	552,665	502,974	541,226	38,252	....
Union	193,665	185,405	268,133	277,337	315,786	38,449	....
Webster	55,850	122,391	110,565	122,116	278,042	155,926	....
Other counties and small mines	....	....	....	60,000	19,153	....	40,847
Total	2,217,198	2,646,805	3,006,097	3,161,094	3,761,606	a 600,512	....

a Net increase.

The annual coal production in the State since 1873 has been as follows:

Annual coal production of Kentucky, 1873–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	300,000	1888	2,570,000
1874	360,000	1889	2,399,755
1875	500,000	1890	2,701,496
1876	650,000	1891	2,916,069
1877	850,000	1892	3,025,313
1878	900,000	1893	3,007,179
1879	1,000,000	1894	3,111,192
1880	1,000,000	1895	3,357,770
1881	1,100,000	1896	3,333,478
1882	1,300,000	1897	3,602,097
1883	1,650,000	1898	3,887,908
1884	1,550,000	1899	4,607,255
1885	1,600,000	1900	5,328,964
1886	1,550,000	1901	5,469,986
1887	1,933,185	1902	6,766,984

MARYLAND.

Total production in 1902, 5,271,609 short tons; spot value, $5,579,869.

Owing to the limited area of the Maryland coal fields and to the fact that all of the known productive territory has been taken up and developed, any great increase in the production from this State is hardly to be expected. During 1902 the mines were operated to their utmost capacity, so far as this was possible in connection with a limited car supply, in order to make up for the scarcity of fuel caused by the strike in the anthracite regions of Pennsylvania. The coal fields of Maryland and the contiguous territories in Pennsylvania and West Virginia are the nearest to tidewater of any of the eastern bituminous coal fields, and naturally these were the ones first and most strenuously called upon to supply the deficiency of anthracite. So far as Maryland was concerned the effect was shown more in the advance in price than by the increase in production. Notwithstanding the great demand, Maryland's production showed a gain of only 158,482 short tons, or 3 per cent, the value increasing $533,378, or 10.6 per cent.

The reports for 1902 show that there were 25 machines in use, which produced 252,753 tons of coal, against 15 machines and 177,724 tons of machine-mined coal in 1901.

The advantage possessed by Maryland in her "big vein" and easily mined coal is shown in the fact that the annual tonnage per employee was 958.8 in 1901 and 904.6 in 1902, the "intensity" of labor for the year being somewhat curtailed by lack of railroad cars. The average production per man per day increased from 3.66 tons in 1901 to 3.74 in 1902.

The statistics of production in Maryland during the last fourteen years are shown in the following table:

Distribution of the coal product of Maryland, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2,885,336	44,217	10,162	2,939,715	$2,517,474	$0.86	....	3,702
1890	3,296,393	52,621	8,799	3,357,813	2,899,572	.86	244	3,842
1891	3,771,584	36,959	11,696	3,820,239	3,082,515	.80	244	3,891
1892	3,385,384	30,955	3,623	3,419,962	3,063,580	.89	225	3,886
1893	3,676,137	26,833	13,071	3,716,041	3,267,317	.88	240	3,935
1894	3,435,600	51,750	14,078	3,501,428	2,687,270	.77	215	3,974
1895	3,840,991	59,950	14,644	3,915,585	3,160,592	.81	248	3,912
1896	4,068,558	53,046	22,332	4,143,936	3,299,928	.80	204	4,039
1897	4,391,703	27,762	22,663	4,442,128	3,363,996	.76	262	4,719
1898	4,618,990	36,941	18,953	4,674,884	3,532,257	.76	253	4,818
1899	4,716,581	68,750	22,065	4,807,396	3,667,056	.76	275	4,624
1900	3,949,539	51,565	23,584	4,024,688	3,927,381	.98	203	5,319
1901	5,043,991	41,282	27,854	5,113,127	5,046,491	.99	262	5,333
1902	5,187,175	48,631	35,803	5,271,609	5,579,869	1.06	242	5,827

Maryland and the adjoining counties in West Virginia, which make up what is known as the Cumberland region, are the only ones outside of the anthracite region of Pennsylvania where records of production have been kept from the earlier years. These have been commonly known as the Georges Creek or Cumberland and Piedmont regions. The Cumberland region was opened in 1842. The Piedmont region began shipping in 1853. The records of shipment have been carefully preserved and are published annually in the reports of the "Cumberland Coal Trade." The following table, which shows the shipments from this entire region, has been obtained from the published report of the "Cumberland Coal Trade."

Total shipments from the Cumberland coal field in

[Long tons.]

Year.	Frostburg region.						
	Cumberland and Pennsylvania R. R.				Cumberland Coal and Iron Company's R. R.		
	By Baltimore and Ohio R. R.	By Chesapeake and Ohio Canal.	By Pennsylvania R. R.	Total.	By Baltimore and Ohio R. R.	By Chesapeake and Ohio Canal.	Total.
1842	757	....	....	757	951	....	951
1843	3,661	....	....	3,661	6,421	....	6,421
1844	5,156	....	....	5,156	9,734	....	9,734
1845	13,738	....	....	13,738	10,915	....	10,915
1846	11,240	....	....	11,240	18,555	....	18,555
1847	20,615	....	....	20,615	32,325	....	32,325
1848	36,571	....	....	36,571	43,000	....	43,000
1849	63,676	....	....	63,676	78,773	....	78,773
1850	73,783	3,167	....	76,950	119,023	875	119,898
1851	70,893	51,438	....	122,331	103,808	31,540	135,348
1852	128,534	46,357	....	174,891	139,925	19,362	159,287
1853	150,381	84,060	....	234,441	155,278	70,535	225,813
1854	148,953	63,731	....	212,684	173,580	92,114	265,694
1855	93,691	77,095	....	170,786	97,710	100,691	198,401
1856	86,994	80,387	....	167,381	121,945	105,149	227,094
1857	80,743	55,174	....	135,917	88,573	54,000	142,573
1858	48,018	166,712	....	214,730	66,009	87,539	153,548
1859	48,415	211,639	....	260,054	72,423	86,203	158,626
1860	70,669	232,278	....	302,947	80,500	63,600	144,100
1861	23,878	68,303	....	92,181	25,983	29,296	55,279
1862	71,745	75,206	....	146,951	41,096	23,478	64,574
1863	117,796	173,269	....	291,065	111,087	43,523	154,610
1864	287,126	194,120	....	481,246	67,676	64,522	132,198
1865	384,297	285,295	....	669,592	104,651	57,907	162,558
1866	592,938	291,019	....	883,957	52,251	52,159	104,410
1867	623,031	385,249	....	1,008,280	40,106	72,904	113,010
1868	659,115	424,406	....	1,083,521	100,345	57,919	158,264
1869	1,016,777	573,243	....	1,590,020	130,017	78,908	208,925
					2,092,660	1,192,224	3,284,884
					Eckhart Branch R. R.		
1870	909,511	520,196	....	1,429,707	114,404	83,941	198,345
1871	1,247,279	656,085	....	1,903,364	69,864	194,254	264,118
1872	1,283,956	612,537	22,021	1,918,514	26,586	203,666	230,252
1873	1,509,570	641,220	114,589	2,265,379	89,765	137,582	227,347
1874	1,295,804	631,882	67,671	1,995,357	113,670	135,182	248,852
1875	1,095,880	715,673	160,213	1,971,766	52,505	164,165	216,670
1876	939,262	443,435	131,866	1,514,563	15,285	189,005	204,290
1877	755,278	473,946	170,884	1,399,808	63,181	111,350	174,531
1878	823,801	486,038	145,864	1,455,703	99,455	123,166	222,621
1879	933,240	397,009	154,264	1,484,513	141,907	104,238	246,145
1880	1,055,491	471,800	213,446	1,740,737	197,525	131,325	328,850
1881	1,113,263	270,156	153,501	1,536,920	271,570	151,526	423,096
1882	576,701	115,344	91,574	783,619	199,183	76,140	275,323
1883	851,985	302,678	217,065	1,371,728	197,235	141,390	338,625
1884	1,193,780	150,471	199,138	1,543,389	289,884	124,718	414,602
1885	1,091,904	171,460	206,227	1,469,591	289,407	117,829	407,236
1886	1,131,949	115,531	141,520	1,389,000	243,321	113,791	357,112
1887	1,584,114	132,177	176,241	1,892,532	332,798	125,305	458,103
1888	1,660,406	155,216	193,046	2,008,668	374,888	95,191	470,079
1889	1,430,381	26,886	177,152	1,634,419	368,497	26,407	394,904
1890	1,511,418	....	291,704	1,803,122	522,334	....	522,334
1891	1,628,574	9,070	289,232	1,926,876	463,142	39,294	502,436
1892	1,426,994	93,705	214,011	1,734,710	349,207	170,116	519,323
1893	1,332,634	135,409	360,807	1,828,850	341,321	201,947	543,268
1894	1,068,739	95,523	372,205	1,536,467	436,216	208,914	645,130
1895	1,193,834	101,076	255,133	1,550,043	464,407	212,534	676,941
1896	1,344,402	169,195	163,471	1,677,068	610,418	195,279	805,697
1897	1,790,813	96,536	169,679	2,057,028	586,592	166,691	753,283
1898	2,131,626	24,997	116,195	2,272,818	507,196	213,139	720,335
1899	2,334,109	27,570	161,191	2,522,870	473,608	164,853	638,461
1900	1,813,462	14,621	126,615	1,954,698	304,320	96,513	400,833
1901	2,683,109	193,063	373,195	3,249,367	(a)	(a)	(a)
1902	2,981,013	192,557	250,822	3,424,392	(a)	(a)	(a)
Total	50,655,743	12,184,910	5,880,532	68,721,185	8,609,691	4,219,351	12,829,042

[a] Merged in Cumberland and Pennsylvania figures.

[b] Includes 205,460 tons used on line of Cumberland and Pennsylvania Railroad and its branches, and at Cumberland and Piedmont; also 392,771 tons used by the Baltimore and Ohio Railroad Company in locomotives, rolling mills, etc.

Maryland and West Virginia from 1842 to 1902, inclusive.

[Long tons.]

Frostburg region. Georges Creek and Cumberland R. R. By Chesapeake and Ohio Canal.	By Pennsylvania R. R.	Local, and Baltimore and Ohio R. R.	Total.	Piedmont region. Georges Creek R. R.	Hampshire R. R. by Baltimore and Ohio R. R.	Total. Baltimore and Ohio R. R., and local.	Chesapeake and Ohio Canal.	Pennsylvania R. R.	Aggregate.
......	......	......	......	......	......	1,708	......	......	1,708
......	......	......	......	......	......	10,082	......	......	10,082
......	......	......	......	......	......	14,890	......	......	14,890
......	......	......	......	......	......	24,653	......	......	24,653
......	......	......	......	......	......	29,795	......	......	29,795
......	......	......	......	......	......	52,940	......	......	52,940
......	......	......	......	......	......	79,571	......	......	79,571
......	......	......	......	......	......	142,449	......	......	142,449
......	......	......	......	......	......	192,806	4,042	......	196,848
......	......	......	......	......	......	174,701	82,978	......	257,679
......	......	......	......	......	......	268,459	65,719	......	334,178
......	......	......	......	73,725	......	376,219	157,760	......	533,979
......	......	......	......	181,303	......	503,836	155,845	......	659,681
......	......	......	......	227,245	65,570	478,486	183,786	......	662,272
......	......	......	......	269,210	42,765	502,330	204,120	......	706,450
......	......	......	......	252,368	51,628	465,912	116,574	......	582,486
......	......	......	......	218,318	63,060	395,405	254,251	......	649,656
......	......	......	......	257,740	47,934	426,512	297,842	......	724,354
......	......	......	......	289,298	52,564	493,031	295,878	......	788,909
......	......	......	......	85,554	36,660	172,075	97,599	......	269,674
......	......	......	......	69,482	36,627	218,950	98,684	......	317,634
......	......	......	......	266,430	36,240	531,553	216,792	......	748,345
......	......	......	......	......	44,552	399,354	258,642	......	657,996
......	......	......	......	......	71,345	560,293	343,202	......	903,495
......	......	......	......	......	90,964	736,153	343,178	......	1,079,331
......	......	......	......	......	72,532	735,669	458,153	......	1,193,822
......	......	......	......	......	88,658	848,118	482,325	......	1,330,443
......	......	......	......	......	83,724	1,230,518	652,151	......	1,882,669
				2,190,673					
				Empire and West Virginia mines.					
......	......	......	......	28,035	60,988	1,112,938	604,137	......	1,717,075
......	......	......	......	81,218	96,453	1,494,814	850,339	......	2,345,153
......	......	......	......	85,441	121,364	1,517,347	816,103	22,021	2,355,471
......	......	......	......	77,582	103,793	1,780,710	778,802	114,589	2,674,101
......	......	......	......	57,492	109,194	1,576,160	767,064	67,671	2,410,895
......	......	......	......	63,537	90,800	1,302,237	879,838	160,698	2,342,773
......	......	......	......	108,723	7,505	1,070,775	632,440	131,866	1,835,081
......	......	......	......	......	......	818,450	584,996	170,884	1,574,330
......	......	......	......	......	998	924,254	609,204	145,864	1,679,322
......	......	......	......	......	51	1,075,198	501,247	154,264	1,730,709
......	......	......	......	66,573	......	1,319,589	603,125	213,446	2,136,160
83,136	125,097	4,947	213,180	88,722	......	1,478,502	504,818	278,598	2,261,918
78,298	93,861	31,436	203,595	277,929	......	1,085,249	269,782	185,435	1,540,466
215,767	202,223	77,829	495,819	338,001	......	1,444,766	680,119	419,288	2,544,173
69,765	156,959	283,336	510,060	466,928	......	2,233,928	341,954	356,097	2,934,979
79,455	214,518	291,685	585,658	403,489	......	2,076,485	368,744	420,745	2,865,974
53,480	98,371	348,196	500,047	346,308	......	2,069,774	282,802	239,891	2,592,467
4,863	153,230	418,057	576,150	449,011	......	2,724,347	262,345	389,104	3,375,796
112	286,787	341,024	627,923	564,397	......	2,669,216	286,700	715,151	3,671,067
......	365,029	243,487	608,516	576,047	......	2,357,585	57,459	798,842	3,213,886
......	677,593	228,138	905,731	774,904	......	2,723,341	......	1,282,748	4,006,089
......	763,845	229,266	993,111	959,673	......	2,855,225	51,121	1,474,087	4,380,433
......	568,003	236,314	804,317	971,214	......	2,557,177	266,901	1,205,486	4,029,564
......	741,954	201,938	943,892	1,031,797	......	2,423,159	338,107	1,586,541	4,347,807
......	773,074	111,036	884,110	900,399	......	2,084,265	304,437	1,577,404	3,966,106
125	1,031,015	110,258	1,141,398	1,157,803	......	2,418,554	314,551	1,793,080	4,526,185
......	995,443	75,400	1,070,843	1,307,822	......	2,807,161	364,474	1,689,795	4,861,430
......	918,712	111,135	1,029,847	1,463,331	......	3,615,142	263,227	1,426,120	5,304,489
......	913,775	100,312	1,014,087	1,526,396	......	3,900,403	238,136	1,395,097	5,533,636
......	1,068,771	92,895	1,161,666	1,808,464	......	4,269,323	192,423	1,669,715	6,131,461
......	703,837	116,974	820,811	1,995,574	......	3,750,257	111,134	1,310,525	5,171,916
......	857,003	215,901	1,072,904	1,817,058	......	4,350,011	193,105	1,596,213	6,139,329
......	701,346	225,216	926,562	1,937,913	......	4,801,484	192,557	1,294,826	6,288,867
585,001	12,410,446	4,094,780	17,090,227	21,731,781	1,475,969	84,754,968	18,284,712	24,286,091	127,325,771

MICHIGAN.

Total production in 1902, 964,718 short tons; spot value, $1,653,192.

Michigan enjoyed the distinction, if such it can be called, of being one of the seven States whose production in 1902 was less than that of 1901. The conditions which brought this about in Michigan were the same which restricted the production in the New and Kanawha River districts of West Virginia, a prolonged strike having for its ultimate result the recognition of the mine-workers' union. The strike which affected many of the larger operations in the State was started on April 1 and continued until September 1. As a result the total time lost in Michigan exceeded that of any other bituminous coal producing State except West Virginia and Pennsylvania. On account of the great magnitude of the industry in the latter State the effect upon the production of bituminous coal was inappreciable, and West Virginia increased her production in spite of the time lost by strikes. In Michigan, however, the result was a decrease in production of 276,523 short tons, or more than 22 per cent. More than 80 per cent of the mine workers (1,935 out of 2,344) were on strike for an average of 123.6 days, involving a total loss in working time of 239,146 days. As the average production per man per day for the time worked during the year was 2.4 tons, this meant a loss in output of 573,950 tons, or, in other words, except for this loss of time, the production of the State would have reached a total of about 1,500,000 tons. The operators, however, were not without some compensation for the loss in production. The scarcity of coal due to the anthracite strike and the consequent abnormal demand caused a sharp advance in values and the average price for Michigan's product rose from $1.41 per ton in 1901 to $1.71 in 1902, the total value being within $100,000 of that obtained for the output in 1901.

The number of machines in use in the mines of Michigan increased from 31 to 58, and notwithstanding the loss in total production, the machine-mined product increased from 177,969 short tons in 1901 to 196,248 tons in 1902.

The production for each employee decreased from 545.4 tons in 1901 to 411.6 tons in 1902, though the tonnage per day per man increased from 2.21 to 2.40.

The statistics of production, by counties, in 1901 and 1902 are shown in the following tables:

Coal production of Michigan in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Bay	225,765	16,805	11,251	253,821	$388,474	$1.53	232	549
Eaton		4,753	50	4,803	9,071	1.89	255	23
Genesee and Huron	3,894	1,668	2,288	7,850	14,171	1.81	241	40
Jackson	1,853	17,187	1,248	20,288	38,576	1.90	270	52
Saginaw	910,147	4,336	23,559	938,042	1,275,331	1.36	252	1,570
Shiawassee	16,437			16,437	27,441	1.67	210	42
Total	1,158,096	44,749	38,396	1,241,241	1,753,064	1.41	247	2,276

Coal production of Michigan in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Bay	209,133	29,596	9,916	248,645	$410,615	$1.65	149	660
Eaton		7,981	99	8,080	18,890	2.34	231	41
Saginaw	604,904	50,100	15,300	670,304	1,141,409	1.70	176	1,489
Huron, Jackson, and Shiawassee	4,650	30,301	2,738	37,689	82,278	2.18	208	154
Total	818,687	117,978	28,053	964,718	1,653,192	1.71	171	2,344

The following tables show the distribution of the coal product of Michigan since 1892 and the total output of the State from the begining of the coal-mining industry:

Distribution of the coal product of Michigan, 1892–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1892	27,200	45,180	5,610	77,990	$121,314	$1.56	230	195
1893	27,787	16,367	1,825	45,979	82,462	1.79	154	162
1894	60,817	7,055	2,150	70,022	103,049	1.47	224	223
1895	80,403	27,019	4,900	112,322	180,016	1.60	186	320
1896	83,150	6,547	3,185	92,882	150,631	1.62	157	320
1897	188,636	24,686	10,270	223,592	325,416	1.46	230	537
1898	232,155	75,622	7,945	315,722	462,711	1.47	245	715
1899	574,280	34,191	16,237	624,708	870,152	1.39	232	1,291
1900	792,679	40,258	16,538	849,475	1,259,683	1.48	261	1,709
1901	1,158,096	44,749	38,396	1,241,241	1,753,064	1.41	247	2,276
1902	818,687	117,978	28,053	964,718	1,653,192	1.71	171	2,344

Coal production of Michigan, 1877–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
Previous to 1877	350,000	1890	74,977
1877	69,197	1891	80,307
1878	85,322	1892	77,990
1879	82,015	1893	45,979
1880	129,053	1894	70,022
1881	130,130	1895	112,322
1882	135,339	1896	92,882
1883	71,296	1897	223,592
1884	36,712	1898	315,722
1885	45,178	1899	624,708
1886	60,434	1900	849,475
1887	71,461	1901	1,241,241
1888	81,407	1902	964,718
1889	67,431		

MISSOURI.

Total production in 1902, 3,890,154 short tons; spot value, $5,374,642.

Compared with the production in 1901, the output of coal in Missouri in 1902 shows an increase of 88,066 short tons, or 2.3 per cent in quantity, and of $667,478, or 14.2 per cent in value.

The disadvantages under which the coal-mining industry of Missouri exists in being surrounded by other coal-producing States whose product can be more cheaply mined, and in having her larger cities contiguous to such other fields, have been referred to in the preceding reports of this series. The coal mined in this State must depend upon markets comparatively local, and any increased production may be considered as indicating a growth in local population and industry. Illinois on the east, Iowa on the north, Kansas on the west, and Arkansas and Indian Territory on the south and southwest, are all more blessed by nature for producing cheap coal than is Missouri. This is shown by the fact that both in 1901 and 1902 the average productive capacity per man per day in the coal mines of Missouri was much less than in any of the other States except Indian Territory in 1901 and Iowa in 1902. Missouri's tonnage per man per day was 1.73 in 1901 and 1.98 in 1902. As compared with these rates the other States show the following averages: Illinois, 2.97 in 1901 and 3.08 in 1902; Iowa, 2.04 in 1901 and 2.09 in 1902; Kansas, 2.20 in 1901 and 2.53 in 1902; Arkansas, 2.59 in 1901 and 2.88 in 1902; Indian Territory, 1.74 in 1901 and 2.18 in 1902. To these circumstances may readily be ascribed the comparatively stationary condition of Missouri's coal production, although it has shown an increasing tendency during the last six years.

The statistics of production in 1901 and 1902 are shown in the following tables:

Coal production of Missouri in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Adair	327,615	28,749	1,647	358,011	$433,654	$1.21	175	769
Audrain	26,387	9,202	327	35,916	51,414	1.43	222	91
Barton	140,858	1,302	2,194	144,354	178,358	1.24	275	307
Bates	261,803	13,462	5,755	281,020	289,850	1.03	208	512
Boone	6,000	16,209	420	22,629	34,170	1.51	253	55
Caldwell	13,000	5,430	2,000	20,430	34,235	1.68	278	105
Callaway	1,920	25,592	496	28,008	43,808	1.56	223	75
Henry	67,109	15,442	35	82,586	128,609	1.56	229	214
Johnson	....	11,255	....	11,255	16,648	1.48	183	46
Lafayette	408,559	22,394	7,969	438,922	711,532	1.62	184	1,638
Linn	68,150	16,438	668	85,256	137,284	1.61	234	255
Macon	1,018,360	7,858	14,758	1,040,976	1,053,056	1.01	218	2,523
Putnam	129,699	2,524	1,174	133,397	182,991	1.37	231	423
Ralls	22,838	700	150	23,688	28,834	1.22	218	60
Randolph	386,696	9,270	7,437	403,403	461,983	1.15	227	905
Ray	254,464	7,571	5,397	267,432	394,070	1.47	177	1,129
Vernon	231,825	1,220	5,025	238,070	244,610	1.02	207	483
Chariton, Grundy, and Livingston	34,962	6,822	1,477	43,261	86,547	2.00	228	168
Howard and Jackson	8,375	10,425	1,200	20,000	50,000	2.50	260	100
Montgomery and Morgan	2,503	867	104	3,474	5,511	1.59	138	13
Small mines	....	120,000	....	120,000	140,000	......	....	....
Total	3,411,123	332,732	58,233	3,802,088	4,707,164	1.24	223	9,871

Coal production of Missouri in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Adair	312,171	14,896	4,092	331,159	$437,631	$1.32	190	796
Audrain	14,211	11,068	929	26,208	43,253	1.65	169	111
Barton	186,215	10,638	3,493	200,346	240,374	1.20	197	436
Bates	319,361	28,376	6,970	354,707	397,928	1.12	198	741
Boone	11,190	15,636	180	27,006	37,169	1.38	140	122
Callaway	900	25,406	116	26,422	45,466	1.72	195	93
Carroll	....	2,376	....	2,376	5,065	2.13	114	23
Chariton	....	2,116	....	2,116	4,204	1.99	106	14
Henry	64,853	32,798	1,180	98,831	161,493	1.63	184	345
Howard	....	2,683	....	2,683	5,195	1.94	193	17
Johnson	....	5,530	10	5,540	10,465	1.89	172	37
Lafayette	488,392	44,444	10,965	543,801	929,862	1.71	210	1,646
Linn	63,794	16,653	661	81,108	130,966	1.61	197	308

Coal production of Missouri in 1902, by counties—Continued.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Macon	1,039,687	9,212	15,827	1,064,726	1,328,796	1.25	219	1,968
Monroe	....	2,101	....	2,101	3,839	1.83	156	12
Montgomery	1,226	2,558	317	4,101	9,052	2.21	165	21
Putnam	121,424	3,648	2,911	127,983	197,869	1.55	212	387
Ralls	18,252	1,100	20	19,372	27,088	1.40	100	55
Randolph	399,680	19,008	5,479	424,167	524,636	1.24	215	987
Ray	204,859	26,164	4,043	235,066	383,492	1.63	198	740
St. Clair	670	3,160	30	3,860	6,390	1.66	146	29
Schuyler	1,428	2,772	40	4,240	6,435	1.52	67	44
Vernon	204,412	8,433	5,494	218,339	266,369	1.22	155	452
Other counties[a]	51,268	28,216	4,412	83,896	171,605	2.05	244	358
Total	3,503,993	318,992	67,169	3,890,154	5,374,642	1.38	202	9,742

[a] Caldwell, Cedar, Cooper, Dade, Grundy, Jackson, Livingston, Morgan, Pettis, and Saline.

The distribution of the product for consumption during the last fourteen years has been as follows:

Distribution of the coal product of Missouri, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2,246,845	275,999	34,979	2,557,823	$3,479,057	$1.36	....	....
1890	2,449,305	240,237	45,679	2,735,221	3,382,858	1.24	229	5,971
1891	2,350,707	265,595	58,304	2,674,606	3,283,242	1.23	218	6,199
1892	2,399,605	293,414	40,930	2,733,949	3,369,659	1.23	230	5,893
1893	2,525,227	322,754	49,461	2,897,442	3,562,757	1.23	206	7,375
1894	1,955,255	242,501	47,283	2,245,039	2,634,564	1.17	138	7,523
1895	2,104,452	231,090	36,851	2,372,393	2,651,612	1.12	163	6,299
1896	2,047,251	243,029	41,262	2,331,542	2,518,194	1.08	168	5,082
1897	2,384,797	239,686	41,143	2,665,626	2,887,884	1.08	168	6,414
1898	2,393,315	249,662	45,344	2,688,321	2,871,296	1.07	198	6,542
1899	2,691,433	289,826	44,555	3,025,814	3,591,945	1.20	212	7,136
1900	3,187,194	293,229	59,680	3,540,103	4,280,328	1.21	214	8,180
1901	3,411,123	332,732	58,233	3,802,088	4,707,164	1.24	223	9,871
1902	3,503,993	318,992	67,169	3,890,154	5,374,642	1.38	202	9,742

The following table shows that in about one-half of the coal-producing counties the production in 1902 was less than in 1901. The increases, however, were greater in quantity, making a net gain of 88,066 short tons.

Coal production in Missouri, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease 1902.
Adair	74,796	175,452	244,314	358,011	331,159		26,852
Audrain	30,976	45,907	44,074	35,916	26,208		9,708
Barton	70,551	111,468	166,592	144,354	200,346	55,992	
Bates	318,973	456,797	270,712	281,020	354,707	73,687	
Boone	13,779	20,280	18,619	22,629	27,006	4,377	
Caldwell	25,000	48,100	34,100	20,430	16,000		4,430
Callaway	21,215	23,210	16,435	28,008	26,422		1,586
Cole	2,000	2,500					
Grundy	39,532	42,071	39,239	42,361	34,936		7,425
Henry	39,082	95,071	81,010	82,586	98,831	16,245	
Jackson	40,000	32,000	16,700	20,000	21,000	1,000	
Johnson	3,700	1,500	4,939	11,255	5,540		5,715
Lafayette	301,066	369,253	457,858	438,922	543,801	104,879	
Linn	68,643	84,928	71,311	85,256	81,108		4,148
Livingston	4,500	1,150	1,200	900	2,138	1,238	
Macon	742,413	539,543	836,248	1,040,976	1,064,726	23,750	
Montgomery and Morgan	1,200	1,855	2,146	3,474	[a] 4,101	627	
Putnam	117,059	134,655	111,626	133,397	127,983		5,414
Ralls	7,980	22,640	20,145	23,688	19,372		4,316
Randolph	253,558	304,962	442,456	403,403	424,167	20,764	
Ray	210,961	206,622	216,617	267,432	235,066		32,366
Vernon	181,337	185,214	322,827	238,070	218,339		19,731
Other counties and small mines	120,000	120,636	120,935	120,000	27,198		92,802
Total	2,688,321	3,025,814	3,540,103	3,802,088	3,890,154	[b] 88,066	

[a] Montgomery County only. [b] Net increase.

The following table, in which is exhibited the total production of the State since 1873, shows that while the output has increased annually since 1896—that is to say, during the 6 years of industrial prosperity throughout the United States—the output in 1902 did not quite attain the record made in 1888, which continues to be the banner year of coal production in the State.

Coal production of Missouri, 1873–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	784,000	1888	3,909,967
1874	789,680	1889	2,557,823
1875	840,000	1890	2,735,221
1876	1,008,000	1891	2,674,606
1877	1,008,000	1892	2,773,949
1878	1,008,000	1893	2,897,442
1879	1,008,000	1894	2,245,039
1880	1,680,000	1895	2,372,393
1881	1,960,000	1896	2,331,542
1882	2,240,000	1897	2,665,626
1883	2,520,000	1898	2,688,321
1884	2,800,000	1899	3,025,814
1885	3,080,000	1900	3,540,103
1886	1,800,000	1901	3,802,088
1887	3,209,916	1902	3,890,154

MONTANA.

Total production in 1902, 1,560,823 short tons; spot value, $2,443,447.

Compared with 1901, the production of coal in Montana for 1902 shows an increase of 164,742 short tons, or 11.8 per cent in quantity, and of $434,131, or 21.6 per cent in value. The output, however, did not reach the records made in either 1897 or 1900, the latter being the banner year of coal production in Montana, with a total of 1,661,775 short tons. The smaller production in 1901 and 1902 has been due to the exhaustion of the Sand Coulee mines in Cascade County. These mines when in full operation had a daily capacity of about 2,000 tons, and their exhaustion has naturally affected the total production of the State.

The use of machines in the mines of this State shows a decrease both in 1901 and 1902, the number in use declining from 81 in 1900 to 70 in 1901, and to 65 in 1902, the machine-mined product likewise decreasing from 1,045,115 tons in 1900 to 748,981 in 1901, and further to 691,669 in 1902. In spite of this decrease in machine mining, however, the average production for each employee increased in 1902 as compared with 1901. As shown in the following tables, 2,158 men worked an average of 231 days in 1901 and produced 1,396,081 tons of coal, an average tonnage per man of 647 for the year and of 2.8 for each day. In 1902, 1,938 men were employed for 270 days in the production of 1,560,823 tons, an average for each man of 805 tons for the year and of 2.98 tons per day.

The statistics of production by counties for the last 2 years are shown in the following tables:

Coal production of Montana in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	468,124	18,632	11,804	....	498,560	$617,639	$1.24	217	842
Cascade	709,558	14,266	27,770	37,813	789,407	1,191,783	1.51	243	1,065
Choteau	1,120	3,900	30	....	5,050	13,210	2.62	158	23
Park	7,800	3,844	1,200	65,137	77,981	144,254	1.85	224	161
Fergus, Gallatin, Granite, and Lewis and Clarke	24,063	200	820	....	25,083	42,430	1.69	258	67
Total	1,210,665	40,842	41,624	102,950	1,396,081	2,009,316	1.44	231	2,158

Coal production of Montana in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	576,472	9,270	19,212	....	604,954	$791,222	$1.31	297	573
Cascade	697,883	14,050	14,398	35,241	761,572	1,274,169	1.67	248	923
Choteau	260	10,512	....	....	10,772	27,064	2.51	136	27
Fergus	600	4,600	....	....	5,200	16,900	3.25	127	26
Park	23,660	1,470	3,770	60,740	89,640	189,080	2.11	267	221
Other counties [a]	86,225	817	1,643	....	88,685	145,012	1.64	341	168
Total	1,385,100	40,719	39,023	95,981	1,560,823	2,443,447	1.57	270	1,938

[a] Deerlodge, Gallatin, Granite, Meagher.

The distribution of the product for consumption and the statistics of labor employed since 1889 have been as follows:

Distribution of the coal product of Montana, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	314,372	12,917	5,436	30,576	363,301	$880,773	$2.42	....	....
1890	466,016	23,427	4,034	24,000	517,477	1,252,492	2.42	....	1,251
1891	501,503	5,395	6,438	28,525	541,861	1,228,630	2.27	....	1,119
1892	521,521	4,866	1,849	36,412	564,648	1,330,847	2.36	258	1,158
1893	789,516	27,063	17,960	57,770	892,309	1,772,116	1.99	242	1,401
1894	861,171	12,900	17,324	36,000	927,395	1,887,390	2.04	192	1,782
1895	1,404,862	19,168	20,463	59,700	1,504,103	2,850,906	1.89	223	2,184
1896	1,314,873	27,476	17,676	183,420	1,543,445	2,279,672	1.47	234	2,335
1897	1,434,858	29,707	18,410	164,907	1,647,882	2,897,408	1.76	252	2,337
1898	1,261,814	29,493	19,386	169,110	1,479,803	2,324,207	1.57	216	2,359
1899	1,294,614	29,686	34,249	137,902	1,496,451	2,347,757	1.57	238	2,378
1900	1,445,456	26,814	55,854	133,651	1,661,775	2,713,707	1.63	252	2,376
1901	1,210,665	40,842	41,624	102,950	1,396,081	2,009,316	1.44	231	2,158
1902	1,385,100	40,719	39,023	95,981	1,560,823	2,443,447	1.57	270	1,938

The production, by counties, for the last 5 years and the increases and decreases in 1902, as compared with 1901, are presented in the following table:

Production of coal in Montana, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Carbon	272,396	337,525	393,877	498,560	604,954	106,394	....
Cascade	988,821	965,378	1,123,395	789,407	761,572	....	27,835
Choteau	6,537	6,885	5,757	5,050	10,772	5,722	....
Fergus	950	900	900	500	5,200	4,700	....
Gallatin	63,626	56,671	51,671	24,583	88,000	63,417	....
Lewis and Clarke	319	....	....	....	....	....	....
Park	147,154	128,850	86,025	77,981	89,640	11,659	....
Other counties	....	242	150	....	685	685	....
Total	1,479,803	1,496,451	1,661,775	1,396,081	1,560,823	[a] 164,742	....

[a] Net increase.

The earliest production of coal in Montana, so far as we have any record, was made in 1883, when a total output of less than 20,000 tons was reported. The growth of the industry since that date is exhibited in the following table:

Coal production of Montana, 1883–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1883	19,795	1893	892,309
1884	80,376	1894	927,395
1885	86,440	1895	1,504,193
1886	49,846	1896	1,543,445
1887	10,202	1897	1,647,882
1888	41,467	1898	1,479,803
1889	363,301	1899	1,496,451
1890	517,477	1900	1,661,775
1891	541,861	1901	1,396,081
1892	564,648	1902	1,560,823

NEW MEXICO.

Total production in 1902, 1,048,763 short tons; spot value, $1,500,230.

Contrary to the general rule, the coal production of New Mexico has shown a decrease in both 1901 and 1902, and unlike the other exceptions in 1902, no particular reason seems to have existed in this case. In California, Oregon, and Texas the decreased production is tatributable to the cheapness and increased consumption of oil for fuel; in Michigan the production was curtailed by a long and profitless strike. No such conditions are reported for New Mexico nor for Wyoming, and the only apparent reason for the decrease seems to have been simply a falling off in demand for coal in the Territory and State. There were some labor troubles in New Mexico, but as they entailed a total loss of only 9,820 working days, or only a little more than 2 per cent of the total working time, they were not of sufficient duration seriously to curtail production.

As shown in the following tables, the number of men employed and the average time made in 1902 were both considerably less than in 1901. The effect of this was to cause an increase in the average production per man from 438 tons in 1901 to 567 tons in 1902. The tonnage per man per day increased from 1.96 to 2.61.

The statistics of production, by counties, in the last 2 years are shown in the following table:

Coal production of New Mexico in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bernalillo-McKinley	499,328	2,072	15,133	....	516,533	$696,085	$1.35	240	1,170
Colfax	222,861	5,861	6,279	14,295	249,296	262,225	1.05	163	800
Lincoln	148,018	5,700	2,903	....	156,621	310,742	1.98	288	188
Rio Arriba	37,417	825	700	....	38,942	51,150	1.39	237	49
San Juan, Sante Fe, Socorro	115,386	1,166	8,602	....	125,154	223,450	1.79	289	271
Total	1,023,010	15,624	33,617	14,295	1,086,546	1,546,652	1.42	224	2,478

Coal production of New Mexico in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Colfax	304,221	10,902	8,731	22,519	346,373	$392,244	$1.13	254	665
McKinley	418,981	3,515	9,612	....	432,108	593,361	1.37	152	747
Rio Arriba	47,000	....	600	....	47,600	69,000	1.45	244	52
San Juan	100	1,600	....	....	1,700	2,175	1.28	119	8
Santa Fe	81,636	422	8,837	....	90,895	179,944	1.98	281	152
Other counties [a]	121,562	3,075	5,400	50	130 087	263,506	2.03	278	225
Total	973,500	19,514	33,180	22,569	1,048,763	1,500,230	1.43	217	1,849

[a] Lincoln, San Miguel, and Socorro.

The following table illustrates how the product of the Territory has been distributed for consumption during the last fourteen years, its total value, with the number of men employed and the average number of days worked:

Distribution of the coal product of New Mexico, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	466,127	8,953	6,383	6,000	487,463	$870,468	$1.79	....	....
1890	358,332	11,360	6,085	....	375,777	504,390	1.34	192	827
1891	448,612	3,471	6,245	4,000	462,328	779,018	1.68	265	806
1892	645,557	8,776	6,997	....	661,330	1,074,601	1.62	223	1,083
1893	636,002	5,618	8,776	14,698	665,094	979,044	1.47	229	1,011
1894	561,523	8,266	14,365	13,042	597,196	935,857	1.57	182	985
1895	695,634	13,045	11,292	683	720,654	1,072,520	1.49	190	1,383
1896	607,319	6,677	7,446	1,184	622,626	930,381	1.49	172	1,559
1897	689,423	7,844	19,714	....	716,981	991,611	1.38	208	1,659
1898	949,903	7,660	17,601	17,124	992,288	1,344,750	1.35	242	1,873
1899	1,021,801	14,128	14,785	....	1,050,714	1,461,865	1.39	257	1,750
1900	1,198,289	15,574	58,103	27,333	1,299,299	1,776,170	1.37	261	2,037
1901	1,023,010	15,624	33,617	14,295	1,086,546	1,546,652	1.42	224	2,478
1902	973,500	19,514	33,180	22,569	1,048,763	1,500,230	1.43	217	1,849

The following tables show the production in the Territory, by counties, since 1898, with the increases and decreases in 1902, as compared with 1901, and the total production of the Territory since 1882, in which year the first output was reported:

Coal production of New Mexico, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
McKinley	445,558	493,310	450,646	516,533	432,108	....	84,425
Colfax	269,215	368,373	388,480	249,296	346,373	97,077	....
Lincoln	....	12,737	150,442	156,621	99,000	....	57,621
Rio Arriba	31,000	32,000	45,800	38,942	47,600	8,658	....
Santa Fe	246,215	137,534	252,731	106,454	90,895	....	15,559
Other counties	300	6,760	11,200	18,700	32,787	14,087	....
Total	992,288	1,050,714	1,299,299	1,086,546	1,048,763	....	[a]37,783

[a] Net decrease.

Coal production of New Mexico, 1882–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1882	157,092	1893	665,094
1883	211,347	1894	597,196
1884	220,557	1895	720,654
1885	306,202	1896	622,626
1886	271,285	1897	716,981
1887	508,034	1898	992,288
1888	626,665	1899	1,050,714
1889	486,943	1900	1,299,299
1890	375,777	1901	1,086,546
1891	462,328	1902	1,048,763
1892	661,330		

NORTH CAROLINA.

Total production in 1902, 23,000 short tons; spot value, $34,500.

The entire production of North Carolina continues to come from the Cumnock mines, in Chatham County. The output in 1902 was nearly double that of 1901, and exceeded all previous records except those of 1895 and 1899. The average price advanced from $1.25 per ton to $1.50, and the total value in 1902 was 130 per cent in excess of that of 1901.

The production and distribution of coal in North Carolina since 1889 are shown in the following tables:

Distribution of the coal product of North Carolina, 1891–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1891	18,780	600	975	20,355	$39,635	$1.93	254	80
1892	6,679	....	....	6,679	9,599	1.44	160	90
1893	15,000	....	2,000	17,000	25,500	1.50	80	70
1894	13,500	1,000	2,400	16,900	29,675	1.76	145	95
1895	23,400	600	900	24,900	41,350	1.66	226	61
1896	5,356	295	2,162	7,813	11,720	1.50	220	18
1897	21,280	....	....	21,280	27,000	1.34	215	51
1898	9,852	304	1,339	11,495	14,368	1.25	....	....
1899	24,126	486	2,284	26,896	34,965	1.30	210	70
1900	14,757	492	2,485	17,734	23,447	1.32	151	84
1901	10,000	....	2,000	12,000	15,000	1.25	300	25
1902	20,400	100	2,500	23,000	34,500	1.50	285	40

Coal production of North Carolina, 1889-1902.

Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*
1889	192	1896	7,813
1890	10,262	1897	21,280
1891	20,355	1898	11,495
1892	6,679	1899	26,896
1893	17,000	1900	17,734
1894	16,900	1901	12,000
1895	24,900	1902	23,000

NORTH DAKOTA.

Total production in 1902, 226,511 short tons; spot value, $325,967.

All of the coal produced in the State of North Dakota is lignite, which, to be mined and sold at a profit, must have a comparatively local market. It will not stand transportation well and can not compete with bituminous coals except when the price of the latter is quite high. The distance of North Dakota from the bituminous coal areas has encouraged the development of her own lignite resources with what appears to be considerable success. The producers are to be commended for the energetic manner in which they have developed the industry during the last few years. Attempts are now being made to establish a briquetting industry and thus improve the quality of the product as a fuel and enable it to be stored without deterioration.

The statistics of production, by counties, during the last two years are shown in the following tables:

Coal production of North Dakota in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Burleigh and Emmons	35,836	4,306	4,712	44,854	$50,111	$1.12	285	69
McLean and Oliver		1,516		1,516	3,016	1.99	275	4
Morton	48,250	4,300	300	52,850	64,035	1.21	170	68
Stark	16,650	2,050		18,700	19,237	1.03	193	25
Ward	33,928	14,603	150	48,681	77,752	1.60	160	114
Total	134,664	26,775	5,162	166,601	214,151	1.29	198	280

Coal production of North Dakota in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Morton	13,542	4,575	200	18,317	$23,078	$1.26	181	43
Stark	29,700	5,300	....	35,000	38,025	1.09	223	37
Ward	68,417	22,519	2,850	93,786	171,122	1.82	193	233
Other counties [a]	70,343	3,245	5,820	79,408	93,742	1.18	277	89
Total	182,002	35,639	8,870	226,511	325,967	1.44	213	402

[a] Burleigh, Emmons, and McLean.

The production of lignite in North Dakota in 1902 would have shown even a greatei increase than that made, except for the scarcity of labor. So serious did the situation become, because of more congenial employment in other lines of industry, that application was made to an employment agency in Chicago for any kind of labor that could be secured.

The way in which the industry has grown is shown in the following tables:

Distribution of the coal product of North Dakota, 1889-1902.

Year.	Loaded at mines for shipment	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	18,610	10,297	....	28,907	$41,431	$1.43	....	....
1890	....	30,000	....	30,000	42,000	1.40	....	....
1891	....	30,000	....	30,000	42,000	1.40	....	....
1892	38,000	2,725	....	40,725	39,250	.96	216	54
1893	47,968	1,612	50	49,630	56,250	1.13	193	88
1894	37,311	4,480	224	42,015	47,049	1.12	156	77
1895	35,380	3,617	....	38,997	41,646	1.07	143	62
1896	71,447	6,183	420	78,050	84,908	1.09	166	141
1897	65,032	10,458	1,756	77,246	83,803	1.08	168	170
1898	71,223	11,525	1,147	83,895	93,591	1.12	187	151
1899	77,731	20,788	290	98,809	117,500	1.19	154	210
1900	106,584	21,729	1,570	129,883	158,348	1.22	142	326
1901	134,664	26,775	5,162	166,601	214,151	1.29	198	280
1902	182,002	35,639	8,870	226,511	325,967	1.44	213	402

Coal production of North Dakota, 1884–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1884	35,000	1894	42,015
1885	25,000	1895	38,997
1886	25,955	1896	78,050
1887	21,470	1897	77,246
1888	34,000	1898	83,895
1889	28,907	1899	98,809
1890	30,000	1900	129,883
1891	30,000	1901	166,601
1892	40,725	1902	226,511
1893	49,630		

OHIO.

Total production in 1902, 23,519,894 short tons; spot value, $26,953,789.

Ohio continues to hold fourth place among the coal-producing States in quantity of coal mined and third place in the value of the product. From 1883 to 1896 Ohio occupied third place both as to quantity and value of production, Illinois having superseded it as second in rank in 1883. West Virginia succeeded Ohio as third in rank in quantity of production in 1896, and has remained in that position since that date, although on account of the interruption to operations by the strikes in the southern portion of the former State in 1902, Ohio came within 5 per cent of regaining its old position.

Compared with 1901 the production in 1902 increased 2,576,087 short tons, or 12.3 per cent, in quantity, and $6,025,631, or 28.8 per cent, in value. The production has in fact increased annually since 1897, when the output amounted to 12,196,942 tons, compared with which the tonnage of 1902 shows a gain of 92.8 per cent. The value of the product in 1902 was more than double that of any year prior to 1899.

The amount of coal mined by the use of machines in 1902 was 12,094,641 short tons as compared with 9,908,316 tons in 1901 and 8,835,743 tons in 1900. The number of machines in use in 1902 was 559 against 376 in 1901 and 341 in 1900. The percentage of machine-mined tonnage to the total product of Ohio in the last three years has been 46.53 in 1900, 47.30 in 1901, and 51.42 in 1902. Taken in connection with these figures it is interesting to note that the individual production in 1902 exhibits a decided decrease from 1901. In 1901 32,111 men were employed in the production of 20,943,807 short tons, or in the proportion of 652 tons for each man during the year. As the average time made was 198 days the rate per man per day was

3.29 tons. In 1902, 38,965 men produced 23,519,894 tons, an average of 604 tons each. The average working time being 200 days, the tonnage per man per day was 3.02.

As an indication of the activity in the development work carried on in Ohio during 1902 it may be stated that 29 new producers, whose product exceeded 5,000 tons each, were added to the lists for that year, in addition to which there were 38 new operations reported which had not reached a productive stage at the close of the 1902.

One county in Ohio attained for the first time a total production exceeding 3,000,000 tons. The county making this record was Athens. Four others—Perry, Guernsey, Hocking, and Jackson in the order named—exceeded 2,000,000 tons each, and all of these but Jackson had over 2,500,000 tons each to their credit. Belmont County came within a fraction of 1 per cent of reaching 2,000,000 tons, and Jefferson County, with an increase of nearly half a million tons over 1901, came within 10 per cent of that figure. Two other counties—Stark and Tuscarawas—exceeded 1,000,000 tons. Only one other county—Columbiana—produced as much as 500,000 tons in 1902. Three of the principal producing counties—Athens, Hocking, and Perry—form what is well known as the Hocking Valley region, which contributes between 35 and 40 per cent of the State's entire output. These three counties combined yielded 8,704,735 tons, or 37 per cent of the total, in 1902, and 8,184,364 tons, or 38 per cent, in 1901.

There were 29 counties in the State which produced coal in 1902, and in all but 6 of these the output exceeded that of 1901. The principal increases were made by Jefferson and Belmont counties, each of which gained nearly half a million tons. Hocking County sustained the heaviest loss, with a decrease of 128,630 tons, or more than one-third of the entire decrease in the State. The losses in production in Ohio were not due to labor difficulties, as no strikes were reported in any of the counties whose production showed a decline. Such interruptions to work as were caused by strikes were comparatively unimportant.

Details of production, by counties, in 1901 and 1902, together with the distribution of the product for consumption, are presented in the following tables:

Coal production of Ohio in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Athens	2,865,305	14,875	80,540	8,000	2,968,720	$2,649,445	$0.89	198	4,426
Belmont	1,374,608	122,582	9,668	....	1,506,858	1,406,279	.93	195	1,979
Carroll	159,941	17,822	3,010	....	180,773	178,544	.99	232	271
Columbiana	666,119	53,473	15,088	....	734,680	760,736	1.04	200	1,239
Coshocton	379,611	32,848	1,120	....	413,579	444,793	1.08	231	775
Guernsey	2,250,745	7,762	29,363	....	2,287,870	1,904,622	.83	226	2,532
Harrison	75,619	3,856	217	....	79,692	76,835	.96	145	180
Hocking	2,715,974	44,800	7,998	....	2,768,772	2,529,338	.91	234	3,269
Jackson	2,066,492	88,044	20,780	....	2,175,316	2,714,708	1.25	198	4,112
Jefferson	1,154,005	154,232	12,968	1,100	1,322,305	1,286,214	.97	230	1,936
Lawrence	86,004	21,212	....	....	107,216	113,770	1.06	234	312
Mahoning	62,516	45,245	1,588	....	109,349	123,985	1.13	202	219
Medina	88,473	15,604	4,607	....	108,684	154,996	1.43	171	217
Meigs	162,501	73,754	1,359	....	237,614	220,665	.93	163	594
Morgan	27,276	....	....	....	27,276	27,297	1.00	161	48
Muskingum	117,012	20,300	358	....	137,670	129,727	.94	171	259
Perry	2,382,195	20,387	44,290	....	2,446,872	2,206,930	.90	189	3,281
Stark	846,323	36,916	13,757	....	896,996	1,359,636	1.52	126	3,369
Summit	96,184	9,811	993	....	106,988	156,932	1.47	157	318
Tuscarawas	1,427,817	71,497	11,148	....	1,510,462	1,426,242	.94	222	2,198
Vinton	46,177	703	....	....	46,880	50,366	1.07	187	131
Gallia, Noble, Scioto, and Washington	78,404	3,857	250	....	82,511	77,221	.94	162	201
Portage, Trumbull, and Wayne	174,550	6,798	5,376	....	186,724	328,877	1.76	147	245
Small mines	....	500,000	....	....	500,000	600,000	....	....	....
Total	19,303,851	1,366,378	264,478	9,100	20,943,807	20,928,158	1.00	198	32,111

Coal production of Ohio in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Athens	3,281,410	13,146	22,241	2,800	3,319,597	$3,635,762	$1.09	154	6,069
Belmont	1,763,658	219,302	14,996	....	1,997,956	2,069,488	1.04	190	3,395
Carroll	190,969	30,996	3,414	....	225,379	288,956	1.28	232	452
Columbiana	724,765	48,102	20,991	....	793,858	885,656	1.12	230	1,171
Coshocton	388,289	48,995	500	....	437,784	536,196	1.22	225	792
Gallia	16,962	4,508	....	....	21,470	24,650	1.15	224	72
Guernsey	2,615,805	9,802	30,003	....	2,655,610	2,440,906	.92	229	2,735
Harrison	355,192	4,500	1,800	....	361,492	315,756	.87	251	337

Coal production of Ohio in 1902, by counties—Continued.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Hocking	2,584,424	19,312	37,405	....	2,641,141	$2,893,974	$1.10	184	3,444
Holmes	600	14,185	....	....	14,785	21,482	1.45	127	72
Jackson	2,344,492	37,237	30,780	....	2,412,509	3,432,741	1.42	232	4,425
Jefferson	1,694,538	101,553	15,776	934	1,812,801	1,905,820	1.05	237	2,985
Lawrence	165,060	18,309	....	....	183,369	240,857	1.31	179	650
Mahoning	72,415	52,234	3,098	....	127,747	178,517	1.40	211	305
Medina	76,399	9,333	4,986	....	90,718	161,729	1.78	233	222
Meigs	263,402	63,506	12,731	....	339,639	390,713	1.15	208	659
Morgan	86,821	....	....	....	86,821	127,135	1.46	134	187
Muskingum	190,542	34,871	....	....	225,413	252,621	1.12	174	422
Perry	2,664,968	68,470	10,559	....	2,743,997	2,913,599	1.06	172	4,865
Stark	998,599	68,620	13,210	....	1,080,429	1,946,667	1.80	232	2,386
Summit	51,400	12,332	3,710	....	67,442	107,417	1.59	214	158
Trumbull	6,100	5,490	440	....	12,030	27,335	2.27	174	46
Tuscarawas	1,421,827	144,660	12,073	50	1,578,610	1,654,120	1.05	222	2,220
Vinton	90,751	1,124	566	....	92,441	116,614	1.26	172	270
Wayne	74,824	2,056	1,510	....	78,390	140,153	1.79	124	222
Other counties[a]	108,192	8,469	1,805	....	118,466	244,925	2.07	167	404
Total	22,232,404	1,041,112	242,594	3,784	23,519,894	26,953,789	1.15	200	38,965

[a] Noble, Portage, Scioto, and Washington.

The distribution of Ohio's coal product for consumption, its value, and the statistics of labor employed since 1889 are shown in the following table:

Distribution of the coal product of Ohio, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	8,566,223	1,196,872	144,223	69,469	9,976,787	$9,355,400	$0.94	....	19,343
1890	10,161,887	1,164,876	143,984	23,759	11,494,506	10,783,171	.94	201	20,576
1891	11,393,209	1,281,568	140,420	53,486	12,868,683	12,106,115	.94	206	22,182
1892	11,995,256	1,411,642	117,486	38,543	13,562,927	12,722,745	.94	212	22,576
1893	11,713,116	1,348,743	167,002	24,785	13,253,646	12,351,139	.92	188	23,931
1894	10,636,402	1,101,940	126,397	45,117	11,909,856	9,841,723	.83	136	27,105
1895	11,933,686	1,227,224	152,277	42,619	13,355,806	10,618,477	.79	176	24,644
1896	11,494,275	1,181,610	172,722	26,595	12,875,202	10,253,461	.79	161	25,500
1897	10,725,047	1,259,290	192,755	19,850	12,196,942	9,535,409	.78	148	26,410
1898	13,053,427	1,226,184	222,913	14,343	14,516,867	12,027,336	.83	169	26,986
1899	14,880,893	1,393,025	211,992	14,360	16,500,270	14,361,903	.87	200	26,038
1900	17,347,472	1,292,264	277,188	71,226	18,988,150	19,292,246	1.02	215	27,628
1901	19,303,851	1,366,378	264,478	9,100	20,943,807	20,928,158	1.00	198	32,111
1902	22,232,404	1,041,112	242,594	3,784	23,519,894	26,953,789	1.15	200	38,965

In connection with this table it will be observed that the amount of coal mined in the State made into coke in 1902 was only 3,784 tons. The reason for this small report of coal made into coke is that most of the coal so used was shipped from a distance to the ovens and was reported as a part of the coal loaded at mines for shipment. The actual amount of coal made into coke in Ohio in 1902 was 219,401 short tons.

The production by counties during the last five years and the increases and decreases in 1902 as compared with 1901 are shown in the following table:

Coal production of Ohio, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase 1902.	Decrease 1902.
Athens	1,651,449	1,786,041	2,283,520	2,968,720	3,319,597	350,877	....
Belmont	1,036,102	1,242,383	1,345,284	1,506,858	1,997,956	491,098	....
Carroll	230,786	227,191	167,521	180,773	225,379	44,606	....
Columbiana	893,680	885,179	692,264	734,680	793,858	59,178	....
Coshocton	367,292	392,373	353,314	413,579	437,784	24,205	....
Gallia	11,488	13,536	15,620	14,826	21,470	6,644	....
Guernsey	1,326,480	1,562,986	1,852,327	2,287,870	2,655,610	367,740	....
Harrison	29,112	1,390	6,342	79,692	361,492	281,800	....
Hocking	1,269,786	2,018,865	2,518,605	2,768,772	2,641,141	....	127,631
Holmes	....	....	....	....	14,785	14,785	....
Jackson	1,770,265	2,032,233	2,304,892	2,175,316	2,412,509	237,193	....
Jefferson	800,540	924,214	1,110,586	1,322,305	1,812,801	490,496	....
Lawrence	64,849	116,972	95,425	107,216	183,369	76,153	....
Mahoning	35,785	43,906	46,462	109,349	127,747	18,398	....
Medina	249,406	191,351	129,913	108,684	90,718	....	17,966
Meigs	174,216	273,730	242,275	237,614	339,639	102,025	....
Morgan	26,730	24,905	24,004	27,276	86,821	59,545	....
Muskingum	137,506	142,645	184,274	137,670	225,413	87,743	....
Perry	1,831,975	1,735,487	2,364,791	2,446,872	2,743,997	297,125	....
Portage	82,659	108,008	101,240	150,678	100,266	....	50,412
Stark	888,158	1,079,228	1,116,524	896,996	1,080,429	183,433	....
Summit	51,722	68,702	109,355	106,988	67,442	....	39,546
Trumbull	1,640	7,575	14,099	8,506	12,030	3,524	....
Tuscarawas	909,857	979,431	1,260,588	1,510,462	1,578,610	68,148	....
Vinton	81,274	71,839	68,901	46,880	92,441	45,561	....
Washington	2,958	8,322	5,300	3,010	3,604	594	....
Wayne	43,356	13,754	16,357	27,540	78,390	50,850	....
Noble, Scioto	47,796	[a] 48,024	58,367	64,675	14,596	....	50,079
Small mines	500,000	500,000	500,000	500,000	([b])	....	[b] 500,000
Total	14,516,867	16,500,270	18,988,150	20,943,807	23,519,894	[c] 2,576,087	....

[a] Includes Geauga County.
[b] Small mines production included in county distribution.
[c] Net increase.

The annual production since 1872 has been as follows:

Annual coal production of Ohio, 1872–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1872	5,315,294	1888	10,910,951
1873	4,550,028	1889	9,976,787
1874	3,267,585	1890	11,494,506
1875	4,864,259	1891	12,868,683
1876	3,500,000	1892	13,562,927
1877	5,250,000	1893	13,253,646
1878	5,500,000	1894	11,909,856
1879	6,000,000	1895	13,355,806
1880	7,000,000	1896	12,875,202
1881	8,225,000	1897	12,196,942
1882	9,450,000	1898	14,516,867
1883	8,229,429	1899	16,500,270
1884	7,640,062	1900	18,988,150
1885	7,816,179	1901	20,943,807
1886	8,435,211	1902	23,519,894
1887	10,300,708		

OREGON.

Total production in 1902, 65,648 short tons; spot value, $160,075.

Oregon is numbered among the seven States whose production in 1902 was less than in 1901, although the number of men employed and the average working time increased. The increase in the labor employed, as well as the large amount of coal consumed at the mines in 1902, was due in all probability to the development work on the Beaver Hill mines in Coos County. The larger part of the product in 1902, as in previous years, was from the Newport mine in the same county.

The following tables show the statistics of production in Oregon for the last 11 years and the total output since 1885:

Distribution of the coal product in Oregon, 1892–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average number of employees.	Average number of days worked.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
1892	31,760	2,353	548	34,661	$148,546	90	120
1893	37,835	3,594	254	41,683	164,500	110	192
1894	45,068	2,171	282	47,521	183,914	88	243
1895	68,108	5,294	283	73,685	247,901	414	*a* 69
1896	88,116	12,951	654	101,721	294,564	254	191
1897	92,921	5,207	9,161	107,289	291,772	375	200
1898	54,305	3,290	589	58,184	212,184	142	199
1899	78,608	6,656	1,624	86,888	260,917	124	238
1900	48,160	9,590	1,114	58,864	220,001	141	273
1901	53,472	14,531	1,008	69,011	173,646	187	228
1902	42,591	11,232	11,825	65,648	160,075	265	234

a The apparently large number of men employed and small average working time are due to the large force of men employed in developing the Beaver Hill mine, which was producing coal for shipment during only 20 days in 1895. The average time made at the Newport mine was over 200 days per man.

Coal production of Oregon, 1885-1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1885	50,000	1894	47,521
1886	45,000	1895	73,685
1887	37,696	1896	101,721
1888	75,000	1897	107,289
1889	64,359	1898	58,184
1890	61,514	1899	86,888
1891	51,826	1900	58,864
1892	34,661	1901	69,011
1893	41,683	1902	65,648

PENNSYLVANIA.

Total production in 1902, 124,953,538 long tons, or 139,947,962 short tons; spot value, $182,206,046.

Anthracite: Total production in 1902, 36,940,710 long tons; spot value, $76,173,586.

Bituminous: Total production in 1902, 98,574,367 short tons; spot value, $106,032,460.

The great strike in the anthracite region of Pennsylvania which made the year 1902 one of the most notable in the annals of the coal-mining industry is still so fresh in the memories of the people of the United States that it is not deemed necessary to discuss it in connection with this report except in so far as it directly affected the production of anthracite and, indirectly, that of bituminous coal. Brief reference to the causes leading up to the strike, its duration, etc., is made in the subsequent report on anthracite production, prepared by Mr. William W. Ruley, of Philadelphia, chief of the Bureau of Anthracite Coal Statistics. The report of the Anthracite Coal Strike Commission is available for those who desire more particular information.

The immediate effect of the suspension of work, which began on May 12 and lasted until October 25, was a decrease in the production of anthracite as compared with 1901 of 23,301,850 long tons, or 38.7 per cent. The value decreased in somewhat less proportion, owing to the higher prices obtained during the strike and even after its termination, but with a total falling off of $36,330,434. The returns for 1902 show that the average time made by 148,141 men employed in the anthracite region in 1902 was 116 days, or 80 days less than the working time made by 145,309 men in 1901. In 1901, a year of unusual activity and prosperity in the anthracite regions, the average working time made was 196 days of 10 hours, which shows that from one cause or another the anthracite employees will average not more than 4 working days a week. The amount of elapsed time from the beginning to the end of the strike was 172 days, which at an average of 4 working days to the week would mean an actual loss in working time of 98 days. As shown elsewhere in this report, the average daily production per man in 1902 was 2.4 short tons, equivalent to 2.14 long tons. At this rate, if the mines had been running during the time lost by strike and if the usual percentage of lost time were allowed for, the production during this period would have been approximately 28,900,000 long tons, and the total output of anthracite for the year would have been in the neighborhood of 65,750,000 long tons.

The cutting off of the supply of anthracite created an unprecedented demand for bituminous coal, which was naturally directed for the most part toward the soft-coal areas of Pennsylvania. As a result, unprecedented activity prevailed throughout the bituminous regions in the central and western portions of the State, eventuating in an increase in production over 1901 of 16,268,421 short tons, the total output of bituminous coal for the State amounting to 98,574,367 short tons, as against 82,305,946 tons in 1901. The production of bituminous coal in Pennsylvania in 1902 was nearly double that of 1896 and was more than double that of any year prior to 1895.

Large as was the production of bituminous coal in the State, and great as was the increase over 1901, it was not sufficient to overcome the loss caused by the strike in the anthracite region. Reducing the anthracite tonnage to the standard unit of measurement adopted for this report (the short ton of 2,000 pounds), the total coal product for the State in 1902 is found to have been 139,947,962 short tons, which, as compared with the output in 1901, 149,777,613 tons, exhibits a decrease of 9,829,651 short tons, or 6.6 per cent, and, notwithstanding the higher prices for both kinds of coal, the aggregate amount received for them was $11,695,560, or 6 per cent, less than the value of the product in 1901.

Mention has been made in previous reports of this series of the decided changes that have taken place in the conditions affecting the the anthracite industry, and the practical elimination of anthracite as a manufacturing fuel, with the exception of the small sizes, either used alone or mixed with bituminous coal. These small sizes, however, can not be classed among the profitable production. They must be sold in competition with bituminous coal and the prices received for them at the mines are frequently below the actual cost of mining. This loss must necessarily be made up from the sale of domestic sizes, which now represent practically all the profitable output. During the strike of 1902 many manufacturers who had been using small anthracite were driven to the use of bituminous coal. In some of these cases the latter fuel has become established, and the anthracite operators have in consequence permanently lost markets for their by-product or small sizes. Against this, however, may be set the great increase in the construction of apartment houses, of large office buildings, and of enormous hotels in the eastern cities of the United States where the cheapness and smokeless character of this fuel makes it desirable for use in the power plants and in the steam-heater furnaces. Still, the indications are that the anthracite producers are confronted with what appears to be a continually contracting "sphere of influence," and although increasing population in the Eastern States may cause for a few years to come an increasing production of anthracite, the gradually augmenting cost of that fuel, combined with the growing competition of bituminous coal, coke, and gas, tend to the belief that the maximum of yearly production has about been reached. The history of production during the last quarter of the last century shows that although the output of anthracite has somewhat more than doubled during that time, it has not by any means kept pace with the production of bituminous coal. In the five years from 1876 to 1880 the average yearly output of anthracite was 26,250,000 tons, and the average annual bituminous coal production of the country amounted to 35,650,000 tons, or a little more than one and one-third times that of anthracite. In the last five years of the century the average yearly production of anthracite was 55,625,165 tons, and the average bituminous coal production was 171,495,837 tons, or more than three times that of anthracite. In other words, the production of bituminous coal increased nearly five times in the same time that anthracite production a little more than doubled.

The following table shows the comparative growth of anthracite and bituminous coal production by five-year averages during the last quarter of the nineteenth century. It will be observed that the average production of anthracite in the last five years showed so little gain over the period immediately preceding as to indicate an almost stationary condition, while bituminous production increased nearly 40 per cent. The production of anthracite in both 1901 and 1902 was of an unusual character and the two years are therefore unreliable for comparative statistics. In 1901 the production was unusually large in making up for the shortage created by the strike of 1900, while the production for 1902 was the smallest in sixteen years.

Production of anthracite and bituminous coal in twenty-five years by five-year averages.

[Short tons.]

Period.	Anthracite, quantity.	Bituminous, quantity.
1876–1880	26,250,000	35,650,000
1881–1885	36,194,188	70,816,115
1886–1890	42,151,364	94,488,681
1891–1895	53,405,189	125,216,327
1896–1900	55,625,165	171,495,837

Until 1902 Pennsylvania held the distinction of producing more than one-half of the total output of coal in the United States, but the decrease last year in connection with the general increase in production among the other States reduced Pennsylvania's percentage of the total output to 46. Even with the reduced production however, Pennsylvania continues to exceed the output of any foreign country with the exception of Great Britain and Germany. It exceeds the production of Austria, France, and Belgium combined, and amounts to about 15 per cent of the entire world's production. In 1880 Pennsylvania produced 65 per cent of the total output of the United States, and averaged 55 per cent from 1880 to 1900.

In the following table is shown the total production of Pennsylvania and of the United States since 1880, with the percentage of the total produced by Pennsylvania in each year:

Production of Pennsylvania coal compared with total United States, 1880–1902.

Year.	Total United States.	Pennsylvania.	Per cent of Pennsylvania to total.
	Short tons.	*Short tons.*	
1880	71,481,569	47,529,711	65
1881	85,881,030	54,320,018	63
1882	103,285,789	57,254,507	55
1883	115,212,125	62,488,190	54
1884	119,735,051	62,404,488	52
1885	110,957,522	62,137,271	56
1886	112,743,403	62,857,210	56
1887	129,975,557	70,372,857	54
1888	148,659,402	77,719,624	52
1889	141,229,514	81,719,059	58
1890	157,788,657	88,770,814	56
1891	168,566,668	93,453,921	55
1892	179,329,071	99,167,080	55
1893	182,352,774	98,038,267	54
1894	170,741,526	91,833,584	54
1895	193,117,530	108,216,565	56
1896	191,986,357	103,903,534	54
1897	200,223,665	107,029,654	53
1898	219,976,267	118,547,777	54
1899	253,741,192	134,568,180	53
1900	269,684,027	137,210,241	51
1901	293,299,816	149,777,613	51
1902	301,582,348	139,947,962	46

The production of anthracite and bituminous coal in Pennsylvania is discussed separately in the following pages. The chapter on anthracite production has been prepared for this report, as heretofore, by Mr. William W. Ruley, of Philadelphia, the Chief of the Bureau of Anthracite Coal Statistics. Mr. Ruley is thoroughly familiar with all the conditions affecting the anthracite industry. One of the features of his report for this year is the discussion as to the proportion of the various sizes of coal shipped to market and the changes which have taken place in recent years in this regard.

PENNSYLVANIA ANTHRACITE.

By William W. Ruley.

The production of anthracite coal in 1902 was the smallest since 1886, reaching only 36,940,710 long tons, as compared with a production of 60,242,560 long tons in 1901. This decrease was due solely to the strike in the anthracite regions, which lasted from May 10 to October 23, 1902, during which period mining was practically suspended.

The causes which led to this strike, its progress and final adjustment, are so familiar to the public that nothing more than a brief account of it will be given in the latter part of this report. Those interested in a more comprehensive and detailed account are referred to the report of the Anthracite Coal Strike Commission, which is printed and ready for distribution.

Next to the small production, the most noticeable feature of the business for 1902 was the relatively large proportion of small-sized coal produced, the tonnage for sizes below "pea" being 8,012,345 long tons, or 30.93 per cent less than in 1901, while the total production decreased 41.76 per cent. This was largely due to the fact that many washeries were kept in operation during the strike period. There has, however, been a constant increase in the production of this small coal, because of the increased number of washeries built in recent years to recover coal from the old culm banks.

To illustrate the increase of washery product as compared with the total output the following statement is given, showing the amount of coal obtained in this manner from 1890 to 1902, inclusive:

Shipments of anthracite coal from washeries compared with total shipments, 1890–1902.

[Long tons.]

Year.	Shipments from washeries.	Total shipments.	Per cent of washery output to total shipments.
1890	41,600	36,615,459	0.11
1891	85,702	40,448,336	.21
1892	90,495	41,893,320	.22
1893	245,175	43,089,537	.57
1894	634,116	41,391,200	1.53
1895	1,080,800	46,511,477	2.32
1896	895,042	43,177,485	2.07
1897	993,603	41,637,864	2.39
1898	1,099,019	41,899,751	2.62
1899	1,368,275	47,665,204	2.87
1900	2,059,349	45,107,484	4.57
1901	2,567,335	53,568,601	4.79
1902	1,959,466	31,200,890	6.28

It will be noted from this table that nearly 5 per cent of the total shipments in 1901 came from washeries, and that 6.28 per cent in 1902 came from this source. There were 40 washeries in operation in 1902.

In connection with small-sized coal reclaimed from washeries it is interesting to note the proportion of the various sizes shipped to market in 1901 and 1902, and the following table gives this information.

A comparison of the variations of these two years is hardly a fair one, on account of the abnormal conditions existing in 1902. The figures for 1901, however, represent a normal condition.

To illustrate the change which has taken place in the percentage of the various sizes shipped in a little more than a decade a similar statement is given for 1890.

Shipments of anthracite according to sizes in 1890, 1901, and 1902.

[Long tons.]

Size.	1890.		1901.		1902.	
	Quantity.	Per cent.	Quantity.	Per cent.	Quantity.	Per cent.
Lump	4,308,282	11.8	2,187,553	4.08	1,227,114	3.93
Broken	4,657,172	12.7	4,423,581	8.26	2,548,930	8.17
Egg	4,684,173	12.8	6,989,330	13.05	3,880,404	12.44
Stove	8,344,550	22.8	10,561,957	19.72	5,757,713	18.45
Chestnut	6,160,501	16.8	10,250,550	19.14	5,611,471	17.99
Pea	4,703,791	12.9	7,555,948	14.11	4,162,913	13.34
Buckwheat No. 1	2,949,592	8	7,894,613	14.72	4,419,775	14.17
Smaller than buckwheat No. 1	807,398	2.2	3,705,066	6.92	3,592,570	11.51
Total	36,615,459	100	53,568,601	100	31,200,890	100

It will be seen by comparing the years 1890 and 1901 that the sizes above pea have fallen from 76.9 per cent to 64.24 per cent, and the sizes below pea have increased from 10.3 per cent to 21.65 per cent, and that the percentage of lump coal has decreased to less than one-third of what it was in 1890. A considerable part of this increase in small sizes is made up of washery product. It should be stated that these tables do not include the shipments from Sullivan County mines.

Of the total product in 1902, 31,486,120 long tons were shipped to market, 995,655 tons were sold to local trade at the mines, and 4,458,935 tons were used for steam and heat. The proportion of these items as compared with 1901 is shown below.

Distribution of the anthracite product in 1901 and 1902.

[Long tons.]

	1901.		1902.	
	Quantity.	Per cent.	Quantity.	Per cent.
Shipped to market	53,694,530	89.13	31,486,120	85.23
Sold to local trade	1,185,480	1.97	995,655	2.70
Used at mines for steam and heat	5,362,550	8.90	4,458,935	12.07
Total	60,242,560	100.00	36,940,710	100.00

The much larger relative proportion of coal used for steam and heat in 1902 than in 1901 is noticeable, and is due to the fact that although little coal was taken out during the strike period it was necessary to keep the engines and pumps in operation.

The coal used for steam is mostly small sizes and culm, and its value is not considered in making up the average value per ton nor is it included in the total value of product. This average value in 1902 was $2.35 per ton, the highest recorded in recent years, and the total product was valued at $76,173,586.

In the months following the strike exceedingly high prices were realized by some of what are known as the independent operators, which accounts for the very considerable increase over the average for the previous year.

In the following table is shown the production, total value, price per ton, etc., of anthracite for the last five years:

Statistics of production of anthracite, 1898–1902.

Year.	Quantity.	Value.	Average price per ton.	Average number of employees.	Average number of days worked.
	Long tons.				
1898	47,663,076	$75,414,537	$1.75	145,184	172
1899	53,944,647	88,142,130	1.80	139,608	173
1900	51,221,353	85,757,851	1.85	144,206	166
1901	60,242,560	112,504,020	2.05	145,309	196
1902	36,940,710	76,173,586	2.35	148,141	116

In the two following tables the production is shown according to counties for the years 1901 and 1902:

Anthracite production in 1901, by counties.

[Long tons.]

County.	Total quantity.	Shipments.	Local trade.	Used at mines.
Susquehanna	663,486	623,614	9,870	30,002
Lackawanna	15,874,320	14,584,747	301,731	987,842
Luzerne	21,345,737	18,997,180	520,486	1,828,071
Carbon	1,774,258	1,525,896	27,638	220,724
Schuylkill	13,678,641	11,900,379	185,809	1,592,453
Columbia	1,082,613	994,316	14,366	73,931
Sullivan	134,459	125,929	3,790	4,740
Northumberland	4,947,465	4,373,070	99,926	474,469
Dauphin	741,581	569,399	21,864	150,318
Total	60,242,560	53,694,530	1,185,480	5,362,550

Anthracite production in 1902, by counties.

[Long tons.]

County.	Total quantity.	Shipments.	Local trade.	Used at mines.
Susquehanna	404,248	373,451	9,792	21,005
Lackawanna	10,779,268	9,659,014	269,678	850,576
Luzerne	12,852,826	11,040,374	377,379	1,435,073
Carbon	986,201	796,791	24,621	164,789
Schuylkill	7,704,202	6,240,258	193,278	1,270,666
Columbia	670,115	588,058	11,323	70,734
Sullivan	296,000	285,230	2,982	7,788
Northumberland	2,878,615	2,308,253	92,719	477,643
Dauphin	369,235	194,691	13,883	160,661
Total	36,940,710	31,486,120	995,655	4,458,935

In order to show the shipments of anthracite by years from the beginning of the industry the following table is compiled, which gives the shipments for each year, divided according to regions, since 1820:

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1902.

Year.	Schuylkill region. Quantity.	Schuylkill region. Per cent.	Lehigh region. Quantity.	Lehigh region. Per cent.	Wyoming region. Quantity.	Wyoming region. Per cent.	Total. Quantity.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*
1820			365				365
1821			1,073				1,073
1822	1,480	39.79	2,240	60.21			3,720
1823	1,128	16.23	5,823	83.77			6,951
1824	1,567	14.10	9,541	85.90			11,108
1825	6,500	18.60	28,393	81.40			34,893
1826	16,767	34.90	31,280	65.10			48,047
1827	31,360	49.44	32,074	50.56			63,434
1828	47,284	61.00	30,232	39.00			77,516
1829	79,973	71.35	25,110	22.40	7,000	6.25	112,083
1830	89,984	51.50	41,750	23.90	43,000	24.60	174,734
1831	81,854	46.29	40,966	23.17	54,000	30.54	176,820
1832	209,271	57.61	70,000	19.27	84,000	23.12	363,271
1833	252,971	51.87	123,001	25.22	111,777	22.91	487,749
1834	226,692	60.19	106,244	28.21	43,700	11.60	376,636
1835	339,508	60.54	131,250	23.41	90,000	16.05	560,758
1836	432,045	63.16	148,211	21.66	103,861	15.18	684,117
1837	530,152	60.98	223,902	25.75	115,387	13.27	869,441
1838	446,875	60.49	213,615	28.92	78,207	10.59	738,697
1839	475,077	58.05	221,025	27.01	122,300	14.94	818,402
1840	490,596	56.75	225,313	26.07	148,470	17.18	864,379
1841	624,466	65.07	143,037	14.90	192,270	20.03	959,773
1842	583,273	52.62	272,540	24.59	252,599	22.79	1,108,412
1843	710,200	56.21	267,793	21.19	285,605	22.60	1,263,598
1844	887,937	54.45	377,002	23.12	365,911	22.43	1,630,850
1845	1,131,724	56.22	429,453	21.33	451,836	22.45	2,013,013
1846	1,308,500	55.82	517,116	22.07	518,389	22.11	2,344,005
1847	1,665,735	57.79	633,507	21.98	583,067	20.23	2,882,309
1848	1,733,721	56.12	670,321	21.70	685,196	22.18	3,089,238
1849	1,728,500	53.30	781,556	24.10	732,910	22.60	3,242,966
1850	1,840,620	54.80	690,456	20.56	827,823	24.64	3,358,899
1851	2,328,525	52.34	964,224	21.68	1,156,167	25.98	4,448,916
1852	2,636,835	52.81	1,072,136	21.47	1,284,500	25.72	4,993,471

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1902—Cont'd.

Year.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Quantity.	Per cent.	Quantity.	Per cent.	Quantity.	Per cent.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*
1853	2,665,110	51.30	1,054,309	20.29	1,475,732	28.41	5,195,151
1854	3,191,670	53.14	1,207,186	20.13	1,603,478	26.73	6,002,334
1855	3,552,943	53.77	1,284,113	19.43	1,771,511	26.80	6,608,567
1856	3,603,029	52.91	1,351,970	19.52	1,972,581	28.47	6,927,580
1857	3,373,797	50.77	1,318,541	19.84	1,952,603	29.39	6,644,941
1858	3,273,245	47.86	1,380,030	20.18	2,186,094	31.96	6,839,369
1859	3,448,708	44.16	1,628,311	20.86	2,731,236	34.98	7,808,255
1860	3,749,632	44.04	1,821,674	21.40	2,941,817	34.56	8,513,123
1861	3,160,747	39.74	1,738,377	21.85	3,055,140	38.41	7,954,264
1862	3,372,583	42.86	1,351,054	17.17	3,145,770	39.97	7,869,407
1863	3,911,683	40.90	1,894,713	19.80	3,759,610	39.30	9,566,006
1864	4,161,970	40.89	2,054,669	20.19	3,960,836	38.92	10,177,475
1865	4,356,959	45.14	2,040,913	21.14	3,254,519	33.72	9,652,391
1866	5,787,902	45.56	2,179,364	17.15	4,736,616	37.29	12,703,882
1867	5,161,671	39.74	2,502,054	19.27	5,325,000	40.99	12,988,725
1868	5,330,737	38.52	2,502,582	18.13	5,968,146	43.25	13,801,465
1869	5,775,138	41.66	1,949,673	14.06	6,141,369	44.28	13,866,180
1870	4,968,157	30.70	3,239,374	20.02	7,974,660	49.28	16,182,191
1871	6,552,772	41.74	2,235,707	14.24	6,911,242	44.02	15,699,721
1872	6,694,890	34.03	3,873,339	19.70	9,101,549	46.27	19,669,778
1873	7,212,601	33.97	3,705,596	17.46	10,309,755	48.57	21,227,952
1874	6,866,877	34.09	3,773,836	18.73	9,504,408	47.18	20,145,121
1875	6,281,712	31.87	2,834,605	14.38	10,596,155	53.75	19,712,472
1876	6,221,934	33.63	3,854,919	20.84	8,424,158	45.53	18,501,011
1877	8,195,042	39.35	4,332,760	20.80	8,300,377	39.85	20,828,179
1878	6,282,226	35.68	3,237,449	18.40	8,085,587	45.92	17,605,262
1879	8,960,829	34.28	4,595,567	17.58	12,586,293	48.14	26,142,689
1880	7,554,742	32.23	4,463,221	19.05	11,419,279	48.72	23,437,242
1881	9,253,958	32.46	5,294,676	18.58	13,951,383	48.96	28,500,017
1882	9,459,288	32.48	5,689,437	19.54	13,971,371	47.98	29,120,096
1883	10,074,726	31.69	6,113,809	19.23	15,604,492	49.08	31,793,027
1884	9,478,314	30.85	5,562,226	18.11	*a* 15,677,753	51.04	30,718,293
1885	9,488,426	30.01	5,898,634	18.65	*a* 16,236,470	51.34	31,623,530
1886	9,381,407	29.19	5,723,129	17.89	*a* 17,031,826	52.82	32,136,362
1887	10,609,028	30.63	4,347,061	12.55	*a* 19,684,929	56.82	34,641,018
1888	10,654,116	27.93	5,639,236	14.78	*a* 21,852,366	57.29	38,145,718
1889	10,486,185	29.28	6,294,073	17.57	*a* 19,036,835	53.15	35,817,093
1890	10,867,822	29.68	6,329,658	17.28	*a* 19,417,979	53.04	36,615,459
1891	12,741,258	31.50	6,381,838	15.78	21,325,240	52.72	40,448,336
1892	12,626,784	30.14	6,451,076	15.40	22,815,480	54.46	41,893,340
1893	12,357,444	28.68	6,892,352	15.99	23,839,741	55.33	43,089,537
1894	12,035,005	29.08	6,705,434	16.20	22,650,761	54.72	41,391,200
1895	14,269,932	30.68	7,298,124	15.69	24,943,421	56.63	46,511,477
1896	13,097,571	30.34	6,490,441	15.03	23,589,473	54.63	43,177,485
1897	12,181,061	29.26	6,249,540	15.00	23,207,263	55.74	41,637,864
1898	12,078,875	28.83	6,253,109	14.92	23,567,767	56.25	41,899,751
1899	14,199,009	29.79	6,887,909	14.45	26,578,286	55.76	47,665,204
1900	13,502,732	29.94	6,918,627	15.33	24,686,125	54.73	45,107,484
1901	16,019,591	29.92	7,211,974	13.45	30,337,036	56.63	53,568,601
1902	8,471,391	27.15	3,470,736	11.12	19,258,763	61.73	31,200,890
Total	417,944,349	33.26	212,039,554	16.87	626,798,256	49.87	1,256,782,159

a Includes Loyalsock field.

The figures given in this table show only shipments to market and do not include coal sold to local trade or used at mines.

As has been customary in previous reports, a tabular arrangement of the various sections of the anthracite fields is given below, and a list of the railroads entering the territory.

Anthracite coal fields, by field, local district, and trade region.

Coal field or basin.	Local district.	Trade region.
Southern	Carbondale	Wyoming.
	Scranton	
	Pittston	
	Wilkesbarre	
	Plymouth	
	Kingston	
Eastern middle	Green Mountain	Lehigh.
	Black Creek	
	Hazleton	
	Beaver Meadow	
Southern	Panther Creek	Schuylkill.
	East Schuylkill	
	West Schuylkill	
	Lorberry	
	Lykens Valley	
Western middle	East Mahanoy	
	West Mahanoy	
	Shamokin	

The above-named fields comprise an area of something over 480 square miles, and are located in the eastern middle part of the State, in the counties of Carbon, Columbia, Dauphin, Lackawanna, Luzerne, Northumberland, Schuylkill, and Susquehanna, and are classed under three general divisions, namely, the Wyoming, the Lehigh, and the Schuylkill regions. Geologically they are divided into fields or basins, which again are subdivided into districts.

The Bernice field, in Sullivan County, is not included in any of these regions. The classification of the product of this field is a matter of some contention. The fracture of the coal and some of its physical characteristics are more like some bituminous or semianthracite coals than strict anthracite, but on account of its high percentage of fixed carbon and low percentage of moisture it is classed as anthracite by the Second Pennsylvania Geological Survey, and the product is so included in this report.

The above territory is reached by ten so-called initial railroads, as follows:

Philadelphia and Reading Railway Company.
Lehigh Valley Railroad Company.
Central Railroad of New Jersey.
Delaware, Lackawanna and Western Railroad Company.
Delaware and Hudson Company's Railroad.

Pennsylvania Railroad Company.
Erie Railroad Company.
New York, Ontario and Western Railroad Company.
Delaware, Susquehanna and Schuylkill Railroad Company.
New York, Susquehanna and Western Railroad Company.

As noted in the beginning of this report, there was a general strike in the anthracite regions from May 10 to October 23.

Early in February, 1902, the United Mine Workers of America asked that a joint conference with the operators be set for March 12, 1902, at Scranton, to prepare a wage scale for the year commencing April 1, 1902.

This conference was not granted, and a convention of the anthracite mine workers was held at Shamokin, March 18 to 24, during which resolutions were passed demanding recognition of the union, an eight-hour day, the weighing of coal, and a uniform scale, with the notice that after April 1, 1902, miners should work only three days a week until an agreement was reached with the operators. An appeal was made to the Civic Federation to assist in securing these demands.

The request was taken up by the industrial department of the Federation, and the whole subject was discussed before it by representatives of the miners and operators. An adjournment was then taken for thirty days, at which time further discussion ensued, and a committee of the operators and miners was appointed to take the matter up and report back to the Federation. So far as known the Federation took no further action, nor did the committee make any report.

These discussions failing to settle the matter, the executive committee of the United Mine Workers ordered a temporary suspension of work, beginning May 12, 1902, and called a delegate convention to decide whether a permanent strike should be ordered for May 14, 1902.

At this convention it was voted to continue the strike, which lasted until October 23, 1902, and was then ended by the appointment by the President of the United States of a commission to look into the matters in dispute and to make an award, by which both operators and miners had in advance agreed to abide. This commission made its report to the President March 18, 1903.

PENNSYLVANIA BITUMINOUS COAL.

Total production in 1902, 98,574,367 short tons; spot value, $106,-032,460.

During the last five years the production of bituminous coal in Pennsylvania has not only increased annually, but since 1898 the price also has steadily advanced, so that since 1898 the production has increased a little over 50 per cent, while the value has increased 144 per cent. The output in 1902 was more than double that of any year prior to 1895. Between 1891 and 1898 the producers of bituminous coal were mining coal in the face of a steady decline in value. From 87 cents per ton in 1891, the average price declined each year until the lowest record ever made, 67 cents, was reached in 1898.

The reaction set in in 1899 and continued as regularly as the decline until the record high-water mark was made in 1902, with an average price per ton for that year of $1.08. The large production and the extremely high prices of bituminous coal in 1902 were caused for the most part by the cutting off of the supply of anthracite by the prolonged strike in the anthracite region. The demand for bituminous coal in Pennsylvania was unprecedented, and in the efforts to supply it the transportation facilities were found entirely inadequate. Several millions of tons more would have been added to the production in 1902 if cars and motive power sufficient could have been furnished by the railroads. As it was, the output in 1902 exceeded that of 1901 by 16,268,421 short tons, or 19.8 per cent, in quantity, and $24,634,874, or 30.3 per cent, in value. The production of bituminous coal in Pennsylvania in 1902 was larger than the entire production of the United States in any year prior to 1882, twenty years before.

Of the total production in 1902, 35,058,038 tons, or 35.57 per cent, were produced by the use of mining machines. In 1901, 29,591,368 tons, or 35.95 per cent of the total, were machine mined, which shows that while the machine-mined product in 1902 increased more than 5,400,000 tons over 1901 the proportion that it bore to the total product was somewhat less. The number of machines in use in 1902 was 2,620, as compared with 2,058 in 1901 and 1,786 in 1900. Of the machines in use in 1902, 1,800 were of the pick or "puncher" type, 814 were chain machines, and 6 were long-wall.

The returns for Pennsylvania bituminous mines in 1902 show that during that year 12,580 men were idle at one time or another, and that the total number of working days lost by them was 264,862, an average of 21 days each; and, although with the exception of West Virginia, this represented the largest number of men on strike and the largest amount of time lost by strikes in any coal-producing State outside of the anthracite region of Pennsylvania, it was not (on account of the great number of men employed) sufficient materially to affect the production. The time lost by strike in the Pennsylvania bituminous coal mines was less than 1 per cent of the total time made, and as the production in 1902 was less than it would have been had the railroads been equal to the demands made upon them it is doubtful if the tonnage would have been any larger had there been no labor troubles at all.

In Pennsylvania, as in most of the bituminous-coal producing States, the individual efficiency in 1902 showed an increase over 1901. In the earlier year the amount of soft coal mined per man was 808 short tons, and as the average time made that year was 230 days, the average tonnage per day was 3.51 for each employee. The number of men employed in this work was 101,904. In 1902, 112,630 men worked 248 days, and averaged 875 tons each per year and 3.53 tons per day.

The counties of Fayette and Westmoreland, which contain the Connellsville coking region, have stood, for a number of years, at the head of the bituminous coal producing counties. In 1902 these two counties produced 37,799,569 short tons, against 31,352,524 short tons in 1901, the percentage of the State's total product being about the same in both years. The tonnage has been almost evenly divided between the two counties, Fayette having a slight advantage. Allegheny County, which contains the great iron-making district of Pittsburg and vicinity, comes third in rank, with an output in 1902 of almost 12,000,000 tons. Cambria County, which includes the city of Johnstown and its iron and steel mills, is fourth in importance, having, in 1902, an output of over 10,500,000 tons. After these, among the more important counties and their tonnage in 1902, are Washington, 8,529,954 tons; Clearfield, 7,334,785 tons; Jefferson, 6,083,494 tons; and Somerset, 5,845,669 tons. All of these counties increased their production in 1902, the largest increase being that of Westmoreland County, 3,646,211 tons, and the next largest, Fayette, 2,800,834 tons.

Of the 37,799,569 tons produced in Fayette and Westmoreland counties in 1902, 19,651,866 tons, or more than half, was made into coke at the mines.

The statistics of production, by counties, in the last two years, with the distribution of the product for consumption, are shown in the following tables:

Bituminous coal production of Pennsylvania in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Allegheny	9,758,070	439,172	109,858	....	10,307,100	$10,294,035	$1.00	243	12,389
Armstrong	1,511,355	29,794	14,106	....	1,555,255	1,433,513	.92	255	2,342
Beaver	163,683	9,405	2,924	....	176,012	185,923	1.06	145	429
Bedford	447,779	4,413	6,540	41,590	500,322	500,990	1.00	228	939
Blair	318,389	1,302	5,063	44,025	368,779	388,768	1.05	203	549
Butler	263,441	4,074	1,646	....	269,161	245,174	.91	230	526
Cambria	8,301,413	96,334	145,672	501,782	9,045,201	9,181,837	1.02	219	13,929
Center	835,079	2,656	1,777	....	839,512	774,751	.92	197	1,205
Clarion	348,902	2,156	3,782	....	354,840	327,999	.92	191	748
Clearfield	5,679,850	34,081	84,240	88,236	5,886,407	5,377,127	.91	206	8,760
Elk	972,925	17,115	17,274	....	1,007,314	957,137	.95	223	1,711

Bituminous coal production of Pennsylvania in 1901, by counties—Continued.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Fayette	4,826,113	162,680	300,310	10,898,121	16,187,224	$16,243,131	$1.00	254	14,559
Huntingdon	361,964	3,704	8,861	....	374,529	395,376	1.05	216	706
Indiana	929,587	4,356	11,212	129,105	1,074,260	997,012	.93	213	1,851
Jefferson	4,612,722	19,398	147,704	1,026,744	5,806,568	4,909,817	.85	259	6,914
Lawrence	163,477	4,700	3,782	....	171,959	145,948	.85	270	404
Mercer	549,434	6,820	21,084	....	577,338	501,609	.87	204	1,007
Somerset	4,689,377	29,420	68,734	44,129	4,831,660	5,245,113	1.09	212	6,222
Tioga	833,736	20,508	6,828	....	861,072	1,124,828	1.31	192	2,274
Washington	5,807,698	26,939	75,984	....	5,910,621	5,751,934	.97	210	7,290
Westmoreland	8,357,216	160,876	300,689	6,346,519	15,165,300	15,321,983	1.01	238	16,532
Bradford, Clinton	327,787	404	226	....	328,417	353,287	1.08	314	393
Lycoming, McKean	105,320	975	800	....	107,095	140,294	1.31	257	225
Small mines	....	600,000	....	....	600,000	600,000	......	......	....
Total	60,165,317	1,681,282	1,339,096	19,120,251	82,305,946	81,397,586	.99	230	101,904

Bituminous coal production of Pennsylvania in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Allegheny	11,146,343	447,835	162,160	163,231	11,919,569	$12,339,715	$1.04	225	14,616
Armstrong	1,727,498	37,833	27,848	....	1,793,179	1,799,815	1.00	260	2,545
Beaver	205,549	17,255	2,358	....	225,162	305,438	1.36	262	347
Bedford	638,928	5,822	8,692	143,806	797,248	1,051,677	1.32	258	1,330
Blair	192,828	1,125	3,440	140,811	338,204	373,437	1.10	253	491
Butler	427,592	21,647	4,927	....	454,166	551,069	1.21	246	731
Cambria	9,420,308	165,942	186,049	789,536	10,561,835	12,895,501	1.22	241	13,964
Center	997,006	2,159	1,433	....	1,000,598	1,002,407	1.00	242	1,145
Clarion	448,238	4,872	5,111	....	458,221	577,638	1.26	193	775
Clearfield	6,873,639	81,423	83,560	296,163	7,334,785	8,414,670	1.15	228	9,940
Elk	716,624	19,442	12,632	7,484	756,182	735,622	.97	227	1,127
Fayette	6,568,460	251,521	335,855	11,832,222	18,988,058	18,930,437	1.00	273	15,739
Huntingdon	387,751	8,485	8,326	55,923	460,485	685,680	1.49	231	780
Indiana	1,447,320	3,813	17,449	186,699	1,655,281	1,848,822	1.12	259	2,141
Jefferson	4,825,820	17,737	60,593	1,179,344	6,083,494	5,168,321	.85	260	6,166
Lawrence	190,190	17,706	4,549	....	212,445	264,546	1.25	257	457
Mercer	597,447	8,152	23,114	....	628,713	673,455	1.07	266	933
Somerset	5,723,387	32,430	105,231	50,278	5,911,326	7,593,413	1.28	228	7,719
Tioga	1,126,097	16,299	7,453	....	1,149,849	1,761,098	1.53	246	2,337
Washington	8,348,994	44,753	136,207	....	8,529,954	8,805,995	1.03	230	9,142
Westmoreland	10,426,183	221,817	343,867	7,819,644	18,811,511	19,626,499	1.04	274	19,472
Other counties[a]	502,002	1,500	600	....	504,102	627,205	1.24	288	733
Total	72,938,204	1,429,568	1,541,454	22,665,141	98,574,367	106,032,460	1.08	248	112,630

[a] Clinton, Greene, and Lycoming.

The distribution of the product for consumption during the last fourteen years has been as follows:

Distribution of the bituminous coal product of Pennsylvania, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total Quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	24,059,913	1,590,651	332,937	10,190,588	36,174,089	$27,953,315	$0.77	....	53,780
1890	29,288,923	1,473,317	395,837	11,144,096	42,302,173	35,376,916	.84	232	61,333
1891	29,976,914	2,007,348	321,225	10,483,003	42,788,490	37,271,053	.87	223	63,661
1892	32,425,949	2,207,827	356,779	11,704,021	46,694,576	39,017,164	.84	223	66,655
1893	33,322,328	1,934,429	426,122	8,387,845	44,070,724	35,260,674	.80	190	71,931
1894	29,722,803	1,589,595	342,294	8,257,771	39,912,463	29,479,820	.74	165	75,010
1895	35,164,453	1,732,803	468,381	12,851,591	50,217,228	35,980,357	.72	206	71,130
1896	37,696,555	1,570,161	504,224	9,786,513	49,557,453	35,368,249	.71	206	72,625
1897	40,419,846	1,653,049	556,604	11,968,392	54,597,891	37,636,347	.69	205	77,599
1898	48,019,561	1,520,750	732,984	14,891,838	65,165,133	43,352,588	.67	229	79,611
1899	53,671,963	1,525,772	972,692	17,979,748	74,150,175	56,247,791	.76	245	82,812
1900	58,696,100	1,506,778	1,067,942	18,571,506	79,842,326	77,438,545	.97	242	92,692
1901	60,165,317	1,681,282	1,339,096	19,120,251	82,305,946	81,397,586	.99	230	101,904
1902	72,938,204	1,429,568	1,541,454	22,665,141	98,574,367	106,032,460	1.08	248	112,630

In the following table is exhibited the total production in the last five years and the increases and decreases in 1902 as compared with 1901:

Bituminous coal production of Pennsylvania, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Allegheny	8,889,997	9,972,060	10,051,905	10,307,100	11,919,569	1,612,469	....
Armstrong	818,401	1,054,389	1,313,188	1,555,255	1,793,179	237,924	....
Beaver	223,855	258,466	262,398	176,012	225,162	49,150	....
Bedford	456,507	493,965	570,055	500,322	797,248	296,926	....
Blair	404,043	407,356	496,992	368,779	338,204	....	30,575
Bradford	22,508	31,835	32,065	22,189	....	....	22,189
Butler	161,312	214,899	221,704	269,161	454,166	185,005	....
Cambria	6,740,461	7,208,834	8,190,366	9,045,201	10,561,835	1,516,634	....
Center	714,175	912,648	932,265	839,512	1,000,598	161,086	....
Clarion	278,131	289,753	404,639	354,840	458,221	103,381	....
Clearfield	6,055,739	6,251,442	6,620,834	5,886,407	7,334,785	1,448,378	....
Clinton	166,250	221,574	288,881	306,228	365,732	59,504	....
Elk	873,485	1,221,979	926,403	1,007,314	756,182	....	251,132
Fayette	12,696,063	14,609,289	15,055,242	16,187,224	18,988,058	2,800,834	....
Greene	....	....	....	....	25,550	25,550	....
Huntingdon	312,607	357,812	368,942	374,529	460,485	85,956	....
Indiana	563,791	616,911	924,782	1,074,260	1,655,281	581,021	....
Jefferson	5,625,168	5,841,960	6,199,290	5,806,568	6,083,494	276,926	....
Lawrence	185,408	183,555	187,810	171,959	212,445	40,486	....
Lycoming	98,118	101,923	99,000	107,095	112,820	5,725	....
McKean	25,622	23,703	20,214	....	....	....	....

Bituminous coal production of Pennsylvania, 1898–1902, by counties—Continued.

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Mercer	316,669	486,724	528,070	577,338	628,713	51,375	....
Somerset	1,846,398	2,950,343	4,779,307	4,831,660	5,911,326	1,079,666	....
Tioga	921,760	670,126	931,301	861,072	1,149,849	288,777	....
Washington	4,753,673	4,987,360	4,856,138	5,910,621	8,529,954	2,619,333	....
Westmoreland	11,414,989	14,181,269	14,980,535	15,165,300	18,811,511	3,646,211	....
Small mines	600,000	600,000	600,000	600,000	(a)	(a)	a 600,000
Total	65,165,133	74,150,175	79,842,326	82,305,946	98,574,367	b 16,268,421	....

a Small mines production included in county distribution. b Net increase.

The following table exhibits the total production of bituminous coal in the State since 1873:

Production of bituminous coal in Pennsylvania, 1873–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	13,098,829	1888	33,796,727
1874	12,320,000	1889	36,174,089
1875	11,760,000	1890	42,302,173
1876	12,880,000	1891	42,788,490
1877	14,000,000	1892	46,694,576
1878	15,120,000	1893	44,070,724
1879	16,240,000	1894	39,912,463
1880	21,280,000	1895	50,217,228
1881	22,400,090	1896	49,557,453
1882	24,640,000	1897	54,417,974
1883	26,880,000	1898	65,165,133
1884	28,000,000	1899	74,150,175
1885	26,000,000	1900	79,842,326
1886	27,094,501	1901	82,305,946
1887	31,516,856	1902	98,574,367

TENNESSEE.

Total production in 1902, 4,382,968 short tons; spot value, $5,399,721.

Compared with 1901, the coal production of Tennessee in 1902 exhibits an increase of 749,678 short tons, or 20.6 per cent in quantity, and of $1,332,332, or 32.8 per cent in value. Since 1893, or for a period of nine years, the production of coal in Tennessee has increased annually, reaching its maximum in 1902, with an output 50 per cent larger than that of 1897, five years before, and more than double that of 1892. The effect of the great demand for soft coal in 1902, so far as Tennessee is concerned, is shown more in the advanced value than in the increased tonnage, large as the latter was. The average price of $1.23 realized for Tennessee coal in 1902 was the highest reached in fourteen years.

Tennessee lost more time from strikes in 1902 than any of the other States except West Virginia, Pennsylvania, Michigan, and Alabama. Of the 8,860 men employed in the coal mines of the State, 1,904 were on strike during a part of the year, the average time lost by each being 71.6 days. The entire time lost was equal to about 6.3 per cent of the total time made during the year.

The use of machines in Tennessee during 1902 showed a considerable increase over the preceding year, the number of mining machines in use increasing from 21 to 38, and the machine-mined product from 220,573 short tons to 303,995 short tons. The percentage of machine-mined coal to the total product was 6.94 in 1902, as against 6.07 in 1901. Whether this had any effect upon the increased efficiency of the men as shown by the returns for 1902 is doubtful, as the increase in the machine-mined coal was only a little more than 10 per cent of the total increase in production. There was, however, quite a marked increase in the individual production. The returns for 1902 show that 8,750 men were employed for 230 days in producing 4,382,968 tons of coal, an average of 501 tons per man per year and of 2.18 tons per man per day, against 401.7 tons per year and 1.76 tons per day as the average production for each man in 1901, when 9,046 men were employed for 228 days in producing 3,633,290 tons.

The statistics of production during the last two years are shown in the following table:

Coal production of Tennessee in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Anderson	633,998	11,535	18,876	....	664,409	$738,095	$1.11	210	1,774
Campbell	544,286	12,050	8,507	5,500	570,343	727,170	1.27	195	1,542
Claiborne	419,698	6,840	2,900	22,152	451,590	454,342	1.01	204	639
Hamilton	153,883	2,370	1,995	84,745	242,993	257,588	1.06	242	640
Marion	227,801	3,798	3,220	72,790	307,609	373,435	1.21	260	646
Morgan	277,988	1,062	180	87,774	367,004	383,134	1.04	224	1,563
Rhea	6,722	7,748	3,406	165,129	183,005	183,649	1.00	255	344
Scott	72,025	12,453	4,176	14,000	102,654	109,325	1.06	221	343
Cumberland, Grundy, and Putnam	285,135	1,826	3,723	97,052	387,736	431,923	1.11	245	835
Roane and White	186,395	14,797	13,478	136,777	351,447	404,228	1.15	294	720
Small mines	....	4,500	....	....	4,500	4,500	....	....	....
Total	2,807,931	78,979	60,461	685,919	3,633,290	4,067,389	1.12	228	9,046

Coal production of Tennessee in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Anderson	751,687	3,201	4,388	....	759,276	$892,437	$1.18	234	1,315
Campbell	488,429	27,913	17,823	120,000	654,165	978,575	1.50	201	1,707
Claiborne	694,987	15,710	4,900	33,168	748,765	815,285	1.09	233	1,016
Cumberland	107,450	650	1,482	....	109,582	105,271	.96	244	173
Grundy	264,093	622	2,658	65,177	332,550	404,855	1.22	181	528
Marion	221,116	13,858	714	76,758	312,446	456,436	1.46	228	894
Morgan	357,940	1,408	6,696	103,598	469,642	518,374	1.10	268	1,069
Rhea	56,744	7,461	3,389	172,103	239,697	282,838	1.18	259	521
Scott	74,480	6,496	5,640	11,913	98,529	143,538	1.46	237	261
Other counties [a]	400,483	11,050	15,593	231,190	658,316	802,112	1.22	255	1,266
Total	3,417,409	88,369	63,283	813,907	4,382,968	5,399,721	1.23	230	8,750

[a] Bledsoe, Franklin, Hamilton, Overton, Roane, Sequatchie, and White.

The distribution of the product for consumption for the last fourteen years has been as follows:

Distribution of the coal product of Tennessee, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	1,334,424	29,101	23,034	539,130	1,925,689	$2,238,309	$1.21	....	4,108
1890	1,482,357	41,932	23,583	621,713	2,169,585	2,395,746	1.10	263	5,082
1891	1,626,964	100,478	33,302	652,934	2,413,678	2,668,188	1.105	230	5,097
1892	1,448,262	55,452	17,037	571,313	2,092,064	2,355,441	1.13	240	4,926
1893	1,427,219	42,560	20,921	411,558	1,902,258	2,048,449	1.08	232	4,976
1894	1,571,406	59,985	28,993	520,495	2,180,879	2,119,481	.97	210	5,542
1895	1,808,056	51,923	25,477	650,188	2,535,644	2,349,032	.93	224	5,120
1896	1,990,538	43,752	40,343	588,473	2,663,106	2,281,295	.86	211	6,531
1897	2,150,179	37,620	39,275	661,775	2,888,849	2,329,534	.81	221	6,337
1898	2,199,075	37,971	52,523	733,327	3,022,896	2,337,512	.77	234	6,643
1899	2,444,655	86,351	55,675	743,978	3,330,659	2,940,644	.88	252	6,949
1900	2,615,253	66,320	49,451	781,538	3,509,562	4,003,082	1.14	242	7,646
1901	2,807,931	78,979	60,461	685,919	3,633,290	4,067,389	1.12	228	9,046
1902	3,417,409	88,369	63,283	813,907	4,382,968	5,399,721	1.23	230	8,750

In the following table is given the production, by counties, during the last five years, with the increases and decreases in 1902 as compared with 1901:

Coal production of Tennessee, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase 1902.	Decrease 1902.
Anderson	578,866	637,214	672,752	664,409	759,276	94,867	....
Campbell	325,757	429,717	502,991	570,343	654,165	83,822	....
Claiborne	298,574	387,499	392,699	451,590	748,765	297,175	....
Cumberland	....	1,080	88	55,327	109,582	54,255	....
Grundy	251,806	305,736	300,198	326,990	332,550	5,560	....
Hamilton	199,828	199,230	227,063	242,993	250,526	7,533	....
Marion	309,665	339,366	310,730	307,609	312,446	4,837	....
Morgan	339,292	350,336	388,142	367,004	469,642	102,638	....
Putnam	11,450	8,586	7,275	3,648	....	....	3,648
Rhea	184,239	181,428	210,528	183,005	239,697	56,692	....
Roane	170,556	162,441	181,753	159,221	152,947	....	6,274
Scott	145,216	157,256	100,338	102,654	98,529	....	4,125
White	203,047	166,270	210,505	192,226	182,501	....	9,725
Other counties and small mines	4,600	4,500	4,500	6,271	72,342	66,071	....
Total	3,022,896	3,330,659	3,509,562	3,633,290	4,382,968	773,450	23,772
Net increase	134,047	307,763	178,903	123,728	749,678	....	....

The annual output for the State since 1873 has been as follows:

Coal production of Tennessee, 1873–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	350,000	1888	1,967,297
1874	350,000	1889	1,925,689
1875	360,000	1890	2,169,585
1876	550,000	1891	2,413,678
1877	450,000	1892	2,092,064
1878	375,000	1893	1,902,258
1879	450,000	1894	2,180,879
1880	641,042	1895	2,535,644
1881	750,000	1896	2,663,106
1882	850,000	1897	2,888,849
1883	1,000,000	1898	3,022,896
1884	1,200,000	1899	3,330,659
1885	1,440,957	1900	3,509,562
1886	1,714,290	1901	3,633,290
1887	1,900,000	1902	4,382,968

TEXAS.

Total production in 1902, 901,912 short tons; spot value, $1,477,245.

The effect of the oil developments in Texas in 1902 was decidedly unfavorable to the coal-mining interests and the production fell off more than 200,000 tons as compared with 1901. During 1902 a large amount of crude petroleum was forced on the market at prices with which the coal mined in the State, particularly the lignite, could not compete, and several of the lignite mines were compelled to shut down. The wild exploitation of the Beaumont oil fields resulted, as those familiar with petroleum conditions knew it would, in an early end of "gusher" lives, and with a falling off in pressure and wasteful production the industry has settled down to a fairly conservative basis.

As a result of this condition in the petroleum fields a more hopeful aspect has been given to the coal-mining interests, and in the early months of 1903 some of the lignite mines which had been shut down during the oil excitement were reopened, and it is to be expected that the production for the current year will show a decided gain over 1902.

There were 16 counties in the State which produced coal in 1902. In 7 of these counties the product was classed as bituminous coal, and 9 counties produced lignite or brown coal.

The seven bituminous-producing counties were Eastland, Erath, Maverick, Parker, Webb, Wise, and Young. The counties in which lignite coal is produced are Anderson, Bastrop, Houston, Medina, Milam, Raines, Robertson, Shelby, and Wood.

Coleman and Palo Pinto counties were dropped from the list of counties producing bituminous coal in 1902, Young County was added, and Anderson, Houston, and Raines were added to the lignite producers.

The statistics of production in the last two years are shown in the following tables.

Coal production of Texas in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Bituminous:								
Coleman, Eastland, Erath, Maverick, Palo Pinto, Parker, Webb, Wise	787,700	4,203	12,895	804,798	$1,655,736	$2.06	267	2,616
Lignite:								
Bastrop, Medina, Milam, Robertson, Shelby, Wood	296,681	222	6,252	303,155	251,288	.83	248	435
Total	1,084,381	4,425	19,147	1,107,953	1,907,024	1.72	264	3,051

Coal production of Texas in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Bituminous:								
Eastland, Erath, Maverick, Parker, Webb, Wise, Young	683,345	4,881	7,779	696,005	$1,326,155	$1.91	278	1,963
Lignite:								
Anderson, Bastrop, Houston, Medina, Milam, Raines, Robertson, Shelby, Wood	203,822	710	1,375	205,907	151,090	.73	192	406
Total	887,167	5,591	9,154	901,912	1,477,245	1.64	267	2,369

The record of production and distribution since 1889 has been as follows:

Distribution of the coal product of Texas, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	120,602	6,552	1,062	128,216	$340,617	$2.66	....	....
1890	180,800	1,840	1,800	184,440	465,900	2.53	241	674
1891	169,300	900	1,900	172,100	412,300	2.40	225	787
1892	241,005	4,460	225	245,690	569,333	2.32	208	871
1893	300,064	462	1,680	302,206	688,407	2.28	251	996
1894	417,281	2,412	1,155	420,848	976,458	2.32	283	1,062
1895	475,157	7,705	2,097	484,959	913,138	1.88	171	1,642
1896	522,177	12,846	8,992	544,015	896,251	1.65	187	1,953
1897	621,635	8,357	9,349	639,341	972,323	1.52	220	1,766
1898	678,732	3,247	4,755	686,734	1,139,763	1.66	245	2,130
1899	839,166	34,690	9,976	883,832	1,334,895	1.51	256	2,410
1900	954,521	4,318	9,534	968,373	1,581,914	1.63	246	2,844
1901	1,084,381	4,425	19,147	1,107,953	1,907,024	1.72	264	3,051
1902	887,167	5,591	9,154	901,912	1,477,245	1.64	267	2,369

UTAH.

Total production in 1902, 1,574,521 short tons; spot value, $1,797,454.

The coal-mining industry of Utah has developed with great rapidity during the last five years, during which time the output has increased more than 200 per cent, the product in 1902 being more than three times that of 1897. This State, however, formed one of the few exceptions to the prevailing tendency toward higher prices, the average price per ton declining from $1.26 in 1901 to $1.14 in 1902.

Of the total amount of coal produced in Utah during 1902, 74,502 tons were undercut by machines as against 14,738 tons of machine-mined coal in 1901. There was no increase in the number of machines in use, the increase in machine tonnage being due to the fact that the machines were not installed until the latter part of 1901 and were used throughout 1902.

The average production per man employed in 1901 was 772.6 tons; in 1902 it was 862 tons. The average production per man per day increased from 2.98 tons in 1901 to 3.33 tons in 1902. There were no strikes reported at any of the coal mines in Utah during 1902.

In the following table are presented the statistics of coal production in Utah during the last two years:

Coal production of Utah in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	1,225,179	6,824	26,257	987	1,259,247	$1,574,168	$1.25	263	1,565
Summit	45,184	3,542	4,161		52,887	73,564	1.39	233	108
Uinta		6,068	8		6,076	9,546	1.57	200	18
Emery, Sanpete	2,485	1,899	20		4,404	8,804	2.00	144	21
Total	1,272,848	18,333	30,446	987	1,322,614	1,666,082	1.26	259	1,712

Coal production of Utah in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	1,226,542	8,501	42,431	230,215	1,507,689	$1,697,986	$1.13	267	1,676
Emery		4,718			4,718	5,250	1.11	87	17
Summit	42,460	4,062	3,001		49,523	70,136	1.42	212	79
Uinta	1,200	2,340			3,540	6,250	1.77	110	24
Iron, Sanpete	7,141	1,910			9,051	17,832	1.97	153	30
Total	1,277,343	21,531	45,432	230,215	1,574,521	1,797,454	1.14	259	1,826

The distribution of the product since 1891 and the total output since 1885 are shown in the following tables:

Distribution of the coal product of Utah, 1891-1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1891	315,711	8,233	21,650	25,451	371,045	$666,646	$1.80	....	621
1892	321,431	6,775	6,509	26,298	361,013	562,625	1.56	230	646
1893	350,423	7,649	4,258	50,875	413,205	611,092	1.48	226	576
1894	364,675	11,173	6,892	48,810	431,550	603,479	1.40	199	671
1895	376,479	25,097	7,253	63,027	471,856	617,349	1.31	203	670
1896	340,338	9,171	7,411	61,707	418,627	500,547	1.20	202	679
1897	424,770	22,667	9,198	64,925	521,560	618,230	1.19	204	704
1898	485,716	11,542	9,845	86,606	593,709	752,252	1.27	243	739
1899	753,881	13,303	13,046	5,819	786,049	997,271	1.27	265	743
1900	1,082,723	17,355	18,650	28,299	1,147,027	1,447,027	1.26	246	1,308
1901	1,272,848	18,333	30,446	987	1,322,614	1,666,082	1.26	259	1,712
1902	1,277,343	21,531	45,432	230,215	1,574,521	1,797,454	1.14	259	1,826

Coal production of Utah, 1885-1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1885	213,120	1894	431,550
1886	200,000	1895	471,836
1887	180,021	1896	418,627
1888	258,961	1897	521,560
1889	236,651	1898	593,709
1890	318,159	1899	786,049
1891	371,045	1900	1,147,027
1892	361,013	1901	1,322,614
1893	413,205	1902	1,574,521

VIRGINIA.

Total production in 1902, 3,182,993 short tons; spot value, $2,543,595.

Increased activity in the mines of Wise County, on the Clinch Valley division of the Norfolk and Western Railroad, resulted in an increase in the total production for the State of 457,120 short tons as compared with that of 1901. Wise County's production in 1902 was 503,724 short tons larger than that of the preceding year, while Tazewell County's production fell off 52,815 tons. These are the only two counties having any importance as producers of coal, the combined output of Montgomery, Pulaski, and Chesterfield counties being less than 40,000 tons in each of the last 2 years. The Richmond basin, from which some of the first coal mined in the United States was taken and which 80 years ago produced over 100,000 tons a year, has ceased to be a factor in the trade. Efforts made a few years ago to rehabilitate the industry there ended disastrously for those interested in the enterprise, as the quality of the coal was of a character which could not compete, even at much cheaper rates, with other fuels. The little coal now mined there is practically all for immediately local markets.

Wise County, now the chief producer in the State, was the latest to be developed. The coal-mining industry began there 10 years ago, the first production being reported in 1893. In 1897 Wise County exceeded Tazewell in coal production, and since that date has increased the lead, until in 1902 the output of Wise County was nearly 3½ times that of Tazewell. Prices fell off in both counties during 1902, the average for the State declining from 86 cents in 1901 to 80 cents in 1902. The statistics of Virginia's production in 1902 show that the machine-mined portion of the output decreased 100,000 tons, or more than 40 per cent from that of 1901, and that the number of machines reported as in use increased from 6 to 11.

The details of production by counties in the last 2 years are shown in the following tables:

Coal production of Virginia in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Montgomery	5,975	4,902	300	....	11,177	$22,670	$2.03	178	53
Tazewell	532,872	5,869	12,161	225,666	776,568	762,448	.98	245	1,105
Wise	834,122	5,240	14,611	1,064,720	1,918,693	1,537,667	.80	295	2,894
Chesterfield, Henrico, Pulaski	17,755	....	1,680	....	19,435	31,204	1.60	275	100
Total	1,390,724	16,011	28,752	1,290,386	2,725,873	2,353,989	.86	279	4,152

Coal production of Virginia in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Montgomery	7,911	4,875	....	....	12,786	$30,716	$2.40	233	53
Tazewell	538,854	9,232	13,216	162,451	723,753	684,663	.95	286	634
Wise	875,257	6,809	17,731	1,522,620	2,422,417	1,782,583	.74	295	3,143
Chesterfield, Pulaski	22,537	....	1,500	....	24,037	45,633	1.90	276	82
Total	1,444,559	20,916	32,447	1,685,071	3,182,993	2,543,595	.80	293	3,912

The distribution of the product for consumption during the last 14 years is shown in the following table. The increase in the amount of coal made into coke is particularly noticeable, more than one-half the total product of the State being so consumed in 1902. More than one-half of Wise County's product in 1901 and nearly two-thirds of the output in 1902 were made into coke.

Distribution of the coal product of Virginia, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	732,881	13,179	7,516	112,210	865,786	$804,475	$0.93	....	1,555
1890	608,641	17,002	4,908	153,460	784,011	589,925	.75	296	1,295
1891	583,082	16,685	3,178	133,454	736,399	611,654	.83	246	820
1892	527,304	20,721	6,611	120,569	675,205	578,429	.86	192	836
1893	714,188	20,578	4,609	80,964	820,339	692,748	.84	253	961
1894	1,015,713	21,162	4,690	187,518	1,229,083	933,576	.76	234	1,635
1895	1,024,200	15,173	22,338	306,613	1,368,324	869,873	.63	225	2,158
1896	824,042	40,951	38,540	351,190	1,254,723	848,851	.68	198	2,510
1897	969,973	29,017	43,087	486,225	1,528,302	1,021,918	.67	213	2,344
1898	1,029,185	19,564	16,234	750,291	1,815,274	1,070,417	.59	230	1,855
1899	1,175,504	23,634	19,004	887,649	2,105,791	1,304,241	.62	252	1,960
1900	1,334,659	45,705	40,639	972,751	2,393,754	2,123,222	.89	239	3,631
1901	1,390,724	16,011	28,752	1,290,386	2,725,873	2,353,989	.86	279	4,152
1902	1,444,559	20,916	32,447	1,685,071	3,182,993	2,543,595	.80	293	3,912

It will be seen from this table that although the production in 1902 was 457,120 tons, or 17 per cent more than that of 1901, there was a decrease in the number of men employed in and about the mines, with, however, an increase of 14 in the average working days. Dividing the tonnage in each year by the number of employees, it is found that the total average production per man was 657 tons in 1901 and 814 tons in 1902. Dividing these again by the average number of days worked in each year, we find that the average tonnage per man per day increased from 2.355 in 1901 to 2.78 in 1902.

The total production of coal in Virginia since 1880 has been as follows:

Coal production of Virginia, 1880–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880	112,000	1892	675,205
1881	112,000	1893	820,339
1882	112,000	1894	1,299,083
1883	252,000	1895	1,368,324
1884	336,000	1896	1,254,723
1885	567,000	1897	1,528,302
1886	684,951	1898	1,815,274
1887	825,263	1899	2,105,791
1888	1,073,000	1900	2,393,754
1889	865,786	1901	2,725,873
1890	784,011	1902	3,182,993
1891	736,399		

WASHINGTON.

Total production in 1902, 2,681,214 short tons, spot value $4,572,295.

Washington is the only one of the Pacific coast States producing true coal, all the product from California and Oregon being lignite. Some of the Washington coals approach anthracite in character, and some natural coke has been produced. Some coke is also made from the bituminous coals mined in the State. Production in the State has increased regularly since 1894, and the output in 1902, as in 1901, was more than double that of any year prior to 1897. Compared with 1901 the production in 1902 increased 102,997 short tons, or 4.0 per cent in quantity, and $301,219, or 7.1 per cent in value.

No production by the use of machines was reported in 1902, although the returns for the preceding year showed 4 machines in use and a machine-mined product of 6,500 tons.

The details of production during the last 2 years are shown in the following tables:

Coal production of Washington in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
King	899,014	9,033	49,502	....	957,549	$1,430,664	$1.49	254	1,850
Kittitas	991,458	5,984	12,159	2,920	1,012,521	1,513,053	1.49	300	1,515
Pierce	497,282	3,016	14,017	71,669	585,984	1,262,792	2.15	284	1,131
Cowlitz, Lewis, Skagit, and Whatcom	12,522	520	....	9,121	22,163	64,567	2.91	210	49
Total	2,400,276	18,553	75,678	83,710	2,578,217	4,271,076	1.66	276	4,545

Coal production of Washington in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
King	940,140	18,017	59,731	....	1,017,888	$1,988,325	$1.95	278	1,696
Kittitas	1,224,371	7,805	18,744	....	1,250,920	1,712,780	1.37	299	1,547
Pierce	311,630	2,539	13,288	56,146	383,603	799,774	2.08	234	1,040
Other counties[a]	22,036	926	5,240	601	28,803	71,416	2.48	288	121
Total	2,498,177	29,287	97,003	56,747	2,681,214	4,572,295	1.71	275	4,404

[a] Lewis, Skagit, and Whatcom.

The following table, in which the distribution of the product for the last fourteen years is exhibited, shows also that with the larger production in 1902 there were less men employed and a decrease of one in the average number of days worked; it is found also that the total average production per man in 1902 was 609 tons against 567 tons in 1901, and that the average tonnage per day increased from 2.05 in 1901 to 2.22 in 1902:

Distribution of the coal product of Washington, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	956,046	15,574	19,958	39,000	1,030,578	$2,393,238	$2.32	....	2,657
1890	1,212,621	17,249	17,019	16,800	1,263,689	3,426,590	2.71	270	2,206
1891	1,008,496	12,025	20,428	15,300	1,056,249	2,437,270	2.31	211	2,447
1892	1,150,865	9,802	40,085	12,675	1,213,427	2,763,547	2.28	247	2,564
1893	1,186,109	18,888	48,506	11,374	1,264,877	2,920,876	2.31	241	2,757
1894	1,030,232	10,822	56,853	8,563	1,106,470	2,578,441	2.33	207	2,662
1895	1,108,868	16,320	43,249	22,973	1,191,410	2,577,958	2.16	224	2,840
1896	1,095,484	16,722	44,613	38,685	1,195,504	2,396,078	2.00	221	2,622
1897	1,347,915	7,149	39,902	39,146	1,434,112	2,777,687	1.94	236	2,739
1898	1,748,411	30,636	56,966	48,558	1,884,571	3,352,798	1.78	270	3,145
1899	1,897,962	20,281	61,443	50,195	2,029,881	3,603,989	1.78	259	3,330
1900	2,318,897	26,120	69,788	59,288	2,474,093	4,700,068	1.90	289	3,670
1901	2,400,276	18,553	75,678	83,710	2,578,217	4,271,076	1.66	276	4,545
1902	2,498,177	29,287	97,003	56,747	2,681,214	4,572,295	1.72	275	4,404

The following table shows the production, by counties, during the last five years and the increases or decreases in 1902 as compared with 1901:

Production of coal in Washington, 1898–1902, by counties.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase 1902.	Decrease 1902.
Cowlitz	1,088	480	500	....	....	....	....
King	785,806	847,303	1,003,101	957,549	1,017,888	60,339	....
Kittitas	566,396	661,210	873,751	1,012,521	1,250,920	238,399	....
Lewis	760	300	300	520	826	306	....
Pierce	509,142	506,385	577,127	585,984	383,603	....	202,381
Skagit	12,226	6,755	10,130	12,643	21,967	9,324	....
Whatcom	9,153	7,448	9,184	9,000	6,010	....	2,990
Total	1,884,571	2,029,881	2,474,093	2,578,217	2,681,214	[a] 102,997	....

[a] Net increase.

The total production for the State since 1885 has been as follows:

Production of coal in Washington, 1885–1902.

Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*
1885	380,250	1894	1,106,470
1886	423,525	1895	1,191,410
1887	772,601	1896	1,195,504
1888	1,215,750	1897	1,434,112
1889	1,030,578	1898	1,884,571
1890	1,263,689	1899	2,029,881
1891	1,056,249	1900	2,474,093
1892	1,213,427	1901	2,578,217
1893	1,264,877	1902	2,681,214

WEST VIRGINIA.

Total production in 1902, 24,570,826 short tons; spot value, $24,748,658.

Compared with the output for 1901, West Virginia's production of coal in 1902 exhibits an increase of 502,424 short tons, or 2.1 per cent. Considering the conditions which obtained in the coal-mining industry, particularly among the Eastern States, throughout the greater part of 1902, this increase is insignificant in amount. The comparatively small gain in a year during which the demand for bituminous coal was unprecedented in the history of the country was due to labor troubles in three of the large coal-producing districts—the New River, the Kanawha, and the Pocahontas. In the first two of these regions the interference with operations resulted in an actual decrease in production of nearly one and a half million tons. Fayette County, which contributes the greater portion of the output in the New River district, shows a decrease in production for 1902 of 1,277,277 short tons, or more than 20 per cent, as compared with 1901. Kanawha and Putnam counties, in the Kanawha district, lost, respectively, 135,286 tons and 58,530 tons. In Fayette County 7,627 men were on strike for an average of 92 days, in Kanawha County 4,074 men were idle an average of 100 days, and in Putnam county 273 men were out for an average of 75 days. In the Pocahontas district McDowell County had 3,321 men idle for an average of 33 days and Mercer County reported 662 men idle an average of 48 days. The total loss in working time in these two counties was 135,764 days, but in neither county was it sufficient to cause a falling off in the output. The total time lost in the New River and Kanawha districts amounted to 1,158,076 working days.

The cause of the trouble from which these results ensued was the refusal of the operators to meet in joint conference the officials of the

United Mine Workers of America, or, in other words, "to recognize the union." At a convention held in Huntington on May 24 a strike was ordered, to begin on June 7 and to continue until certain demands made at a previous convention (March 18) were granted. Obedience to the strike order was not generally given throughout the State. In the northern districts little attention was paid to it, and the few mines at which strikes occurred were not seriously affected. In the Pocahontas field about 60 per cent of the employees quit work, but the strikers lacked enthusiasm and the strike gradually disintegrated, the average time lost by those who quit working averaging, as previously stated, 33 days. The strike in this region was officially "declared off" on September 4. The chief struggle was carried on among the operations along the New and Kanawha rivers. The efforts of the operators to work their mines were desperately resisted by the striking miners, and the military arm of the State government was called upon to suppress the rioting which unfortunately but naturally occurred. Work was, however, gradually resumed after a month or six weeks of comparative idleness, and by the latter part of September the mines were for the most part in full operation. The strike was not declared off until July, 1903. Several months previous to this date the Kanawha River operators had acceded to the demand for "recognition" and had signed the union scale. The New River operators held out, and a new strike order for that region was issued, although the old strike had not been declared off. The new strike in the New River district was as unsuccessful as the first one so far as securing recognition was concerned and less so in the suspension of work. Most of the men in the district were at work when the strike was called off.

The total number of men who were on strike in West Virginia during 1902 was 18,129, a little more than half the total number of mine employees in the State. The average number of working days lost on account of strikes ranged from 10 in Marshall County to 141 in Nicholas, and the average number of days lost by the 18,129 men was 75. The total loss in working days amounted to 1,362,054, equivalent to 18.7 per cent of the total time made by all the coal workers in the State. The average tonnage per day per man employed during the year was about 3½ tons, indicating a loss in possible production by reason of the strikes of about 4,750,000 tons. It is reasonable to infer, then, that, except for the suspension of work due to the labor troubles, the production of West Virginia would have amounted in 1902 to approximately 29,250,000 tons.

The use of machines for undercutting coal in West Virginia has increased steadily during the last 6 years, and may be expected to continue to increase, as the coal seams in the State are for the most part well adapted to machine mining. The returns for 1902 show that there were 579 machines in use last year as against 403 in 1901, an increase of 176, or more than 40 per cent. The machine-mined product increased from 4,817,943 tons to 5,738,045 tons, a gain of 920,102 tons, or 19 per cent.

During the 23 years that the history of coal production has been recorded in the volumes of Mineral Resources of the United States the coal production of West Virginia has increased an average of over 1,000,000 tons each year. Notwithstanding its decreased production in 1895 West Virginia in that year exceeded the output of Ohio, which up to that time held third place as a coal producer.

The details of production in 1901 and 1902, by counties, with the distribution of the product for consumption, are shown in the following tables :

Coal production of West Virginia in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Barbour	266,048	11,287	18,111	17,930	313,376	$228,635	$0.73	218	482
Brooke	68,279	4,838	81	....	73,198	70,134	.96	272	119
Fayette	5,090,139	80,602	66,202	815,446	6,052,389	5,417,032	.90	207	9,207
Harrison	1,728,008	7,996	18,880	7,679	1,762,563	1,394,109	.79	211	1,936
Kanawha	1,878,056	35,747	17,981	52,119	1,983,903	1,782,509	.90	229	3,073
McDowell	3,386,075	40,063	34,187	1,535,186	4,995,511	4,506,511	.90	232	5,178
Marion	3,089,516	17,054	45,053	259,974	3,411,597	2,737,443	.80	215	3,050
Marshall	181,638	31,147	4,452	....	217,237	191,069	.88	290	284
Mason	74,322	42,109	13,533	....	129,964	116,553	.90	192	302
Mercer	676,112	7,736	4,994	275,186	964,028	828,609	.86	239	962
Mineral	593,529	3,706	541	....	597,776	443,472	.74	247	676
Mingo	567,626	4,851	4,409	....	576,886	454,344	.79	254	1,219
Monongalia	89,019	699	184	20,899	110,801	93,713	.85	246	107
Ohio	87,011	103,404	1,346	....	191,761	180,564	.94	276	261
Preston	470,877	1,408	4,076	12,878	489,239	681,647	1.39	224	517
Putnam	237,163	4,270	1,356	....	242,789	237,044	.98	230	691
Randolph	139,339	1,187	679	20,356	161,561	124,229	.77	185	266
Taylor	371,595	7,127	1,868	....	380,590	279,731	.73	192	529
Tucker	713,645	6,273	16,846	360,576	1,097,340	778,045	.71	247	1,689
Hancock and Raleigh	151,812	38,242	839	....	190,893	177,791	.93	165	387
Small mines	....	125,000	....	....	125,000	125,000	......	....	....
otal	19,859,809	574,746	255,618	3,378,229	24,068,402	20,848,184	.87	219	30,935

Coal production of West Virginia in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Barbour	455,511	21,835	9,801	25,578	512,725	$560,068	$1.09	225	769
Braxton	....	4,910	....	....	4,910	5,665	1.15	98	16
Brooke	36,350	3,847	175	....	40,372	53,868	1.33	184	92
Fayette	3,979,127	48,570	54,731	692,684	4,775,112	5,832,098	1.22	181	8,889
Gilmer	....	3,440	....	....	3,440	3,480	1.01	145	8
Grant	28	2,748	....	....	2,776	3,226	1.16	77	45
Hancock	25,623	53,721	1,056	....	80,400	108,953	1.36	234	109
Harrison	1,935,727	22,920	26,166	81,784	2,066,597	1,985,078	.96	175	2,629
Kanawha	1,765,272	31,423	13,341	38,581	1,848,617	2,226,383	1.20	178	4,253
Lewis	....	540	....	....	540	405	.75	45	4
Marion	2,817,880	24,841	54,676	499,797	3,397,194	3,090,184	.91	206	3,279
Marshall	159,484	79,090	5,217	....	243,791	245,350	1.01	211	350
Mason	73,105	68,587	3,035	....	144,727	148,254	1.02	233	353
McDowell	3,761,702	67,210	45,514	1,585,229	5,459,655	4,768,455	.87	240	5,988
Mercer	993,838	9,166	6,291	238,984	1,248,279	1,100,423	.88	221	1,186
Mineral	509,796	5,096	101	....	514,993	450,168	.87	238	654
Mingo	794,358	7,844	3,972	....	806,174	786,165	.98	243	1,548
Monongalia	95,774	1,943	437	55,320	153,474	124,968	.81	233	138
Ohio	137,981	90,752	1,508	....	230,241	243,758	1.06	281	321
Preston	512,641	23,146	14,553	40,096	590,436	698,447	1.18	196	1,036
Putnam	182,087	1,146	1,026	....	184,259	274,992	1.49	221	670
Raleigh	273,548	3,327	4,942	....	281,817	359,251	1.27	190	463
Randolph	310,929	4,965	625	83,626	400,145	410,945	1.03	159	573
Taylor	353,014	13,474	2,162	....	368,650	339,459	.92	189	522
Tucker	634,094	23,792	18,156	490,038	1,166,080	858,245	.74	276	1,426
Clay, Nicholas, Ritchie and Upshur	39,452	5,570	400	....	45,422	70,370	1.55	142	179
Total	19,847,321	623,903	267,885	3,831,717	24,570,826	24,748,658	1.01	205	35,500

The distribution of the product for consumption since 1889 is shown in the following table. This statement also shows the total number of men employed in and about the mines and the average number of days worked by them. From this table it is seen that there were 4,565, or nearly 15 per cent, more men employed in 1902 than in 1901. Many of these were miners from the anthracite region seeking work in the bituminous fields of this State. The time lost by strike in the southern part of the State reduced the average time made from 219 days in 1901 to 205 days in 1902. The tonnage per man per day and per year deduced from these figures shows that in 1901 778 tons were mined for every man employed, and that in 1902 692 tons were produced per man. The tonnage per man per day fell off from 3.55 to 3.38.

Distribution of the coal product of West Virginia, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	4,764,900	493,287	37,368	936,325	6,231,880	$5,086,584	$0.82	....	9,952
1890	5,614,752	438,527	30,594	1,310,781	7,394,654	6,208,128	.84	227	12,236
1891	6,887,151	429,878	47,163	1,856,473	9,220,665	7,359,816	.80	237	14,227
1892	7,560,790	441,159	49,563	1,687,243	9,738,755	7,852,114	.80	228	14,867
1893	8,591,962	390,689	46,898	1,679,029	10,708,578	8,251,170	.77	219	16,524
1894	9,116,314	428,202	64,126	2,019,115	11,627,757	8,706,808	.75	186	17,824
1895	8,858,256	445,023	50,595	2,034,087	11,387,961	7,710,575	.68	195	19,159
1896	9,838,053	426,441	56,395	2,555,407	12,876,296	8,336,685	.65	201	19,078
1897	11,312,408	446,795	58,694	2,430,262	14,248,159	8,987,393	.63	205	20,504
1898	12,965,903	471,796	61,176	3,202,124	16,700,999	10,131,264	.61	218	21,607
1899	15,044,272	476,996	87,022	3,644,705	19,252,995	12,053,268	.63	242	23,625
1900	18,348,162	494,051	142,071	3,662,923	22,647,207	18,416,871	.81	231	29,163
1901	19,859,809	574,746	255,618	3,378,229	24,068,402	20,848,184	.87	219	30,935
1902	19,847,321	623,903	267,885	3,831,717	24,570,826	24,748,658	1.01	205	35,500

In the following table is shown the production in West Virginia, by counties, during the last 5 years, together with the increases and decreases in 1902, as compared with 1901:

Coal production of West Virginia, by counties, 1898–1902.

[Short tons.]

County.	1898.	1899.	1900.	1901.	1902.	Increase, 1902.	Decrease, 1902.
Barbour	35,643	79,735	216,231	313,376	512,725	199,349	....
Brooke	78,055	77,246	60,970	73,198	40,372	....	32,826
Fayette	4,592,772	5,039,815	5,742,138	6,052,389	4,775,112	....	1,277,277
Grant	560	....	....	....	2,776	2,776	....
Hancock	....	....	....	....	80,400	80,400	....
Harrison	410,942	641,022	945,955	1,762,563	2,066,597	304,034	....
Kanawha	1,354,500	1,505,141	2,062,741	1,983,903	1,848,617	....	135,286
Lewis	....	....	....	....	540	540	....
McDowell	3,904,976	4,290,912	4,921,235	4,995,511	5,459,655	464,144	....
Marion	2,114,352	2,733,161	3,241,675	3,411,597	3,397,194	....	14,403
Marshall	195,232	239,436	231,571	217,237	243,791	26,554	....
Mason	116,026	97,233	142,209	129,964	144,727	14,763	....
Mercer	834,169	898,405	1,009,536	964,028	1,248,279	284,251	....
Mineral	586,345	628,539	641,156	597,776	514,993	....	82,783
Mingo	377,531	481,150	574,156	576,886	806,174	229,288	....
Monongalia	35,750	51,520	87,400	110,801	153,474	42,673	....
Ohio	136,929	159,857	137,796	191,761	230,241	38,480	....
Preston	232,603	281,414	381,947	489,239	590,436	101,197	....
Putnam	206,407	210,821	137,870	242,789	184,259	....	58,530
Raleigh	99,852	86,088	90,507	148,493	281,817	133,324	....
Randolph	17,080	47,291	179,588	161,561	400,145	238,584	....
Taylor	260,146	378,765	523,258	380,590	368,650	....	11,940
Tucker	945,217	1,157,470	1,180,053	1,097,340	1,166,080	68,740	....
Other counties and small mines	165,912	167,974	139,215	167,400	53,772	....	[a]113,628
Total	16,700,999	19,252,995	22,647,207	24,068,402	24,570,826	[b]502,424	....

[a] This apparent decrease is due to the distribution of the "small mine" production among the different counties.

[b] Net increase.

It will be seen from the foregoing table that out of 23 counties the production increased in 16 and decreased in 7. The principal gains were made by McDowell County, 464,144 tons, Harrison, 304,034 tons; Mercer, 284,251 tons; Randolph, 238,584 tons, and Mingo, 229,288 tons. Harrison County, which was second in quantity of increased tonnage in 1902, stood first in this respect in 1901 and has made the record for increased production in the last 5 years. This county's output in 1902 was more than 5 times what it was in 1898.

Fayette County sustained the heaviest loss, with a reduced production of 1,277,277 short tons. Kanawha County decreased 135,286 tons. The cause of these decreases as also for the reduced tonnage from Putnam County was the labor troubles already referred to.

The principal coal-producing regions of West Virginia may be divided into four distinct districts. These may be distinguished by certain geographic or physiographic features. They do not include all of the coal-producing counties of the State, but do include the more important ones, and contributed nearly 90 per cent to the total output of the State. Two of these districts are in the northern part of the State, and two in the southern portion. The two in the northern portion of the State are designated, respectively, the Fairmont or Upper Monongahela district, and the Elk Garden or Upper Potomac. Those in the southern portion of the State are the Pocahontas or Flat Top district and the New and Kanawha River district. The Upper Monongahela district is penetrated by the Baltimore and Ohio Railroad, and sends its coal to market over that highway. The Upper Potomac region is also reached by the Baltimore and Ohio Railroad, and is penetrated by the West Virginia Central and Pittsburg Railroad. The Pocahontas or Flat Top region is tributary to the main branch of the Norfolk and Western Railroad. All of the product of this district goes either west or to tidewater over that line. The New and Kanawha River district is named from the two rivers which drain it, the coal being shipped partly by the Chesapeake and Ohio Railroad, which passes through it, and partly by barges on the Kanawha River. The most important district from the productive point of view is the New and Kanawha River, which embraces the counties of Fayette, Kanawha, Raleigh, and Putnam. The coal from these four counties is drawn from two different areas, most of the coal from Kanawha and Putnam counties being from a lower geologic horizon than that of Fayette and Raleigh counties, but the district is practically compact and continuous, is drained by the same waters and reached by the same railroad, so the two areas are considered as one district in this report. The production of these four counties in 1902 was reduced by strikes, and the Pocahontas district assumed first place for the time. The output for the two years was—1901, 8,427,574 tons; 1902, 7,089,805 tons.

The Pocahontas or Flat Top district embraces the counties of McDowell and Mercer in West Virginia and Tazewell County in Virginia. The openings to the mines in Tazewell County are in Virginia, and it has been customary to credit that county and State with the total production, although it is known that most of the coal is taken from the West Virginia side of the line. Because of this the production of Tazewell County has been included in the following table with the Pocahontas or Flat Top district. The production in this district in 1902 was nearly 700,000 tons more than that of 1901, the figures for the two years being, respectively, 6,736,107 tons and 7,431,687 tons.

The Fairmont region, which embraces Harrison and Marion counties, and includes the mines around Clarksburg and Fairmont, has shown the largest ratio of increase of all the coal-producing districts of West Virginia. The production of this district in 1902 was nearly 14 times that of 1886, 17 years before; nearly 5 times that of 1891, and more than 3 times that of 1896. As compared with 1901 it shows an increase of 289,631 tons. The total product in 1902 amounted to 5,463,791 short tons as compared with 5,174,160 tons in 1901.

The Upper Potomac or Elk Garden district is a part of an isolated basin which lies to the east of the main Appalachian field, and which includes the Cumberland region of Maryland, the Somerset district of Pennsylvania, and the Piedmont region of West Virginia. The counties in West Virginia included in this district are Mineral, Tucker, and Randolph. Most of the coal mined is drawn from what is known as "Big Vein," which has furnished the greater portion of Maryland's product. The production in 1902 amounted to 2,081,218 short tons as compared with 1,856,677 short tons in 1901.

In the following table is exhibited the production of these 4 principal districts since 1886:

Coal production of the principal districts of West Virginia, 1886–1902.

[Short tons.]

Year.	New and Kanawha River district.	Pocahontas or Flat Top district. [a]	Fairmont or Upper Monongahela district.	Upper Potomac or Elk Garden district.
1886	2,290,563	968,484	406,976	383,712
1887	2,379,296	1,357,040	520,064	503,343
1888	2,840,630	1,912,695	473,489	518,878
1889	2,669,016	2,290,270	456,582	666,956
1890	3,012,414	2,702,092	600,131	819,062
1891	3,632,209	3,137,012	1,150,569	1,052,308
1892	3,773,021	3,503,260	1,141,430	942,154
1893	4,099,112	3,815,280	1,255,956	1,129,397
1894	3,650,971	5,059,025	1,655,532	927,220
1895	4,399,623	4,044,998	1,550,256	1,125,601
1896	4,650,455	4,608,113	1,743,590	1,245,012
1897	4,921,701	4,859,373	2,074,663	1,425,026
1898	5,947,272	5,521,160	2,525,294	1,531,562
1899	6,544,956	6,033,344	3,374,183	1,786,009
1900	7,804,879	6,901,637	4,187,630	1,999,797
1901	8,427,574	6,736,107	5,174,160	1,856,677
1902	7,089,805	7,431,687	5,463,791	2,081,218

[a] Including production of Tazewell County, Virginia.

In order to show the great advance made by West Virginia as a coal-producing State, the following table has been prepared. The statement shows that there has only been one exception in twenty-three years to a steadily increasing output, and that during this period the average annual increase has exceeded 1,000,000 short tons.

Annual increase in the coal production of West Virginia, 1880–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1881 over 1880	112,000	1894 over 1893	919,179
1882 over 1881	560,000	Total increase in fourteen years.	10,059,757
1883 over 1882	95,833	Decrease in 1895	239,796
1884 over 1883	1,024,167	Total increase in fifteen years.	9,819,961
1885 over 1884	9,062	1896 over 1895	1,488,335
1886 over 1885	636,734	1897 over 1896	1,371,863
1887 over 1886	875,824	1898 over 1897	2,452,840
1888 over 1887	617,180	1899 over 1898	2,551,996
1889 over 1888	733,080	1900 over 1899	3,394,212
1890 over 1889	1,162,774	1901 over 1900	1,421,195
1891 over 1890	1,826,011	1902 over 1901	502,424
1892 over 1891	518,090	Total increase in 23 years	23,002,826
1893 over 1892	969,823	Average annual increase	1,000,123

The annual production of coal in West Virginia since 1873 has been as follows:

Coal production of West Virginia, 1873–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	672,000	1888	5,498,800
1874	1,120,000	1889	6,231,880
1875	1,120,000	1890	7,394,654
1876	896,000	1891	9,220,665
1877	1,120,000	1892	9,738,755
1878	1,120,000	1893	10,708,578
1879	1,400,000	1894	11,627,757
1880	1,568,000	1895	11,387,961
1881	1,680,000	1896	12,876,296
1882	2,240,000	1897	14,248,159
1883	2,335,833	1898	16,700,999
1884	3,360,000	1899	19,252,995
1885	3,369,062	1900	22,647,207
1886	4,005,796	1901	24,068,402
1887	4,881,620	1902	24,570,826

WYOMING.

The total production in 1902, 4,429,491 short tons; spot value, $5,236,339.

Wyoming is numbered among the seven States whose coal output in 1902 was less than that of 1901. It moreover had the distinction, shared only in slighter degree by Oregon, of having the value decrease in greater ratio than the production. Compared with 1901 the production of coal in Wyoming last year shows a decrease of 55,883 short tons, or 1.25 per cent, in quantity, and of $824,123, or 13.6 per cent, in value. The productive efficiency of the men employed also showed a decrease. Wyoming stands next to Maryland (which ranks first) in the average tonnage produced per man in both 1901 and 1902, and there was only one other instance except Maryland in 1901 (West Virginia) and one in 1902 (Pennsylvania, bituminous) in which Wyoming did not produce more coal per man per day than any other State. The average output per man for the year, however, decreased from 871 tons in 1901 to 843.7 tons in 1902, while the average per day fell off from 3.51 tons to 3.4 tons. Part of this decreased tonnage per man was doubtless due to the decrease in the use of mining machines in 1902, the machine-mined product having fallen from 804,826 tons in 1901 to 588,302 tons in 1902.

The details of production, by counties, during the last two years are shown in the following tables:

Coal production of Wyoming in 1901, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	507,343	2,863	20,420		530,626	$825,291	$1.56	253	635
Converse	52,639	581	5,970		59,190	118,380	2.00	235	85
Crook	11,102	56			11,158	21,263	1.91	309	12
Sweetwater	1,632,305	6,753	66,822		1,705,880	2,457,730	1.44	245	2,171
Uinta	1,371,809	14,916	52,422		1,439,147	1,635,251	1.14	223	1,326
Fremont, Johnson, Natrona	5,865	4,550	50		10,465	21,855	2.09	200	17
Sheridan, Weston	641,461	2,242	49,375	35,830	728,908	980,692	1.35	293	905
Total	4,222,524	31,961	195,059	35,830	4,485,374	6,060,462	1.35	248	5,151

Coal production of Wyoming in 1902, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at the mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	352,667	3,374	26,166	....	382,207	$461,338	$1.21	185	559
Converse	65,184	945	6,200	....	72,329	95,690	1.32	203	111
Sweetwater	1,517,583	8,886	68,871	....	1,595,340	1,821,545	1.14	223	1,979
Uinta	1,520,636	14,945	59,527	225	1,595,333	1,756,365	1.10	269	1,536
Other counties[a]	688,380	8,951	48,691	38,260	784,282	1,101,401	1.40	300	1,065
Total	4,144,450	37,101	209,455	38,485	4,429,491	5,236,339	1.18	248	5,250

[a] Bighorn, Crook, Fremont, Johnson, Natrona, Sheridan, and Weston.

The distribution of the product for consumption since 1889 and the annual output of the State since 1868 are shown in the following tables:

Distribution of the coal product of Wyoming, 1889–1902.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	1,354,443	15,433	19,071	....	1,388,947	$1,748,617	....	....	2,675
1890	1,835,299	28,540	6,527	....	1,870,366	3,183,669	....	246	3,272
1891	2,229,401	33,558	60,392	4,490	2,327,841	3,555,275	$1.53	....	3,411
1892	2,378,657	27,054	96,128	2,000	2,503,839	3,168,776	1.27	225	3,133
1893	2,280,685	64,188	87,086	7,352	2,439,311	3,290,904	1.35	189	3,378
1894	2,309,934	21,482	72,362	13,685	2,417,463	3,170,392	1.31	190	3,032
1895	2,106,937	35,628	81,065	23,281	2,246,911	2,977,901	1.33	184	3,449
1896	2,102,468	17,867	68,251	41,038	2,229,624	2,904,185	1.30	209	2,949
1897	2,435,091	17,845	93,974	50,976	2,597,886	3,136,694	1.21	219	3,137
1898	2,698,326	21,655	108,447	35,384	2,863,812	3,664,190	1.28	242	3,475
1899	3,584,667	32,429	188,196	32,100	3,837,392	4,742,525	1.24	261	4,697
1900	3,776,954	28,419	176,769	32,460	4,014,602	5,457,953	1.36	266	5,332
1901	4,222,524	31,961	195,059	35,830	4,485,374	6,060,462	1.35	248	5,151
1902	4,144,450	37,101	209,455	38,485	4,429,491	5,236,339	1.18	248	5,250

Total annual production of coal in Wyoming, 1868–1902.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1868	6,925	1886	829,355
1869	49,382	1887	1,170,318
1870	105,295	1888	1,481,540
1871	147,328	1889	1,388,947
1872	221,745	1890	1,870,366
1873	259,700	1891	2,327,841
1874	219,061	1892	2,503,839
1875	300,808	1893	2,439,311
1876	334,550	1894	2,417,463
1877	342,853	1895	2,246,911
1878	333,200	1896	2,229,624
1879	400,991	1897	2,597,886
1880	527,811	1898	2,863,812
1881	628,181	1899	3,837,392
1882	707,764	1900	4,014,602
1883	779,689	1901	4,485,374
1884	902,620	1902	4,429,491
1885	807,328		

COKE.

By Edward W. Parker.

INTRODUCTION.

In the present chapter, as in the preceding ones of the series, the use of the word "coke" is limited to the product obtained by the distillation or partial combustion of bituminous coal in ovens, either with or without the recovery of the by-products of gas, tar, and ammonia. What is known as "gas-house coke," which is a by-product in the manufacture of illuminating gas, is not considered in this report. Until 1893 practically all of the coke made in the United States was the product of what is commonly known as the beehive oven, the name being derived from the design of the combustion chamber, which is similar in shape to that of the conventional beehive. A few experimental plants of Coppée, Thomas, Welsh, and other designers have been tried, but have not given so satisfactory results as the ordinary beehive type of oven.

During the last decade, however, there has been a steady and noteworthy development of coke manufacture in retort or by-product ovens, which, if continued, will cause the gradual shifting of the coke-making industry from the vicinity of the coal mines to the manufacturing centers, where markets for by-products are available. Although in some instances the coke product from these retort ovens is a secondary and not the primary product, the manufacture of such coke is considered as properly coming within the scope of this investigation. The location of the plant determines to some extent whether the coke is to be the primary product, but whether primary or secondary, it is suitable for metallurgical purposes and comes into direct competition with beehive coke. Moreover, a large amount of beehive coke is now prepared for household consumption, and it is impossible to confine this report to the production of blast furnace or foundry coke.

The production of by-product coke is considered in the subsequent pages of this chapter; but the statistics relating to the production of gas, tar, and ammonia in retort ovens are included in another chapter, a special report on these subjects having been prepared for the present volume of Mineral Resources.

The coal consumed in the manufacture of coke in the United States is drawn from six of the seven bituminous coal fields, namely: (1) The Appalachian field, embracing the great coking-coal regions of Pennsylvania, Virginia, West Virginia, Ohio, Georgia, Alabama, Tennessee, and eastern Kentucky; (2) the Eastern Interior field, which includes the coal areas of Illinois, Indiana, and western Kentucky; (3) the Western Interior field, embracing the States of Iowa, Kansas, Missouri, and Nebraska; (4) the Southwestern field, including Arkansas, Indian Territory, and Texas; (5) the Rocky Mountain field, including Colorado, New Mexico, Utah, Montana, South Dakota, and Wyoming; (6) the Pacific Coast field, in which the only coking coals are found in the State of Washington. The coal of the Northern Interior field, lying wholly within Michigan, has not so far been used for coke.

A considerable amount of coke is made in States in which there are no coal fields, namely, Massachusetts, New York, New Jersey, and Wisconsin. The ovens in Michigan and those under construction in Maryland (near Baltimore) are or will be fed with coal from other States. With the exception of the few beehive ovens in Wisconsin, all of the plants outside of the coking-coal fields are retort ovens.

The writer again desires to make special acknowledgment of the assistance rendered by Miss Belle Hill, of Pittsburg, in the preparation of the tables presented with this report. The accuracy and completeness of these tabulated statements as prepared by Miss Hill deserve particular recognition.

The unit of measurement used in this chapter is uniformly the short ton of 2,000 pounds.

PRODUCTION.

Coke production in the United States in 1902 exceeded that of any year in our history. The product, which includes the output from retort or by-product ovens, amounted, in 1902, to 25,401,730 short tons, as compared with 21,795,883 short tons in 1901, and with 20,533,348 short tons in 1900. The increase in 1902 over 1901 amounted to 3,605,847 short tons, or 16.5 per cent. Large as this increase was, it was considerably less than it would have been had the transportation facilities been commensurate with the demand for coke and with the productive capacity of the ovens. During the greater part of the year operators were kept at a disadvantage by the inability of the railroads to supply cars and motive power to handle the output. This condition was particularly evident in the Connellsville region of Pennsylvania, where at times it was necessary to put a number of ovens out of blast on account of the accumulated stocks which overtaxed the storage capacity at the ovens.

The unprecedented production of coke in 1902 was accompanied by an increase in value which was even more worthy of note. The average price per ton at the ovens was the highest recorded in a period of twenty-three years, and the total value reached the high figure of $63,339,167, an increase over the preceding year of $18,893,244, or 42.5 per cent. The value of the coal used in the manufacture of coke in 1902 exceeded that of 1901 by $7,922,563, from which it appears that the value of the coke product increased $10,970,681 over and above the increased value of the coal used in its production. Prices for coke during the strike in the anthracite coal fields reached an abnormally high stage, as much as $15 per ton being reported as paid for this fuel at one time. In 1901 the highest price obtained for Connellsville furnace coke was $4.25, which was paid during March and April of that year. In September and October of 1902, while contract coke was nominally quoted at $3 per ton, consumers were paying from $10 to $12 per ton for prompt delivery. With the termination of the anthracite strike in the latter part of October prices for coke quickly declined; but they did not reach the comparatively low level that prevailed in the early part of the year. In December furnace coke for prompt delivery was commanding $5 and $6 per ton, and contracts for delivery in the first six months of 1903 were made at from $3.75 to $4 per ton. These prices showed a decided advance over December, 1901, and January, 1902, when contracts for Connellsville furnace coke were made at $2.25 per ton, coke for prompt delivery bringing $3.50 and $3.75 per ton.

In considering the total value and average price for the entire coke product of the United States as presented in this report, it must be remembered that in many cases the values are arbitrarily fixed. A number of the larger manufacturers operate blast furnaces in connection with their coal-mining and coke-making business. In such cases the coke product is sometimes charged against the furnace departments at cost, and sometimes at a figure, based upon the cost of coal mining and coke making, plus a percentage of profit on these operations. The value is not fixed by the market value. In other cases the value is estimated upon the average prices for coke of a similar quality produced and sold in the immediate vicinity. The H. C. Frick Coke Company, of Pittsburg, the largest single producer of coke in the United States, is now no longer in the market as a seller of coke, its entire product being taken by the United States Steel Corporation, of which the Frick company is a component part.

During 1902 there were 69,069 coke ovens in existence in the United States, as compared with 63,951 ovens in 1901. Of these 69,069 ovens, 1,945 were idle throughout the entire year, leaving a total of 67,124 active ovens, which produced an average of 378.4 tons per oven. The total number in 1902 included 1,663 by-product recovery ovens, which produced 1,403,588 tons of coke, an average of 844 tons of coke per oven. There were under construction at the close of 1902, 8,758 new ovens, of which 1,346 were of the retort or by-product type. The number of completed retort ovens increased from 1,165 in 1901 to 1,663 in 1902, and the output of retort-oven coke increased during the same period from 1,179,900 tons to 1,403,588 tons.

Counting each bank of ovens as a separate establishment, the returns for 1902 show a total of 456 establishments, as compared with 423 in 1901. Thirty-five establishments, all comparatively unimportant, were idle throughout the year. There were also 29 new establishments whose ovens were not completed at the close of 1902.

The details of the production of coke in 1901 and 1902 are presented, by States and Territories, in the following tables:

Manufacture of coke in the United States, by States and Territories, in 1901.

State or Territory.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
				Short tons.	*Per ct.*	*Short tons.*		
Alabama	31	7,136	535	3,849,908	55.8	2,148,911	$6,062,616	$2.82
Colorado[a]	15	2,060	1,203	1,148,901	58.4	671,303	1,626,279	2.42
Georgia	2	510	0	89,919	60.7	54,550	154,625	2.83
Indian Territory	3	230	0	74,746	50	37,374	154,834	4.14
Kansas	12	98	3	11,629	61.4	7,138	15,079	2.11
Kentucky	5	461	0	204,297	49	100,285	208,015	2.07
Maryland	1	0	200	....	....	....	....	....
Missouri	3	9	0	9,041	52.5	4,749	9,968	2.099
Montana	3	328	111	102,950	55.4	57,004	337,381	5.918
New Jersey	1	0	100	....	....	....	....	....
New Mexico	2	126	0	72,350	57.5	41,643	118,368	2.84
Ohio	8	419	0	162,624	66.9	108,774	299,430	2.75
Pennsylvania	188	34,906	832	21,736,467	66	14,355,917	27,066,361	1.885
Tennessee	14	2,135	258	739,246	54.6	404,017	952,782	2.358
Utah[b]	1	204	0	....	....	....	....	....
Virginia	7	2,775	0	1,400,231	64.7	907,130	1,483,670	1.635
Washington	4	148	100	78,393	62.7	49,197	239,028	4.858
West Virginia	112	11,544	1,254	3,734,076	61.1	2,283,700	4,110,011	1.80
Illinois	3	154	0					
Indiana	1	54	0					
Massachusetts	1	400	0					
Michigan	2	30	45	793,187	71.1	564,191	1,607,476	2.849
New York	2	30	564					
Wisconsin	1	120	0					
Wyoming	1	74	0					
Total	423	[c]63,951	[d]5,205	34,207,965	63.7	21,795,883	44,445,923	2.039

[a] Includes the production of Utah.
[b] Included with Colorado.
[c] Includes 375 Semet-Solvay, 730 Otto-Hoffman, and 60 Newton-Chambers ovens.
[d] Includes 210 Semet-Solvay, 896 Otto-Hoffman, and 427 Schniewind ovens.

Manufacture of coke in the United States, by States and Territories, in 1902.

State or Territory.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
				Short tons.	*Per ct.*	*Short tons.*		
Alabama	37	7,571	1,334	4,237,491	60.2	2,552,246	$8,300,838	$3.25
Colorado[a]	15	3,010	363	1,695,188	59.2	1,003,393	2,754,341	2.74
Georgia	2	492	38	129,642	63.3	82,064	298,963	3.643
Indian Territory	4	280	0	110,934	44.6	49,441	202,921	4.10
Kansas	10	97	12	35,827	58.3	20,902	54,702	2.617
Kentucky	7	485	12	265,121	47.8	126,879	317,875	2.505
Maryland	1	0	200	....	....	....	....	....
Missouri	2	8	0	10,430	55.4	5,780	14,450	2.50
Montana	3	410	0	99,628	53.7	53,463	360,927	6.75
New Jersey	1	100	0	....	....	....	....	....
New Mexico	2	126	0	40,943	56.9	23,296	74,051	3.178
Ohio	9	449	60	219,401	66.6	146,099	492,793	3.37
Pennsylvania	196	36,609	2,332	25,017,326	65.9	16,497,910	38,451,722	2.33
Tennessee	15	2,269	116	1,025,864	54.6	560,006	1,597,041	2.85
Utah[b]	2	404	0	....	....	....	....	....
Virginia	14	2,974	1,208	1,716,110	65.5	1,124,572	2,322,228	2.065
Washington	5	231	0	68,546	58.8	40,305	199,195	4.94
West Virginia	120	12,656	2,341	4,078,579	61.7	2,516,505	5,833,226	2.318
Illinois	3	149	0					
Indiana	1	50	0					
Massachusetts	1	400	0					
Michigan	2	75	60	852,977	70.2	598,869	2,063,894	3.446
New York	2	30	574					
Wisconsin	1	120	108					
Wyoming	1	74	0					
Total	456	[c] 69,069	[d] 8,758	39,604,007	64.1	25,401,730	63,339,167	2.49

[a] Includes the production of Utah.
[b] Included with Colorado.
[c] Includes 525 Semet-Solvay, 1,067 Otto-Hoffman, 60 Newton-Chambers, and 15 Schniewind ovens.
[d] Includes 210 Semet-Solvay, 664 Otto-Hoffman, 412 Schniewind ovens, and 60 retort coke ovens.

There were only two coke-producing States and one Territory in which the production in 1902 did not exceed that of the preceding year. Two of these, Montana and New Mexico, were in the Rocky Mountain region, and one, Washington, was on the Pacific Coast. All of the Eastern States and of the Middle Western States increased their production. The largest amount of increase was naturally in Pennsylvania, where the output increased from 14,355,917 short tons in 1901 to 16,497,910 tons in 1902, a gain of 2,141,993 tons, or 14.9 per cent. Alabama's production increased 403,335 tons, or 18.8 per cent, from 2,148,911 tons in 1901 to 2,552,246 tons in 1902. The greatest proportionate increase in production among the larger coal-producing States was in Colorado, where the product advanced from 671,303 tons to 1,003,393 tons, an increase of 332,090 tons, or almost 50 per cent. The production in West Virginia, which in 1901 was less than in the preceding year, increased in 1902 to 2,516,505 tons. Virginia and Tennessee also showed substantial gains.

The increases and decreases in the several States during 1902, as compared with 1901, are shown in the following table:

Increases and decreases in coke production, by States, in 1902, as compared with 1901.

State or Territory.	Production.		Increase.		Decrease.	
	1901.	1902.	Quantity.	Per cent.	Quantity.	Per cent.
	Short tons.	*Short tons.*	*Short tons.*		*Short tons.*	
Alabama	2,148,911	2,552,246	403,335	18.77		
Colorado[a]	671,303	1,003,393	332,090	49.47		
Georgia	54,550	82,064	27,514	50.44		
Indian Territory	37,374	49,441	12,067	32.29		
Kansas	7,138	20,902	13,764	192.83		
Kentucky	100,285	126,879	26,594	26.52		
Missouri	4,749	5,780	1,031	21.71		
Montana	57,004	53,463			3,541	6.21
New Mexico	41,643	23,296			18,347	44.06
Ohio	108,774	146,099	37,325	34.31		
Pennsylvania	14,355,917	16,497,910	2,141,993	14.92		
Tennessee	404,017	560,006	155,989	38.61		
Virginia	907,130	1,124,572	217,442	23.97		
Washington	49,197	40,305			8,892	18.07
West Virginia	2,283,700	2,516,505	232,805	10.19		
Illinois, Indiana, Massachusetts, Michigan, New York, Wisconsin, Wyoming	564,191	598,869	34,678	6.15		
Total	21,795,883	25,401,730	3,605,847	16.54		

[a] Includes Utah.

The earliest record of coke production in the United States was that made during the census year of 1880. In that year the total production of coke amounted to 3,338,300 short tons. From 1855, when the use of anthracite coal for iron making surpassed charcoal, to 1875, most of the pig iron manufactured in the United States had been made with the use of anthracite coal. Since 1875 the increase in production and use of coke has rapidly supplanted the use of anthracite coal for iron making, and now little of our large iron tonnage is produced in anthracite furnaces. A comprehensive idea of the growth of the coking industry in the United States is obtained by dividing the history of the last twenty years into five-year periods. The average production for the three years, 1880 to 1882, was about 4,000,000 tons a year. In the five years from 1883 to 1887, inclusive, the average production amounted to 5,980,459 short tons. The average for the next five years, from 1888 to 1892, was nearly double that of the preceding five years, amounting to 10,533,918 tons. This period was followed by the panic years of 1893, 1894, and 1895, and the coke production showed only a small increase in the next five years, averaging during that time 11,418,536 tons per year. The return of prosperous conditions which began in 1896 has shown no decided setback since that time and the production of coke during the five years from 1898 to 1902, inclusive, obtained an average of 20,689,347 tons, and exceeded for the first time a total of 25,000,000 tons in 1902.

In the following table are consolidated the statistics of the manufacture of coke in the United States from 1880 to 1902, inclusive:

Statistics of the manufacture of coke in the United States, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per ct.*
1880	186	12,372	1,159	5,237,741	3,338,300	$6,631,267	$1.99	63
1881	197	14,119	1,005	6,546,662	4,113,760	7,725,175	1.88	63
1882	215	16,356	712	7,577,648	4,793,321	8,462,167	1.77	63
1883	231	18,304	407	8,516,670	5,464,721	8,121,607	1.49	64
1884	250	19,557	812	7,951,974	4,873,805	7,242,878	1.49	61
1885	233	20,116	432	8,071,126	5,106,696	7,629,118	1.49	63
1886	222	22,597	4,154	10,688,972	6,845,369	11,153,366	1.63	64
1887	270	26,001	3,584	11,859,752	7,611,705	15,321,116	2.01	64
1888	261	30,059	2,587	12,945,350	8,540,030	12,445,963	1.46	66
1889	252	34,165	2,115	15,960,973	10,258,022	16,630,301	1.62	64
1890	253	37,158	1,547	18,005,209	11,508,021	23,215,302	2.02	64
1891	243	40,245	911	16,344,540	10,352,688	20,323,216	1.97	63
1892	261	42,002	1,893	18,813,337	12,010,829	23,536,141	1.96	64
1893	258	44,201	717	14,917,146	9,477,580	16,523,714	1.74	63.5
1894	260	44,772	591	[a] 14,348,750	9,203,632	[a] 12,328,856	1.34	64
1895	265	45,565	638	20,848,323	13,333,714	[b] 19,234,319	1.44	64
1896	341	46,944	383	18,694,422	11,788,773	21,660,729	1.837	63
1897	336	47,668	575	20,907,319	13,288,984	22,102,514	1.663	63.5
1898	341	48,383	1,048	25,249,570	16,047,209	25,586,699	1.594	63.6
1899	343	49,603	4,037	30,219,343	19,668,569	34,670,417	1.76	65.1
1900	396	58,484	5,804	32,113,543	20,533,348	47,443,331	2.31	63.9
1901	423	63,951	5,205	34,207,965	21,795,883	44,445,923	2.039	63.7
1902	456	69,069	8,758	39,604,007	25,401,730	63,339,167	2.49	64.1

[a] Excluding New York. [b] Excluding New York and Texas.

NUMBER OF COKE WORKS IN UNITED STATES.

The total number of establishments manufacturing coke in the United States for each year since 1880 is shown in the following table, together with those reported for the census years ending June 30, 1850, 1860, 1870, and 1880. For the details in regard to the number of establishments in each State the reader is referred to the discussion of the production of coke by States in the subsequent part of this report.

Number of coke establishments in the United States since 1850.

Year.	Number.	Year.	Number.
1850 (census year)	4	1890, December 31	253
1860 (census year)	21	1891, December 31	243
1870 (census year)	25	1892, December 31	261
1880 (census year)	149	1893, December 31	258
1880, December 31	186	1894, December 31	260
1881, December 31	197	1895, December 31	265
1882, December 31	215	1896, December 31	341
1883, December 31	231	1897, December 31	336
1884, December 31	250	1898, December 31	341
1885, December 31	233	1899, December 31	343
1886, December 31	222	1900, December 31	396
1887, December 31	270	1901, December 31	423
1888, December 31	261	1902, December 31	456
1889, December 31	253		

The 456 establishments which were in existence on December 31, 1902, included 29, with a total of 4,878 ovens, which were not entirely completed before the close of the year and did not contribute to the production in 1902. There were also 35 establishments, having a total of 1,539 ovens, whose ovens were not operated at all during the entire year. These idle plants were all comparatively small, averaging only 44 ovens to the establishment.

In this report the word "establishment" is used to designate the number of banks of ovens which were in existence, whether operated or idle, and whether they reported from one central office or separately. Prior to 1896 it was customary to include under one establishment all the coke works reported from one general office, hence there is an apparently large increase in the number of establishments in 1896 as compared with the preceding years.

Excluding the number of establishments which did not produce coke in 1902—that is to say, 35 old ones that were idle and 29 new ones which had not begun operations—the total number of active plants last year was 392, a little over double the number which produced coke in the United States in 1880. In that year there were 186 coke-making establishments in the United States which produced a total of 3,338,300 tons, an average of 17,948 tons to each establishment. In 1902, considering each bank of ovens as a separate establishment, the average productive capacity for each plant was 64,800 tons, or 3.6 times the average producing capacity in 1880.

The following tables show the number of coke ovens in existence in each State and Territory for the five years from 1898 to 1902, and the total number of ovens in existence in each year since 1880. The increase in the number of ovens in the three years from 1899 to 1902 was equal to the increase in twelve years from 1888 to 1899. The

69,069 ovens completed at the end of 1902 include 1,663 by-product recovery ovens:

Number of coke ovens in each State at the close of each year, 1898–1902.

State or Territory.	1898.	1899.	1900.	1901.	1902.
Alabama	5,456	5,599	6,529	7,136	7,571
Colorado	1,253	1,243	1,488	2,060	3,010
Georgia	350	350	480	510	492
Illinois	126	130	154	154	149
Indiana	94	52	54	54	50
Indian Territory	130	130	230	230	280
Kansas	47	95	91	98	97
Kentucky	292	300	458	461	485
Massachusetts	....	400	400	400	400
Michigan	....	....	....	30	75
Missouri	8	12	10	9	8
Montana	318	303	342	328	410
New Jersey	....	....	....	....	100
New Mexico	126	126	126	126	126
New York	25	25	30	30	30
Ohio	441	385	369	419	449
Pennsylvania	27,157	27,591	32,548	34,906	36,609
Tennessee	1,949	2,040	2,107	2,135	2,269
Texas	0	0	0	0	0
Utah	104	104	204	204	404
Virginia	1,564	1,588	2,331	2,775	2,974
Washington	90	90	90	148	231
West Virginia	8,659	8,846	10,249	11,544	12,656
Wisconsin	120	120	120	120	120
Wyoming	74	74	74	74	74
Total	48,383	49,603	58,484	63,951	69,069

Number of coke ovens in the United States on December 31 of each year, 1880–1902.

Year.	Ovens.	Year.	Ovens.	Year.	Ovens.
1880	12,372	1888	30,059	1896	46,944
1881	14,119	1889	34,165	1897	47,668
1882	16,356	1890	37,158	1898	48,383
1883	18,304	1891	40,057	1899	49,603
1884	19,557	1892	42,002	1900	58,484
1885	20,116	1893	44,201	1901	63,951
1886	22,597	1894	44,772	1902	69,069
1887	26,001	1895	45,565		

In connection with the increase in the number of establishments in the United States, comment was made upon the increased productive capacity of each plant. This feature is also strikingly illustrated in the increased capacity of the individual ovens. In 1880, 12,372 ovens produced a total output of 3,338,300 short tons of coke, or an average of 270 short tons per oven. Excluding the old-established plants which were idle throughout 1902 and the new ovens which had been completed but had not been put in blast at the beginning of 1903, there were in active operation last year a total of 67,124 ovens which produced a total of 25,401,730 short tons of coke, an average of 378.4 tons per oven. In 1901 the total number of active ovens was 61,396, which produced a total of 21,795,883 short tons of coke, an average of 355 tons per oven, showing that the average productive capacity of each oven in 1902 exceeded that of the preceding year by 23.4 tons. The 1,663 by-product ovens in operation in 1902 produced an average of 844 tons of coke per oven, as against an average of 1,013 tons produced by the 1,165 by-product ovens in operation in 1901. The decrease in the average production of these by-product ovens in 1902 was due to the fact that nearly 500 of these ovens were not completed and put in blast until after the beginning, some of them not until nearly the close, of the year.

The following table shows the number of ovens in course of construction at the end of each year since 1880. This table is not intended to represent the increase in the number of new ovens from year to year, nor does it include the new ovens completed during any one year. It is intended merely to show the condition of the industry in each calendar year as represented by plants under construction. It will be seen that in 1902 there were 8,758 ovens building, a number 50 per cent larger than that shown at the end of 1900, when more ovens were under construction at the close of the year than in any other year previous to 1902. Of the 8,758 ovens in the course of construction at the close of 1902, 1,346 were of the by-product type.

Number of coke ovens building in the United States at the close of each year, 1880–1902.

Year.	Ovens.	Year.	Ovens.	Year.	Ovens.
1880	1,159	1888	2,587	1896	383
1881	1,005	1889	2,115	1897	575
1882	712	1890	1,375	1898	1,048
1883	407	1891	911	1899	4,037
1884	812	1892	1,893	1900	5,804
1885	432	1893	717	1901	5,205
1886	4,154	1894	591	1902	8,758
1887	3,594	1895	638		

PRODUCTION IN PREVIOUS YEARS.

In the following tables are shown the statistics of the production of coke in each State and Territory for each year from 1897 to 1902, inclusive, and the total annual production since 1880. During the twenty-three years covered by these reports there were only five years in which the production was less than that of the preceding year. The first instance was in 1884, when the output was about 600,000 tons less than in 1883. The most notable decreases were caused by the industrial depression of 1893 and 1894, when the output fell off from over 12,000,000 tons in 1892 to 9,477,580 tons in 1893, and to 9,203,932 tons in 1894. The temporary "boom" in the iron trade in 1895 reacted upon the coke industry, and the production increased to over 13,000,000 tons in 1895. This was followed by another period of depression in 1896, since which time the coke industry has kept pace with the prosperous conditions in other lines of trade, and the production has increased without interruption, reaching its maximum total in 1902.

Amount of coke produced in the United States, 1897–1902, by States and Territories.

[Short tons.]

State or Territory.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	1,443,017	1,663,020	1,787,809	2,110,837	2,148,911	2,552,246
Colorado (a)	319,036	445,982	530,424	618,755	671,303	1,003,393
Georgia	33,000	49,529	50,907	73,928	54,550	82,064
Indian Territory	30,364	34,110	24,339	38,141	37,374	49,441
Kansas	6,181	4,180	14,476	5,948	7,138	20,902
Kentucky	32,117	22,242	81,095	95,532	100,285	126,879
Missouri	2,593	740	2,860	2,087	4,749	5,780
Montana	67,849	52,009	56,376	54,731	57,004	53,463
New Mexico	1,438	6,980	44,134	44,774	41,643	23,296
Ohio	95,087	85,535	83,878	72,116	108,774	146,099
Pennsylvania	[b] 8,966,924	[b] 10,715,302	[b] 13,577,870	13,357,295	14,355,917	16,497,910
Tennessee	368,769	394,545	435,308	475,432	404,017	560,006
Texas	394	....	....	....	....	....
Utah	23,617	28,826	(a)	(a)	(a)	(a)
Virginia	354,067	531,161	618,707	685,156	907,130	1,124,572
Washington	26,189	30,197	30,372	33,387	49,197	40,305
West Virginia	1,472,666	1,925,071	2,278,577	2,358,499	2,283,700	2,516,505
Illinois	1,549	2,325	2,370			
Indiana	2,904	1,825				
Massachusetts	....	....	(c)			
Michigan	....	....	....	506,730	564,191	598,869
New York	(c)	(c)	(c)			
Wisconsin	17,216	35,280	33,437			
Wyoming	24,007	18,350	15,630			
Total	13,288,984	16,047,209	19,668,569	20,533,348	21,795,883	25,401,730

[a] Colorado includes Utah.
[b] Includes production of New York and of Massachusetts also in 1899.
[c] Included with Pennsylvania.

The annual production since 1880 has been as follows:

Amount of coke produced in the United States, 1880–1902.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1880	3,338,300	1888	8,540,030	1896	11,788,773
1881	4,113,760	1889	10,258,022	1897	13,288,984
1882	4,793,321	1890	11,508,021	1898	16,047,209
1883	5,464,721	1891	10,352,688	1899	19,668,569
1884	4,873,805	1892	12,010,829	1900	20,533,348
1885	5,106,696	1893	9,477,580	1901	21,795,883
1886	6,845,369	1894	9,203,632	1902	25,401,730
1887	7,611,705	1895	13,333,714		

VALUE OF COKE PRODUCED.

The value of the coke product in 1902 increased in even more decided ratio than that of the output itself. As previously stated, the shortage of fuel, caused by the protracted strike in the anthracite coal fields of Pennsylvania, was reflected in an increased demand for coke which greatly stimulated prices and caused an enhancement in value greatly exceeding any previous record in our history. The total value of the coke product of the United States in 1902 was $63,339,167, an increase of $18,893,244 over 1901, or 42.5 per cent, and of nearly $16,000,000 over the value of the product in 1900, which was the highest previously recorded. During the late summer months of 1902 the Connellsville furnace coke for prompt delivery brought as high as $12 a ton, a figure unprecedented in the history of our coking industry. The average price for the year, however, while showing a decided increase over any provious year, does not accurately reflect these abnormally high prices, as by far the greater portion of the product was sold on contracts made in 1901; still an increase of 42.5 per cent in value, as compared with the increase of 16.6 per cent in production, is worthy of note.

The following tables show the value of the coke produced in each State and Territory during the last six years, and the value of the total product for each year since 1880:

Total value, at the ovens, of the coke made in the United States, 1897–1902, by States and Territories.

State or Territory.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	$3,094,461	$3,378,946	$3,634,471	$5,629,423	$6,062,616	$8,300,838
Colorado	a 999,216	a 1,230,428	a 1,333,769	a 1,746,732	a 1,626,279	a 2,754,341
Georgia	42,240	77,230	116,917	210,646	154,625	298,963
Indian Territory	104,725	96,639	71,965	152,204	154,834	202,921
Kansas	9,272	6,455	30,817	14,985	15,079	54,702
Kentucky	45,454	32,213	161,454	235,505	208,015	317,875
Missouri	3,890	1,050	5,520	5,268	9,968	14,450
Montana	467,481	359,174	356,190	337,079	337,381	360,927
New Mexico	3,232	14,625	99,217	130,251	118,368	74,051
Ohio	235,784	211,558	255,129	194,042	299,430	492,793
Pennsylvania	b 13,727,966	b 16,078,505	c 22,881,910	29,692,258	27,066,361	38,451,722
Tennessee	667,656	642,920	850,686	1,269,555	952,782	1,597,041
Utah	(d)	(d)	(d)	(d)	(d)	(d)
Virginia	495,864	699,781	1,071,284	1,464,556	1,483,670	2,322,228
Washington	115,754	128,933	151,216	160,165	239,028	199,195
West Virginia	1,933,808	2,432,657	3,480,408	4,746,633	4,110,011	5,833,226
Illinois	2,895	4,686	5,565			
Indiana	5,795	3,194				
Massachusetts	....	....	(e)			
Michigan	....	....	....	1,454,029	1,607,476	2,063,894
New York	(e)	(e)	(e)			
Wisconsin	75,000	123,480	125,389			
Wyoming	72,021	64,225	38,510			
Total	22,102,514	25,586,699	34,670,417	47,443,331	44,445,923	63,339,167

a Includes value of Utah coke.
b Includes value of New York coke.
c Includes Massachusetts and New York.
d Included with Colorado.
e Included with Pennsylvania.

Total value, at the ovens, of the coke made in the United States, 1880–1902.

Year.	Value.	Year.	Value.	Year.	Value.
1880	$6,631,265	1888	$12,445,963	1896	$21,660,729
1881	7,725,175	1889	16,630,301	1897	22,102,514
1882	8,462,167	1890	23,215,302	1898	25,586,699
1883	8,121,607	1891	20,393,216	1899	34,670,417
1884	7,242,878	1892	23,536,141	1900	47,443,331
1885	7,629,118	1893	16,523,714	1901	44,445,923
1886	11,153,366	1894	12,328,856	1902	63,339,167
1887	15,321,116	1895	19,234,319		

From the preceding statements, showing the amount and value of the coke produced in a series of years, the following tables have been prepared. These show the average price per ton obtained for the coke product in each State and Territory for the last six years, and the average price of the total product since 1880. These average prices are obtained by dividing the total value by the total amount of coke produced or sold. Although the figures may be accepted as indicating the general tendency of prices, they do not always represent the actual selling value of the coke, as has already been shown. Some of the largest producers of coke consume their entire product in their own blast furnaces. In some such cases the value of the coke is given at the actual cost of production; in others it is based upon the cost of production, adding a percentage of profit on the coking operations; and in still other cases the values are based upon the marketed product of a similar quantity of coke in the immediate vicinity. These conditions, however, continue without material change from year to year, so that the prices as given may be generally accepted as indicating the general condition of the market.

The highest average price in the period of twenty-three years was that of 1902, when the average for all qualities and in all States reached as high as $2.49, an increace of 45 cents, or 22.1 per cent over 1901. As previously explained, the high average prices obtained in 1902 were due to the anthracite coal strike and the shortage of fuel produced thereby.

Average value per short ton at the ovens of the coke made in the United States, 1897–1902, by States and Territories.

State or Territory.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	$2.14	$2.03	$2.03	$2.667	$2.82	$3.25
Colorado	[a]2.916	[a]2.59	[a]2.51	[a]2.82	[a]2.42	[a]2.74
Georgia	1.28	1.56	2.30	2.849	2.83	3.643
Indian Territory	3.45	2.833	2.96	3.99	4.14	4.10
Kansas	1.50	1.544	2.13	2.52	2.11	2.617
Kentucky	1.41	1.448	1.99	2.465	2.07	2.505
Missouri	1.50	1.42	1.93	2.52	2.099	2.50
Montana	6.89	6.906	6.32	6.159	5.918	6.75
New Mexico	2.25	2.095	2.25	2.909	2.84	3.178
Ohio	2.48	2.47	3.04	2.69	2.75	3.37
Pennsylvania	[b]1.53	[b]1.50	[b]1.69	2.22	1.885	2.33
Tennessee	1.81	1.63	1.95	2.67	2.358	2.85
Utah	(c)	(c)	(c)	(c)	(c)	(c)
Virginia	1.40	1.317	1.73	2.137	1.635	2.065
Washington	4.42	4.27	4.98	4.797	4.858	4.94
West Virginia	1.31	1.26	1.53	2.01	1.80	2.318
Illinois	1.87	2.02	2.35			
Indiana	1.995	1.75				
Massachusetts	....	....	(d)			
Michigan	....	....	....	2.87	2.849	3.446
New York	(d)	(d)	(d)			
Wisconsin	4.36	3.50	3.75			
Wyoming	3.00	3.50	2.46			
Average	1.663	1.594	1.76	2.31	2.039	2.49

[a] Includes Utah.
[b] Average value, including New York, and Massachusetts also in 1899.
[c] Included with Colorado.
[d] Included with Pennsylvania.

Average value per short ton at the ovens of the coke made in the United States, 1880–1902.

Year.	Value.	Year.	Value.	Year.	Value.
1880	$1.99	1888	$1.46	1896	$1.837
1881	1.88	1889	1.62	1897	1.663
1882	1.77	1890	2.02	1898	1.594
1883	1.49	1891	1.97	1899	1.76
1884	1.49	1892	1.96	1900	2.31
1885	1.49	1893	1.74	1901	2.039
1886	1.63	1894	1.34	1902	2.49
1887	2.01	1895	1.44		

RANK OF COKE-PRODUCING STATES.

In the following table is shown the relative rank of the States and Territories in the production of coke from 1880 to 1902. Pennsylvania has headed the list during this entire period, while Alabama and West Virginia have for the greater portion of the time contended with each other for second place. In 1902 Alabama replaced West Virginia as second in rank, West Virginia having held this position for the six preceding years. The changes in the rank of the other States were unimportant.

Rank of the States and Territories in production of coke, 1880–1902.

State or Territory.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
Pennsylvania	1	1	1	1	1	1	1	1	1	1	1
West Virginia	2	2	2	2	3	3	4	2	2	3	3
Alabama	5	5	4	3	2	2	2	4	3	2	2
Colorado	7	6	6	5	5	5	5	5	5	5	6
Tennessee	3	3	3	4	4	4	3	3	4	4	5
Virginia	......	......	......	8	7	7	6	6	6	6	4
Ohio	4	4	5	6	8	8	8	7	8	8	8
Montana	......	......	......	......	15	15	......	16	12	10	11
Georgia	6	7	7	7	6	6	7	8	7	7	10
Kentucky	9	10	10	11	12	13	14	12	9	12	7
Washington	......	......	......	......	14	14	15	11	10	17	13
New Mexico	......	......	12	12	9	9	10	13	14	18	9
Indian Territory	11	11	11	13	13	12	12	14	15	15	17
Utah	12	......	13	......	......	......	......	......	......	19	19
Wisconsin	......	......	......	......	......	......	......	......	18	9	14
Kansas	10	9	9	10	11	11	9	10	11	11	12
Indiana	......	......	......	......	......	......	13	9	13	14	15
Illinois	8	8	8	9	10	10	11	15	16	13	18
Missouri	......	......	......	......	......	......	......	17	17	16	16
Texas	......	......	......	......	......	......	......	......	......	......	......

State or Territory.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Pennsylvania	1	1	1	1	1	1	1	1	1	1	1	1
Alabama	2	2	2	3	2	3	3	3	3	3	3	2
West Virginia	3	3	3	2	3	2	2	2	2	2	2	3
Virginia	6	6	6	6	6	6	5	4	4	4	4	4
Colorado	5	4	4	4	5	4	6	5	5	5	5	5
Tennessee	4	5	5	5	4	5	4	6	6	6	7	6
Massachusetts	......	......	......	......	......	......	......	......	7	7	6	7
Ohio	8	8	10	8	8	7	7	7	8	10	8	8
Kentucky	10	9	8	9	9	10	10	15	9	8	9	9
Utah	14	13	11	12	11	14	15	13	16	15	12	10
Georgia	7	7	7	7	7	9	9	9	11	9	11	11
Wisconsin	9	11	12	18	17	17	16	10	13	12	13	12
Montana	11	10	9	10	10	8	8	8	10	11	10	13
Michigan	......	......	......	......	......	......	......	......	......	......	20	14
Indian Territory	13	16	15	19	16	13	11	11	17	14	17	15
New York	......	......	13	11	12	16	12	14	15	16	16	16
Washington	16	15	16	16	13	11	13	12	14	17	14	17
New Mexico	20	......	18	15	14	12	21	17	12	13	15	18
Kansas	12	12	14	13	15	18	17	18	19	19	19	19
Wyoming	19	......	20	17	18	15	14	16	18	18	18	20
Missouri	15	14	17	20	21	21	19	21	20	20	21	21
Illinois	17	18	21	21	20	20	20	19	22	22	22	22
Indiana	18	17	19	14	19	19	18	20	21	21	......	......
Texas	......	......	......	......	22	22	22	......	......	......	......	......

COAL CONSUMED IN THE MANUFACTURE OF COKE.

The determination of the quantity of coal consumed in the manufacture of coke is to a considerable extent a matter of estimate, as a large quantity of the coal so used is charged directly into the ovens from the mines without having been previously weighed or measured. The only method of ascertaining the quantity of coal thus used is by the amount paid to the miners for mining, which is based sometimes upon the measured bushel or ton, and sometimes by the cubical contents of the mine car, all of which standards are apt to differ materially from that of the weighed ton or bushel. There are comparatively few establishments in this country at which the quantity of coal made into coke is accurately ascertained, though as the industry becomes better organized greater attention is being paid to exactness in this regard, and year by year the amounts as presented in the following tables become more accurate. It is still necessary, however, to estimate a large amount of the coal consumed in the manufacture of coke.

A considerable quantity of the coal which is not run directly from the mines to the coke ovens is crushed and washed before coking. In such cases the weight of this coal before washing is given approximately. In other cases the weight after the slate, pyrite, and other impurities have been removed, is reported for the weight of the coal charged into the ovens. In still other instances coke ovens have been constructed chiefly for the purpose of utilizing the slack coal produced, in which cases little or no account is taken of the weight of the coal. It can readily be seen therefore that any statement as to the quantity of coal used in the manufacture of coke is necessarily approximate, but, as these differences appear from year to year, the statistics as collected may be accepted as sufficiently accurate for comparative analysis. As has been stated in previous reports of this series, an apparent discrepancy appears between the statements regarding the quantities of coal consumed in the manufacture of coke as published in the chapter on coal production and those presented herewith. These discrepancies are in general due to the fact that a large quantity of coal is shipped to ovens at a distance from the mine. Where this is the case the tonnage so shipped would be included in the shipments, the coal statistics showing only the quantity of coal made into coke at the ovens.

The quantity of coal used in the manufacture of coke, as obtained for this report, in the several States and Territories, from 1897 to 1902, and the total quantity used each year since 1880, are shown in the following tables:

Quantity of coal used in the manufacture of coke in the United States, 1897–1902, by States and Territories.

[Short tons.]

State or Territory.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	2,451,475	2,814,615	3,028,472	3,582,547	3,849,908	4,237,491
Colorado	[a]616,592	[a]803,686	[a]898,207	[a]997,861	[a]1,148,901	1,695,188
Georgia	67,000	81,108	78,098	140,988	89,919	129,642
Indian Territory	68,495	73,330	59,255	79,534	74,746	110,934
Kansas	11,772	7,856	26,988	10,303	11,629	35,827
Kentucky	64,234	44,484	151,503	190,268	204,297	265,121
Missouri	4,627	1,500	5,320	3,775	9,041	10,430
Montana	139,907	92,552	110,274	108,710	102,950	99,628
New Mexico	2,585	12,557	68,594	74,261	72,350	40,943
Ohio	151,545	134,757	142,678	115,269	162,624	219,401
Pennsylvania	[c]13,538,646	[c]16,307,841	[d]19,930,419	20,239,966	21,736,467	25,017,326
Tennessee	667,996	722,356	779,995	854,789	739,246	1,025,864
Texas	700	0	0	0	0	0
Utah	(e)	(e)	(e)	(e)	(e)	(e)
Virginia	574,542	852,972	994,635	1,083,827	1,400,231	1,716,110
Washington	39,124	48,559	50,813	54,310	78,393	68,546
West Virginia	2,413,283	3,145,398	3,802,825	3,868,840	3,734,076	4,078,579
Illinois	3,591	6,650	4,217 (Illinois and Indiana)			
Indiana	7,022	4,065				
Massachusetts	....	....	(b)			
Michigan	....	....	....	708,295 (Illinois to Wyoming)	793,187	852,977
New York	(b)	(b)	(b)			
Wisconsin	29,207	59,900	54,950			
Wyoming	54,976	35,384	32,100			
Total	20,907,319	25,249,570	30,219,343	32,113,543	34,207,965	39,604,007

[a] Includes coal coked in Utah.
[b] Included with Pennsylvania.
[c] Includes New York.
[d] Includes Massachusetts and New York.
[e] Included with Colorado.

Quantity of coal used annually in the manufacture of coke in the United States, 1880–1902, by States and Territories.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1880	5,237,741	1888	12,945,350	1896	18,694,422
1881	6,546,762	1889	15,960,973	1897	20,907,319
1882	7,577,646	1890	18,005,209	1898	25,249,570
1883	8,516,670	1891	16,344,540	1899	30,219,343
1884	7,951,974	1892	18,813,337	1900	32,113,543
1885	8,071,126	1893	14,917,146	1901	34,207,965
1886	10,688,972	1894	14,348,750	1902	39,604,007
1887	11,859,752	1895	20,848,323		

QUANTITY AND VALUE OF COAL USED IN COKE MAKING.

The quantity and value of the coal used in the manufacture of coke in 1901 and 1902, together with the quantity and value of coal consumed per ton of coke produced, are shown, by States and Territories, in the following tables. The quantity of coal used in 1902 was 39,604,007 short tons, as compared with 34,207,965 tons in 1901, an increase of 5,396,042 tons. The value of the coal consumed increased from $31,378,631 to $39,301,194, showing that of the $18,893,244 increase in the value of coke in 1902 over 1901, $7,922,563 was represented by the increased cost of coal. In 1901 the value of the coal used in making a ton of coke was $1.44; the average price per ton for the coke produced was $2.04, a difference of 60 cents on each ton. In 1902 the value of the coal used in making a ton of coke was $1.54; the average price per ton of coke was $2.49, a difference of 95 cents between the value of the coal used and the coke produced:

Quantity and value of coal used in the manufacture of coke in the United States in 1901, and quantity and value of same per ton of coke.

State or Territory.	Coal used.	Total value of coal.	Value of coal per ton.	Quantity of coal per ton of coke.	Value of coal to a ton of coke.
	Short tons.			*Short tons.*	
Alabama	3,849,908	$4,362,240	$1.133	1.79	$2.03
Colorado [a]	1,148,901	734,356	.639	1.71	1.093
Georgia	89,919	53,951	.60	1.648	.989
Indian Territory	74,746	60,997	.816	2.00	1.632
Kansas	11,629	10,594	.91	1.629	1.484
Kentucky	204,297	89,647	.439	2.037	.894
Missouri	9,041	5,398	.597	1.90	1.136
Montana	102,950	281,124	2.73	1.806	4.93
New Mexico	72,350	40,635	.56	1.737	.975
Ohio	162,624	236,744	1.455	1.495	2.176
Pennsylvania	21,736,467	19,654,216	.904	1.514	1.369
Tennessee	739,246	753,258	1.019	1.83	1.864
Virginia	1,400,231	913,073	.652	1.543	1.006
Washington	78,393	145,197	1.85	1.59	2.95
West Virginia	3,734,076	2,748,643	.736	1.635	1.203
Illinois Massachusetts Michigan New York Wisconsin Wyoming	793,187	1,288,558	1.625	1.406	2.284
Total	34,207,965	31,378,631	.917	1.57	1.44

[a] Includes Utah.

Quantity and value of coal used in the manufacture of coke in the United States in 1902, and quantity and value of same per ton of coke.

State or Territory.	Coal used.	Total value of coal.	Value of coal per ton.	Quantity of coal per ton of coke.	Value of coal to a ton of coke.
	Short tons.			*Short tons.*	
Alabama	4,237,491	$5,083,793	$1.20	1.66	$1.99
Colorado [a]	1,695,188	1,291,269	.76	1.689	1.28
Georgia	129,642	120,874	.932	1.58	1.47
Indian Territory	110,934	109,300	.985	2.24	2.206
Kansas	35,827	44,045	1.229	1.714	2.106
Kentucky	265,121	150,872	.57	2.09	1.19
Missouri	10,430	7,600	.729	1.805	1.316
Montana	99,628	352,020	3.53	1.863	6.576
New Mexico	40,943	33,550	.819	1.757	1.439
Ohio	219,401	338,153	1.54	1.5	2.31
Pennsylvania	25,017,326	24,514,119	.98	1.516	1.485
Tennessee	1,025,864	1,071,354	1.04	1.832	1.905
Virginia	1,716,110	1,304,986	.76	1.526	1.16
Washington	68,546	118,048	1.72	1.70	2.924
West Virginia	4,078,579	3,219,593	.789	1.62	1.278
Illinois, Indiana, Massachusetts, New York, Wisconsin, Wyoming	852,977	1,541,618	1.807	1.424	2.573
Total	39,604,007	39,301,194	.99	1.559	1.543

[a] Includes Utah.

The following table shows approximately the quantity of coal required to produce a ton of coke in each year since 1880:

Coal required to produce a ton of coke, in tons or pounds.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1880	1.57	3,140	1892	1.57	3,140
1881	1.59	3,180	1893	1.57	3,140
1882	1.58	3,160	1894	1.56	3,120
1883	1.56	3,120	1895	1.56	3,120
1884	1.63	3,260	1896	1.58½	3,170
1885	1.58	3,160	1897	1.57	3,140
1886	1.56	3,120	1898	1.57	3,140
1887	1.56	3,120	1899	1.54	3,080
1888	1.51	3,020	1900	1.57	3,140
1889	1.55	3,100	1901	1.57	3,140
1890	1.56	3,120	1902	1.56	3,120
1891	1.58	3,160			

YIELD OF COAL IN COKE.

By the yield of coal in coke is meant the percentage by weight of the constituents of the coal that remains as coke after the process of coking is completed. The following table shows that the general average yield of coal in coke is about 64 per cent, but this is believed to be somewhat excessive. For the reasons stated in connection with the amount of coal made into coke, it is not always possible to obtain exact information on this point, as in many instances the coal is not weighed before being charged into the ovens, and the amount consumed is largely an estimate. It is doubtful if the average yield of coal in coke throughout the United States exceeds 60 per cent.

Percentage yield of coal in coke, 1880–1902.

Year.	Percentage yield of coal.	Year.	Percentage yield of coal.	Year.	Percentage yield of coal.
1880	63	1888	66	1896	63
1881	63	1889	64	1897	63.5
1882	63	1890	64	1898	63.6
1883	64	1891	63	1899	65.1
1884	61	1892	64	1900	63.9
1885	63	1893	63.5	1901	63.7
1886	64	1894	64	1902	64.1
1887	64.2	1895	64		

The following table shows the percentage yield of coal in coke in each State during the last six years:

Percentage yield of coal in coke, 1897–1902, by States.

State or Territory.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	58.8	59	59	58.9	55.8	60.2
Colorado[a]	55.6	59.1	59	62	58.4	59.2
Georgia	49.3	61	65.2	52.4	60.7	63.3
Indian Territory	44.3	46.5	41	48	50	44.6
Kansas	52.5	53	53.6	57.7	61.4	58.3
Kentucky	50	50	53.5	50.2	49	47.8
Missouri	56	49.3	53.8	55.3	52.5	55.4
Montana	48.5	56	51	50.3	55.4	53.7
New Mexico	55.6	55.6	64.3	60.3	57.5	56.9
Ohio	62.7	63.5	58.8	62.5	66.9	66.6
Pennsylvania	[b] 66.2	[b] 65.7	[b] 68.1	66	66	65.9
Tennessee	55	54.6	55.8	55.6	54.6	54.6
Texas	56.3	0	0	0	0	0
Virginia	61.6	62	62.2	63.2	64.7	65.5
Washington	67	62.2	59.8	61.5	62.7	58.8
West Virginia	61	61.2	60	60.9	61.1	61.7
Illinois	43	35	56.2			
Indiana	41.4	44.9				
Massachusetts	....	....	....			
Michigan	....	....	....	71.5	71.1	70.2
New York	....	....	....			
Wisconsin	59	59	60.8			
Wyoming	43.7	51.9	48.7			
Total average	63.5	63.6	65.1	63.9	63.7	64.1

[a] Average, including Utah. [b] Average, including New York, also Massachusetts for 1899.

CONDITION IN WHICH COAL IS CHARGED INTO THE OVENS.

In the following tables will be found a statement of the condition in which the coal was charged into the ovens in the several States and Territories during the last two years, and a résumé of the corresponding statistics for the last thirteen years during which these statistics have been compiled. In a number of the coal-producing States it has been found that a washing of the coal before charging it into the ovens has materially improved the quality of the coke. This has been particularly true in regard to the slack coal used. Most of the run-of-mine coal which is washed before coking is crushed before being washed, in order to effect a more complete separation of the slate, pyrite, and other impurities which exist in the coal.

About two-thirds of the entire amount of coal which is used in coke making is run-of-mine coal, which is charged into the ovens without being washed. It has been found, however, that the coking process is in many cases facilitated and a better quality of coke obtained if the coal is crushed before charging into the ovens, and a large amount of the run-of-mine coal is crushed, or disintegrated, before coking, whether it is washed or not. Little, if any, large-size coal is coked in by-product ovens. During 1902, 11,608,491 short tons, or not quite one-third of the total amount of coal used in coke making, was slack, and a little more than one-half of this slack coal was washed before being coked. Alabama, Colorado, and Pennsylvania show large increases in the amount of slack coal washed before being made into coke, and the total amount of slack coal washed before coking in 1902 exceeded that of the preceding year by 1,517,821 tons, while the amount of washed run-of-mine coal used showed only a slight increase.

Among the more important coal-producing States it is noted that in Pennsylvania only 1,778,134 tons, out of a total of 25,017,326 tons, were washed before coking. In Alabama 3,004,084 tons, out of a total of 4,237,491 tons, were washed; and in Colorado 1,052,935 tons, all of which was slack, out of a total of 1,695,188 tons, were washed before coking. In this State only 831 tons of run-of-mine coal were made into coke in 1902. In West Virginia less than 8 per cent of the total coal consumed in the manufacture of coke was washed, while in Virginia all of the coal consumed was unwashed.

The amount of unwashed run-of-mine coal used in coke making increased from 23,751,468 short tons in 1901, to 26,347,698 tons in 1902. The amount of washed run-of-mine used remained practically the same, being 1,600,714 tons in 1901 and 1,647,818 tons in 1902. The use of unwashed slack increased from 4,546,201 tons to 5,781,088, and the washed slack from 4,309,584 to 5,827,403 tons. The amount of washed slack coal used in coke-making in 1902 was three times the amount consumed in 1896.

Character of coal used in the manufacture of coke in 1901.

[Short tons.]

State or Territory.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
Alabama	1,641,830	491,298	17,796	1,698,984	3,849,908
Colorado[a]	428,642	0	43,078	677,181	1,148,901
Georgia	0	0	10,574	79,345	89,919
Indian Territory	0	0	0	74,746	74,746
Kansas	0	3,839	4,140	3,650	11,629
Kentucky	0	28,000	67,311	108,986	204,297
Missouri	0	0	1,741	7,300	9,041
Montana	0	65,137	0	37,813	102,950
New Mexico	0	13,830	0	58,520	72,350
Ohio	100,345	0	42,279	20,000	162,624
Pennsylvania	19,689,162	647,209	893,476	506,620	21,736,467
Tennessee	224,723	282,129	34,088	198,306	739,246
Virginia	869,203	0	531,028	0	1,400,231
Washington	0	69,272	0	9,121	78,393
West Virginia	733,786	0	2,705,392	294,898	3,734,076
Illinois, Massachusetts, Michigan, New York, Wisconsin, Wyoming	63,777	0	195,298	534,112	793,187
Total	23,751,468	1,600,714	4,546,201	4,309,582	34,207,965

[a] Includes Utah.

Character of coal used in the manufacture of coke in 1902.

[Short tons.]

State or Territory.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
Alabama	1,233,117	509,376	290	2,494,708	4,237,491
Colorado[a]	831	0	641,422	1,052,935	1,695,188
Georgia	28,600	0	0	101,042	129,642
Indian Territory	0	3,947	0	106,987	110,934
Kansas	0	1,766	14,126	19,935	35,827
Kentucky	5,000	28,159	91,496	140,466	265,121
Missouri	0	0	10,430	0	10,430
Montana	0	99,628	0	0	99,628
New Mexico	0	0	208	40,735	40,943
Ohio	161,783	0	19,618	38,000	219,401
Pennsylvania	21,615,568	602,287	1,623,624	1,175,847	25,017,326
Tennessee	287,064	334,109	47,161	357,530	1,025,864
Virginia	1,018,148	0	697 962	0	1,716,110
Washington	0	68,546	0	0	68,546
West Virginia	1,262,393	0	2,517,223	298,963	4,078,579
Illinois, Indiana, Massachusetts, New York, Wisconsin, Wyoming	735,194	0	117,528	255	852,977
Total	26,347,698	1,647,818	5,781,088	5,827,403	39,604,007

[a] Includes Utah.

In the following table the statistics regarding the character of the coal for the years 1890 to 1902, inclusive, are consolidated:

Character of coal used in the manufacture of coke in the United States, 1890–1902.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	14,060,907	338,563	2,674,492	931,247	18,005,209
1891	12,255,415	290,807	2,945,359	852,959	16,344,540
1892	14,453,638	324,050	3,256,493	779,156	18,813,337
1893	10,306,082	350,112	3,049,075	1,211,877	14,917,146
1894	9,648,750	405,266	3,102,652	1,192,082	14,348,750
1895	15,609,875	237,468	3,052,246	1,948,734	20,848,323
1896	11,307,905	763,244	4,685,832	1,937,441	18,694,422
1897	13,234,985	1,037,830	4,180,575	2,453,929	20,907,319
1898	16,758,244	1,672,972	4,487,949	2,330,405	25,249,570
1899	20,870,915	1,457,961	4,976,737	2,913,730	30,219,343
1900	21,062,090	1,369,698	5,677,006	4,004,749	32,113,543
1901	23,751,468	1,600,714	4,546,201	4,309,582	34,207,965
1902	26,347,698	1,647,818	5,781,088	5,827,403	39,604,007

COKE MAKING IN BY-PRODUCT OVENS.

The retort or by-product method of coke making in the United States continues to show encouraging progress. This is principally evident in the number of new plants which have been reported as in course of construction at the close of the last three years. It should be remembered that the construction of one of these plants involves a much larger expenditure of capital and consumes a much longer time in the actual building than is necessary for the completion of a beehive oven plant. The close of 1902 marks the completion of the first decade of the use of by-product ovens in the United States, the first plant having been constructed at Syracuse, N. Y., in 1893. This plant, which was largely experimental, consisted of but 12 ovens. At the close of 1902 there had been completed a total of 1,663 by-product ovens, and 1,346 ovens were in course of construction. In the following table it is shown that at the close of 1900 there were 1,096 ovens building, of which barely 50 per cent had been completed at the end of 1902, showing an average of more than two years consumed in the building of these plants. The amount of coke produced in by-product ovens in 1902 amounted to 1,403,588 short tons, or 5.53 per cent of the total product, as against 1,179,900 tons, or 5.41 per cent of the total, in 1901. The average annual production of by-product ovens amounted to about 1,000 tons of coke each, while the highest average attained per each beehive oven in any year was made in 1902, when it reached 366.6 tons. In the report for 1901 and the two or three preceding ones, the statistics of the production of gas, tar, and ammonia in by-product ovens were discussed in connection with the output of by-product coke. These subjects are given treatment for 1902 in consideration with the report on the production of gas, tar, and ammonia at gashouse plants in the United States, upon which a separate chapter has been prepared.

Reduced to tabular form, the record of by-product coke making in the United States since 1893, when the first plant was constructed at Syracuse, has been as follows:

Record of by-product coke making, 1893–1902.

Year.	Ovens.		Production.
	Built.	Building.	
			Short tons.
1893	12	0	12,850
1894	12	60	16,500
1895	72	60	18,521
1896	160	120	83,038
1897	280	240	261,912
1898	520	500	294,445
1899	1,020	65	906,534
1900	1,085	1,096	1,075,727
1901	1,165	1,533	1,179,900
1902	[a] 1,663	[b] 1,346	1,403,588

[a] Includes 525 Semet-Solvay, 1,067 Otto-Hoffman, 15 Schniewind, and 56 Newton-Chambers.
[b] Includes 210 Semet-Solvay, 664 Otto-Hoffman, 412 Schniewind, and 60 Retort Coke Company ovens.

In the following table is shown the record of by-product coke ovens, by States, at the close of 1900, 1901, and 1902:

Record of by-product ovens by States.

State.	Ovens December 31, 1900.		Ovens December 31, 1901.		Ovens December 31, 1902.	
	Completed.	Building.	Completed.	Building.	Completed.	Building.
Alabama	120	120	120	120	240	40
Maryland	0	0	0	200	0	200
Massachusetts	400	0	400	0	400	0
Michigan	0	30	30	45	75	60
New Jersey	0	100	0	100	100	0
New York	30	564	30	564	30	574
Ohio	0	50	50	0	50	60
Pennsylvania	355	232	355	504	592	412
Virginia	60	0	60	0	56	0
West Virginia	120	0	120	0	120	0
Total	1,085	1,096	1,165	1,533	1,663	1,346

IMPORTS AND EXPORTS.

The following table gives the quantities and value of coke imported and entered for consumption in the United States from 1869 to 1902, inclusive. In the reports of the Treasury Department the quantities given are long tons. These have been reduced to short tons to make the tables consistent with other tables in this report.

Coke imported and entered for consumption in the United States, 1869–1902.

Year ending June 30—	Quantity.	Value.	Year ending Dec. 31—	Quantity.	Value.
	Short tons.			*Short tons.*	
1869		$2,053	1886	28,124	$84,801
1870		6,388	1887	35,320	100,312
1871		19,528	1888	35,201	107,914
1872	9,575	9,217	1889	28,608	88,008
1873	1,091	1,366	1890	20,808	101,767
1874	634	4,588	1891	50,753	223,184
1875	1,046	9,648	1892	27,420	86,350
1876	2,065	8,657	1893	37,183	99,683
1877	4,068	16,686	1894	32,566	70,359
1878	6,616	24,186	1895	29,622	71,366
1879	6,035	24,748	1896	43,372	114,713
1880	5,047	18,406	1897	34,937	98,077
1881	15,210	64,987	1898	46,127	142,334
1882	14,924	53,244	1899	31,197	142,504
1883	20,634	113,114	1900	115,556	371,341
1884	14,483	36,278	1901	72,727	266,075
1885	20,876	64,814	1902	140,488	423,775

The amount and value of coke exported from the United States have increased each year since 1895, as shown in the following table:

Coke exported from the United States since 1895.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1895	131,368	$425,174	1899	280,196	$858,856
1896	169,189	553,600	1900	422,239	1,358,968
1897	173,034	546,066	1901	430,450	1,561,898
1898	199,562	600,931	1902	439,590	1,785,188

PRODUCTION OF COKE BY STATES.

ALABAMA.

Alabama, which for six years prior to 1902 ranked third among the coke-producing States, advanced to second place last year, with an increased production of 403,335 tons over the output of 1901, West Virginia, which for several years stood next to Pennsylvania, taking Alabama's position as the third coke-producing State. Alabama's production in 1902 amounted to 2,552,246 short tons, West Virginia following closely with a total output of 2,516,500 tons. In 1901 Alabama produced 2,148,911 short tons, and West Virginia produced 2,283,700 short tons. The value of Alabama's coal product in 1902 was $8,300,838, as compared with $6,062,616 in 1901, a gain of $2,238,222, or 36.9 per cent, as against an increase of 18.8 per cent in the quantity of coke produced. The average price per ton for the coke produced was the highest in the history of the coke-making industry in the State, advancing from $2.82 in 1901 to $3.25 in 1902. The statistics for 1902 show also an increase in the yield of coal in coke to 60.2 per cent, the best record made in the State.

The number of coke-making establishments in Alabama increased from 31 in 1901 to 37 in 1902; the number of ovens completed from 7,136 to 7,571, and the number of ovens building at the close of 1901 from 535 to 1,334 at the close of 1902. The bank of 120 additional Semet-Solvay ovens mentioned in the report for 1901 as being under construction were completed in 1902, making a total of 240 of these ovens now operating in the State. The ovens under construction included also 40 more Semet-Solvay ovens building by the Semet-Solvay Company, at Tuscaloosa.

The coal fields of Alabama are divided into three districts, known by the names of the rivers which drain them—the Warrior, the Coosa, and the Cahaba. By far the most important of these is the Warrior district, which includes the coke ovens in and around the city of Birmingham. As there is but one coke-producing plant in each of the other two districts, no separation of the statistics of coke production is made by districts for this State.

The statistics of coke production in Alabama since 1880 are as follows:

Statistics of the manufacture of coke in Alabama, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	316	100	106,283	60,781	$183,063	$3.01	57
1881	4	416	120	184,881	109,033	326,819	3.00	59
1882	5	536	....	261,839	152,940	425,940	2.79	58
1883	6	767	122	359,699	217,531	598,473	2.75	60
1884	8	[a] 976	242	413,184	244,009	609,185	2.50	60
1885	11	1,075	16	507,934	301,180	755,645	2.50	59
1886	14	[a] 1,301	1,012	635,120	375,054	993,302	2.65	59
1887	15	1,555	1,362	550,047	325,020	775,090	2.39	59
1888	18	2,475	406	848,608	508,511	1,189,579	2.34	60
1889	19	3,944	427	1,746,277	1,030,510	2,372,417	2.30	59
1890	20	4,805	371	1,809,964	1,072,942	2,589,447	2.41	59
1891	21	5,068	50	2,144,277	1,282,496	2,986,242	2.33	60
1892	20	5,320	90	2,585,966	1,501,571	3,464,623	2.31	58
1893	23	5,548	60	2,015,398	1,168,085	2,648,632	2.27	58
1894	22	5,551	50	1,574,245	923,817	1,871,348	2.025	58.7
1895	22	5,658	50	2,459,465	1,444,339	3,033,521	2.10	58.7
1896	24	5,363	....	2,573,713	1,479,437	3,064,960	2.07	57.5
1897	25	5,365	[b] 120	2,451,475	1,443,017	3,094,461	2.14	58.8
1898	25	[c] 5,456	100	2,814,615	1,663,020	3,378,946	2.03	59
1899	25	[c] 5,599	850	3,028,472	1,787,809	3,634,471	2.03	59
1900	30	[c] 6,529	[c] 690	3,582,547	2,110,837	5,629,423	2.667	58.9
1901	31	[c] 7,136	[c] 535	3,849,908	2,148,911	6,062,616	2.82	55.8
1902	37	[d] 7,571	[e] 1,334	4,237,491	2,552,246	8,300,838	3.25	60.2

[a] One establishment made coke on the ground.
[b] Semet-Solvay ovens.
[c] Includes 120 Semet-Solvay ovens.
[d] Includes 240 Semet-Solvay ovens.
[e] Includes 40 Semet-Solvay ovens.

The character of the coal used in the manufacture of coke in Alabama since 1890 is shown in the following table:

Character of coal used in the manufacture of coke in Alabama, 1890–1902.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	1,480,669	0	206,106	123,189	1,809,964
1891	1,943,469	0	192,238	8,570	2,144,277
1892	2,463,366	0	11,100	111,500	2,585,966
1893	1,246,307	51,163	292,198	425,730	2,015,398
1894	411,097	7,429	477,820	677,899	1,574,245
1895	1,208,020	0	32,068	1,219,377	2,459,465
1896	1,292,191	70,125	51,674	1,159,723	2,573,713
1897	902,310	120,420	91,200	1,337,545	2,451,475
1898	1,290,794	828,294	25,000	670,527	2,814,615
1899	1,656,226	725,238	9,898	637,110	3,028,472
1900	1,729,882	152,077	165,418	1,535,170	3,582,547
1901	1,641,830	491,298	17,796	1,698,984	3,849,908
1902	1,233,117	509,376	290	2,494,708	4,237,491

It will be observed from the foregoing table that the increase in coke production in Alabama has been chiefly due to the utilization of slack coal, nearly all of which is washed before being charged into the ovens. Nearly 60 per cent of the coal used in 1902 was washed slack, and of the run-of-mine coal used nearly 30 per cent was washed.

COLORADO AND UTAH.

As there is but one coke-making establishment in Utah, the statistics of production in that State are combined with Colorado in order to maintain the confidential nature of the individual statements to the Survey. Colorado itself holds the same relative position west of the Mississippi River as a coke-producing State that Pennsylvania holds for the United States. The coke production of Utah is comparatively small and does not materially affect the total. The production of the two States in 1902 amounted to 1,003,393 short tons, as compared with 671,303 short tons in 1901, a gain of 332,090 tons or 49.5 per cent. The rate of increase for these two States in 1902 over 1901 was the largest of any of the more important coke-producing States, and largest of all with the exception of Georgia and Kansas. The total combined production of these two last States, however, amounted to but little over 100,000 tons. The statistics for 1902 show that the number of coke ovens increased 46.1 per cent over 1901, or from 2,060 to 3,010. All of these new ovens have been added to the plants of the Colorado Fuel and Iron Company, the coke product being consumed in the company's own blast furnaces. The coal used in the manufacture of coke is almost entirely slack—1,694,357 tons, out of a total of 1,695,188. Of the slack coal used 1,052,935 tons were washed before coking. The statistics of the production of coke in Colorado and Utah since 1880 and the character of the coal used in the manufacture of coke since 1890 are presented in the following table:

Statistics of the manufacture of coke in Colorado and Utah, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	200	50	51,891	25,568	$145,226	$5.68	49
1881	2	267	0	97,508	48,587	267,156	5.29	50
1882	5	344	0	180,549	102,105	476,665	4.67	57
1883	7	352	0	224,089	133,997	584,578	4.36	60
1884	8	409	24	181,968	115,719	409,930	3.45	64
1885	7	434	0	208,069	131,960	512,162	3.88	63
1886	7	483	0	228,060	142,797	569,120	3.99	62.6
1887	7	532	0	267,487	170,698	682,778	4.00	64
1888	7	602	100	274,212	179,682	716,305	4.00	65.6
1889	9	834	50	299,731	187,638	643,479	3.43	63
1890	8	916	30	407,023	245,756	959,246	3.90	60
1891	7	948	21	452,749	277,074	896,984	3.24	61
1892 *a*	9	*b* 1,128	220	599,200	373,229	1,234,320	3.31	62.3
1893 *a*	8	1,154	200	628,935	362,986	1,137,488	3.13	57.7
1894 *a*	8	1,154	250	542,429	317,196	903,970	2.85	58.5
1895 *a*	9	1,169	0	580,584	340,357	940,987	2.76	58.6
1896 *a*	11	1,275	0	639,238	363,760	1,046,306	2.88	56.9
1897 *a*	12	1,273	0	616,592	342,653	999,216	2.916	55.6
1898 *a*	12	1,253	3	803,686	474,808	1,230,428	2.59	59.8
1899 *a*	12	1,243	50	898,207	530,424	1,333,769	2.51	59
1900 *a*	13	1,488	0	997,861	618,755	1,746,732	2.82	62
1901 *a*	15	2,060	1,203	1,148,901	671,303	1,626,279	2.42	58.4
1902 *a*	15	3,010	363	1,695,188	1,003,393	2,754,341	2.74	59.2

a Includes production and value of coke in Utah and of coal coked.
b Includes 36 gas retorts since 1892.

The character of the coal used in the manufacture of coke in Colorado and Utah since 1890 is shown in the following table:

Character of coal used in the manufacture of coke in Colorado and Utah, 1890–1902.

[Short tons.]

Year.	Run-of-mine. Unwashed.	Run-of-mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
1890	36,058	0	395,023	0	431,081
1891	93,752	0	384,278	0	478,030
1892	82,098	0	517,102	0	599,200
1893	109,915	0	519,020	0	628,935
1894	126,642	0	415,787	0	542,429
1895	119,868	0	453,597	7,119	580,584
1896	143,604	0	378,776	116,858	639,238
1897	0	0	393,214	223,378	616,592
1898	122,983	0	415,298	265,405	803,686
1899	125,322	0	468,196	304,689	898,207
1900	229,311	0	316,527	452,023	997,861
1901	428,642	0	43,078	677,181	1,148,901
1902	831	0	641,422	1,052,935	1,695,188

GEORGIA.

The only coal mines in the State of Georgia are located in Dade and Walker counties, in the extreme northwest corner of the State, the coal beds being a portion of the Warrior coal fields of Alabama. The coal in Georgia produces a fairly good quality of coke—although it is principally the slack coal that is used for that purpose—which finds a market in the iron works in the vicinity of Chattanooga, Tenn.

Georgia's production of coke in 1902 amounted to 82,064 short tons, the largest output since 1895, and exceeding the output of 1901 by 27,514 tons, or a litte over 50 per cent. The value of the product increased from $154,625 to $298,963, the highest figure ever reached. The average price per ton in 1902 was $3.64, as compared with $2.83 in 1901, and with $2.85 in 1900. For the first time in a period of ten years some run-of-mine unwashed coal was made into coke in Georgia. This was due to the inability to supply the demand for coke from the slack coal produced in mining operations.

The statistics of the production of coke in Georgia, 1880 to 1902, are as follows:

Statistics of the manufacture of coke in Georgia, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	1	140	40	63,402	38,041	$81,789	$2.15	60
1881	1	180	40	68,960	41,376	88,753	2.15	60
1882	1	220	44	77,670	46,602	100,194	2.15	60
1883	1	264	36	111,687	67,012	147,166	2.20	60
1884	1	300	0	132,113	79,268	169,192	2.13	60
1885	2	300	0	117,781	70,669	144,198	2.04	60
1886	2	300	0	136,133	82,680	179,031	2.17	60
1887	2	300	0	158,482	79,241	174,410	2.20	50
1888	1	290	0	140,000	83,721	177,907	2.12	60
1889	1	300	0	157,878	94,727	149,059	1.57	60
1890	1	300	0	170,388	102,233	150,995	1.48	60
1891	1	300	0	164,875	103,057	231,878	2.25	62.5
1892	1	300	0	158,978	81,807	163,614	2.00	51.5
1893	1	338	0	171,645	90,726	136,089	1.50	52.8
1894	1	338	0	166,523	93,029	116,286	1.25	55.9
1895	1	330	0	118,900	60,212	70,580	1.17	50.6
1896	1	334	0	109,655	53,673	68,486	1.276	49
1897	1	300	0	67,000	33,000	42,240	1.28	49.3
1898	2	350	0	81,108	49,529	77,230	1.56	61
1899	2	350	100	78,098	50,907	116,917	2.30	65.2
1900	2	480	0	140,988	73,928	210,646	2.849	52.4
1901	2	510	0	89,919	54,550	154,625	2.83	60.7
1902	2	492	38	129,642	82,064	298,963	3.643	63.3

As shown in the following table, nearly all of the coal used in the manufacture of coke in Georgia since 1890 was washed before being charged into the ovens.

Character of coal used in the manufacture of coke in Georgia, 1890-1902.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	0	0	0	170,388	170,388
1891	106,131	0	0	58,744	164,875
1892	0	0	0	158,978	158,978
1893	0	0	0	171,645	171,645
1894	0	166,523	0	0	166,523
1895	0	118,900	0	0	118,900
1896	0	109,655	0	0	109,655
1897	0	67,000	0	0	67,000
1898	0	61,844	0	19,264	81,108
1899	0	48,521	0	29,577	78,098
1900	0	68,988	0	72,000	140,988
1901	0	0	10,574	79,345	89,919
1902	28,600	0	0	101,042	129,642

INDIAN TERRITORY.

Coke production in the Indian Territory in 1902 presented one notable exception to the general condition prevailing throughout the year, in that the average price per ton was less than that of 1901. One establishment and 50 ovens were added to the coke-making equipment of the Territory in 1902, and the product increased from 37,374 short tons to 49,441 tons, and the total value from $154,834 to $202,921.

The statistics of the manufacture of coke in the Indian Territory from 1880 to 1902 are as follows:

Statistics of the manufacture of coke in the Indian Territory, 1880-1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	1	20	0	2,494	1,546	$4,638	$3.00	62
1881	1	20	0	2,852	1,768	5,304	3.00	62
1882	1	20	0	3,266	2,025	6,075	3.00	62
1883	1	20	0	4,150	2,573	7,719	3.00	62
1884	1	20	0	3,084	1,912	5,736	3.00	62
1885	1	40	0	5,781	3,584	12,902	3.60	62
1886	1	40	0	10,242	6,351	22,229	3.30	62
1887	1	80	0	20,121	10,060	33,435	3.33	50
1888	1	80	0	13,126	7,502	21,755	2.90	57
1889	1	80	0	13,277	6,639	17,957	2.70	50
1890	1	80	0	13,278	6,639	21,577	3.25	50
1891	1	80	0	20,551	9,464	30,483	3.22	46

Statistics of the manufacture of coke in the Indian Territory, 1880–1902—Continued.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1892	1	80	0	7,138	3,569	$12,402	$3.47	50
1893	1	80	0	15,118	7,135	25,072	3.51	47
1894	1	80	0	7,274	3,051	10,693	3.50	42
1895	1	80	0	11,825	5,175	17,657	3.41	43.8
1896	2	130	0	53,028	21,021	73,574	3.50	40
1897	2	130	0	68,495	30,364	104,725	3.45	44.3
1898	2	130	0	73,330	34,110	96,639	2.833	46.5
1899	3	130	100	59,255	34,339	71,965	2.96	41
1900	3	230	0	79,534	38,141	152,204	3.99	48
1901	3	230	0	74,746	37,374	154,834	4.14	50
1902	4	280	0	110,934	49,441	202,921	4.10	44.6

The character of the coal used in the manufacture of coke in the Indian Territory since 1890 is shown in the following table:

Character of coal used in the manufacture of coke in the Indian Territory, 1890–1902.

[Short tons.]

Year.	Run of mine. Unwashed.	Run of mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
1890	0	0	0	13,278	13,278
1891	0	0	9,500	11,051	20,551
1892	0	0	0	7,138	7,138
1893	0	0	0	15,118	15,118
1894	0	0	0	7,274	7,274
1895	0	0	0	11,825	11,825
1896	0	0	0	53,028	53,028
1897	0	6,923	0	61,572	68,495
1898	0	15,353	0	57,977	73,330
1899	0	0	0	59,255	59,255
1900	0	0	20,832	58,702	79,534
1901	0	0	0	74,746	74,746
1902	0	3,947	0	106,987	110,934

KANSAS.

This State continues to be of comparatively little importance as a coke producer, the small amount of coke produced being made by the zinc-producing companies for their own use, and the coal used being chiefly slack coal obtained from the mines in the State. There were 10 establishments, with a total of 97 ovens, producing coke in 1902. The product was the largest ever made, amounting to 20,902 tons, with a value of $54,702. The production in 1902 was nearly three times that of 1901.

The statistics of the manufacture of coke in Kansas from 1880 to 1902 are as follows:

Statistics of the manufacture of coke in Kansas, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	2	6	....	4,800	3,070	$6,000	$1.95	64
1881	3	15	....	8,800	5,670	10,200	1.80	64.4
1882	3	20	....	9,200	6,080	11,460	1.70	66
1883	4	23	....	13,400	8,430	16,560	1.96	62.9
1884	4	23	....	11,500	7,190	14,580	2.02	62.5
1885	4	23	....	15,000	8,050	13,255	1.65	53.7
1886	4	36	....	23,062	12,493	19,204	1.54	54.2
1887	4	39	....	27,604	14,950	28,575	1.91	54
1888	6	58	....	24,934	14,831	29,073	1.96	59.5
1889	6	68	....	21,600	13,910	26,593	1.91	64
1890	7	68	....	21,809	12,311	29,116	2.37	56
1891	6	72	....	27,181	14,174	33,296	2.35	52
1892	6	75	....	15,437	9,132	19,906	2.18	59.2
1893	6	75	0	13,645	8,565	18,640	2.18	62.8
1894	6	61	0	13,288	8,439	15,660	1.855	63.5
1895	5	55	0	8,424	5,287	11,289	2.14	62.8
1896	6	55	0	8,940	4,785	8,676	1.813	53.5
1897	4	57	0	11,772	6,181	9,272	1.50	52.5
1898	6	47	50	7,856	4,180	6,455	1.545	53
1899	9	95	0	26,988	14,476	30,817	2.13	53.6
1900	9	91	0	10,303	5,948	14,985	2.52	57.7
1901	12	98	3	11,629	7,138	15,079	2.11	61.4
1902	10	97	12	35,827	20,902	54,702	2.617	58.3

KENTUCKY.

The coke production in Kentucky in 1902 was the largest both in amount and value in the history of the State, amounting to 126,879 short tons, valued at $317,875. The coking industry of Kentucky depends for its existence principally upon the slack coal produced at the coal mines of the State. Kentucky is the only State which contains within its borders the Coal Measures of any two of the great fields. The Appalachian coal area crosses the eastern end of the State, while the southern extremity of the Illinois and Indiana, or Eastern Interior, field is found in the western counties of Kentucky. Coke is made from coal mined from both fields, one of the principal coke plants being that of the St. Bernard Coal Mining Company at Earlington, Hopkins County, which has been able to produce a good quality of coke from these coals, although practically no coke is made from the more extensively developed portions of the field in Illinois and Indiana.

The total amount of coal consumed in the manufacture of coke in

Kentucky in 1902 was 265,121 tons. Of this amount, 231,962 tons were slack, and of the slack coal 140,466 tons were washed before coking.

The statistics of the manufacture of coke in Kentucky from 1880 to 1902 are as follows:

Statistics of the manufacture of coke in Kentucky, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	5	45	....	7,206	4,250	$12,250	$2.88	59
1881	5	45	....	7,406	4,370	12,630	2.89	59
1882	5	45	....	6,906	4,070	11,530	2.83	59
1883	5	45	....	8,437	5,025	14,425	2.87	60
1884	5	45	....	3,451	2,223	8,760	3.94	64
1885	5	33	....	5,075	2,704	8,489	3.14	53
1886	6	76	2	9,055	4,528	10,082	2.23	50
1887	6	98	....	29,129	14,565	31,730	2.18	50
1888	10	132	2	42,642	23,150	47,244	2.04	54
1889	9	166	100	25,192	13,021	29,769	2.28	52
1890	9	175	103	24,372	12,343	22,191	1.80	51
1891	7	115	24	64,390	33,777	68,281	2.02	52
1892	5	287	100	70,783	36,123	72,563	2.01	51
1893	4	283	100	97,212	48,619	97,350	2.00	50
1894	6	293	0	66,418	29,748	51,566	1.73	44.8
1895	5	293	0	63,419	25,460	37,249	1.46	40.1
1896	4	264	0	55,719	27,107	42,062	1.55	48.6
1897	5	268	0	64,234	32,117	45,454	1.41	50
1898	5	292	2	44,484	22,242	32,213	1.448	50
1899	6	300	130	151,503	81,095	161,454	1.99	53.5
1900	5	458	3	190,268	95,532	235,505	2.465	50.2
1901	5	461	0	204,297	100,285	208,015	2.07	49
1902	7	485	12	265,121	126,879	317,875	2.505	47.8

MISSOURI.

The small amount of coke produced in Missouri is from ovens operated in connection with the lead and zinc smelters, in which the product is consumed. The industry is a small one, and the conditions affecting it are similar to those mentioned in regard to Kansas. The production in 1902 amounted to 5,780 short tons, as compared with 4,749 tons in 1901. There were but two establishments making coke last year and the total number of coke ovens was 8. All of the coal used in coke making is slack coal.

The statistics of the production of coke in Missouri from 1887, when coking began in this State, to 1902 are as follows:

Statistics of the manufacture of coke in Missouri, 1887–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1887	1	4	....	5,400	2,970	$10,395	$3.50	55
1888	1	4	....	5,000	2,600	9,100	3.50	52
1889	3	9	....	8,485	5,275	5,800	1.10	62
1890	3	10	....	9,491	6,136	9,240	1.51	65
1891	3	10	....	10,377	6,872	10,000	1.45	66
1892	3	10	....	11,088	7,299	10,949	1.50	65.8
1893	3	10	0	8,875	5,905	9,735	1.65	66.5
1894	3	10	0	3,442	2,250	3,563	1.58	65.4
1895	3	10	0	3,120	2,028	2,442	1.20	65
1896	3	7	0	4,471	2,500	4,131	1.65	55.9
1897	3	15	0	4,627	2,593	3,890	1.50	56
1898	3	8	0	1,500	740	1,050	1.42	49.3
1899	4	12	0	5,320	2,860	5,520	1.93	53.8
1900	3	10	0	3,775	2,087	5,268	2.52	55.3
1901	3	9	0	9,041	4,749	9,968	2.099	52.5
1902	2	8	0	10,430	5,780	14,450	2.50	55.4

MONTANA.

Montana is one of the States whose coke production in 1902 was less than that of the preceding year. A number of new ovens were added to the plant of the Montana Coal and Coke Company during 1902, and an increase in production in 1903 may be expected. The output in 1902 amounted to 53,463 tons, as compared with 57,004 tons in 1901. With one exception the production in 1902 was less than in any year since 1896. All of the coal used in the manufacture of coke in Montana is washed before coking.

The statistics of the manufacture of coke in Montana from 1883, when ovens were first reported, to 1902 are as follows:

Statistics of the manufacture of coke in Montana, 1883–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1883	1	2	0	0	0	0	0	0
1884	3	5	12	165	75	$900	$12.00	46
1885	2	2	0	300	175	2,063	11.72	58.5
1886	4	16	0	0	0	0	0	0
1887	2	27	0	10,800	7,200	72,000	10.00	66.7
1888	1	40	0	20,000	12,000	96,000	8.00	60
1889	2	90	50	30,576	14,043	122,023	8.69	46
1890	2	140	0	32,148	14,427	125,655	8.71	45
1891	2	140	0	61,667	29,009	258,523	8.91	47
1892	2	153	0	64,412	34,557	311,013	9.00	53.6
1893	2	153	0	61,770	29,945	239,560	8.00	48.5
1894	2	153	0	33,313	17,388	165,187	9.50	52.2
1895	3	303	0	55,770	25,337	189,856	7.49	45.4
1896	3	303	0	113,165	60,078	425,483	7.08	53
1897	3	303	0	139,907	67,849	467,481	6.89	48.5
1898	4	318	0	92,552	52,009	359,174	6.91	56
1899	3	303	0	110,274	56,376	356,190	6.32	51
1900	3	342	111	108,710	54,731	337,079	6.159	50.3
1901	3	328	111	102,950	57,004	337,381	5.918	55.4
1902	3	410	0	99,628	53,463	360,927	6.75	53.7

NEW MEXICO.

New Mexico was one of the three exceptions to the general increase in coke production in 1902, the output from this Territory decreasing from 41,643 short tons in 1901 to 23,296 tons, a loss of 18,347 tons, or about 44 per cent. There are but two establishments in the Territory, and a total of 126 ovens. No changes have been made in this respect in the last six years. The coal used in the manufacture of coke in the Territory in 1902 was entirely slack coal, and of the 40,943 tons used all but 208 tons were washed before coking.

The statistics of the production of coke in New Mexico from 1882, when coke ovens were first reported, until 1902 are as follows:

Statistics of the manufacture of coke in New Mexico, 1882–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1882	2	0	12	1,500	1,000	$6,000	$6.00	66⅔
1883	2	12	28	6,941	3,905	21,478	5.50	57¼
1884	2	70	0	29,990	18,282	91,410	5.00	57¼
1885	2	70	0	31,889	17,940	89,700	5.00	56¼
1886	2	70	0	18,194	10,236	51,180	5.00	56
1887	1	70	0	22,549	13,710	82,260	6.00	61
1888	1	70	0	14,628	8,540	51,240	6.00	58
1889	2	70	0	7,162	3,460	18,408	5.32	48
1890	2	70	0	3,980	2,050	10,025	4.89	51.5
1891	1	70	0	4,000	2,300	10,925	4.75	57.5
1892	1	50	0	0	0	0	0	0
1893	1	50	0	14,698	5,803	18,476	3.18	39.5
1894	1	50	0	13,042	6,529	28,213	4.32	50
1895	1	50	0	22,385	14,663	29,491	2.01	65.5
1896	1	50	0	39,286	24,228	48,453	2.00	61.7
1897	2	126	0	2,585	1,438	3,232	2.25	55.6
1898	2	126	0	12,557	6,980	14,625	2.095	55.6
1899	2	126	0	68,594	44,134	99,217	2.25	64.3
1900	2	126	0	74,261	44,774	130,251	2.909	60.3
1901	2	126	0	72,350	41,643	118,368	2.84	57.5
1902	2	126	0	40,943	23,296	74,051	3.178	56.9

NEW YORK.

The 564 ovens of the Otto-Hoffman by-product type, mentioned in the report for 1901 as being under construction at Buffalo by the Lackawanna Iron and Steel Company, had not been completed at the close of 1902, and did not, therefore, contribute to the production of New York last year. The entire output for the State was from the 30 Semet-Solvay ovens at Syracuse. This plant is being increased by an addition of 10 ovens, which were in course of construction at the close of 1902. The statistics of production of New York are included with that of "Other States."

OHIO.

Although Ohio possesses large areas of coal from which a fair quality of coke could be made, and stands fourth among the coal-producing States, the coke-making industry has not been developed to any extent. This is doubtless due to the proximity of the higher grade of coking coals of Pennsylvania and West Virginia, which supply the fuel for the many iron and steel works in Ohio. Stimulated, however, by the increased activity and demand for coke in 1902, the production of the State increased from 108,774 tons in 1901 to 146,099 tons in 1902, this being the largest output ever made. The value increased from $299,430 to $492,793, and the average price per ton advanced from $2.75 to $3.37. Something over one-third of the total product in 1902 was from the new plant of Otto-Hoffman ovens completed in 1901, at Hamilton, near Cincinnati. At the close of 1902 there were 60 retort ovens in course of construction by the Retort Coke Oven Company, at Cleveland. The number of establishments in the State increased from 8 in 1901 to 9 in 1902, and the number of completed ovens from 419 to 449. Two of these establishments, with a total of 23 ovens, were idle throughout the year.

In the following table the statistics of the production of coke in Ohio for the years 1880 to 1902 are consolidated:

Statistics of the manufacture of coke in Ohio, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	15	616	25	172,453	100,596	$255,905	$2.54	58
1881	15	641	0	201,045	119,469	297,728	2.49	59
1882	16	647	0	181,577	103,722	266,113	2.57	57
1883	18	682	0	152,502	87,834	225,660	2.57	58
1884	19	732	0	108,164	62,709	156,294	2.49	58
1885	13	642	0	68,796	39,416	109,723	2.78	57
1886	15	560	0	59,332	34,932	94,042	2.69	59
1887	15	585	223	164,974	93,004	245,981	2.65	56
1888	15	547	12	124,201	67,194	166,330	2.48	54
1889	13	462	0	132,828	75,124	188,222	2.50	56
1890	13	443	1	126,921	74,633	218,090	2.92	59
1891	9	421	0	69,320	38,718	76,901	1.99	56
1892	10	436	0	95,236	51,818	112,907	2.18	54.4
1893	9	435	0	42,963	22,436	43,671	1.95	52
1894	8	363	0	55,324	32,640	90,875	2.78	59
1895	8	377	0	51,921	29,050	69,655	2.40	56
1896	9	431	0	128,923	80,868	208,789	2.58	62.7
1897	9	433	0	151,545	95,087	235,784	2.48	62.7
1898	10	441	0	134,757	85,535	211,558	2.47	63.5
1899	8	385	0	142,678	83,878	255,129	3.04	58.8
1900	8	369	50	115,269	72,116	194,042	2.69	62.5
1901	8	[a] 419	0	162,624	108,774	299,430	2.75	66.9
1902	9	[a] 449	[b] 60	219,401	146,099	492,793	3.37	66.6

[a] Includes 50 Otto-Hoffman ovens. [b] Retort Coke Company ovens.

The character of the coal used in the manufacture of coke in Ohio since 1890 is shown in the following table:

Character of coal used in the manufacture of coke in Ohio since 1890.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	34,729	0	54,473	37,719	126,921
1891	5,200	0	64,120	0	69,320
1892	35,334	0	32,402	27,500	95,236
1893	0	0	24,859	18,104	42,963
1894	0	0	14,845	40,479	55,324
1895	28,053	0	10,868	13,000	51,921
1896	88,616	0	24,325	15,982	128,923
1897	92,192	0	29,353	30,000	151,545
1898	92,963	0	19,794	22,000	134,757
1899	88,771	0	23,907	30,000	142,678
1900	68,175	0	17,094	30,000	115,269
1901	100,345	0	42,279	20,000	162,624
1902	161,783	0	19,618	38,000	219,401

PENNSYLVANIA.

Approximately two-thirds of the entire coke product of the United States is made in Pennsylvania and 60 per cent of Pennsylvania's product, or 40 per cent of the entire output of the United States, is from the famous Connellsville region. In 1902 the coke production of Pennsylvania amounted to 16,497,910 short tons, out of a total for the United States of 25,401,730 tons. In 1901 Pennsylvania produced 14,355,917 tons, out of a total of 21,795,883 tons. Of these totals, the Connellsville region produced in 1901, 10,235,943 tons, and in 1902, 10,418,366 tons. To this production of the Connellsville region might be reasonably added the output of the recently developed areas in the vicinity of Uniontown, which have been classified in this report under the name of the Lower Connellsville district. This new district produced in 1901, 1,116,379 short tons, and in 1902, 1,899,111 tons, making the total for the two districts in 1901, 11,352,322, and in 1902, 12,317,477 short tons.

As compared with 1901, the coke production of Pennsylvania in 1902 shows an increase of 2,141,993 short tons, or 14.9 per cent, each district in the State participating in the increased production, although the increase in the Connellsville region was comparatively small. That the increase in the Connellsville region was not larger was due to the great shortage of cars and lack of motive power on the part of the transportation companies, there being constant complaint throughout the entire year of the inability of the railroads to handle this traffic properly. A number of establishments were obliged to put their ovens out of blast for considerable periods on account of the congested condition of the railroad business. The inability to increase production more materially was, however, somewhat compensated for in the enhanced value of the coke produced. The output of the Connellsville region in 1902, which did not exceed that of 1901 by as much as 2 per cent, showed an increase in value of from $19,172,697 to $23,785,433, a gain of $4,612,736, or 24 per cent. The value of the total product for the State increased from $27,066,361 to $38,451,722, a gain of $11,385,361, or 42 per cent. This indicates that the value of Connellsville coke did not increase in the same ratio as that produced in other portions of the State.

It should be stated, however, that a large part of the Connellsville product was marketed in 1902 at contract prices made the preceding year, and, moreover, the production of the H. C. Frick Company, the largest producer in the region, as in the United States, is no longer sold in the open market, but is entirely consumed in the furnaces and mills of the United States Steel Corporation, of which the Frick company is a subsidiary member. Consequently the value placed upon this product is largely an arbitrary figure and does not represent actual market conditions. Notwithstanding the fact that during the anthracite strike the prices of Connellsville coke for prompt delivery reached as high as $12 per ton, a comparatively small amount was sold at these high figures, the greater portion going to contract purchasers. The smaller producing districts of the State not only increased their production in greater proportion than did the Connellsville region, but also obtained more direct and substantial benefit from the abnormal prices which prevailed for a time during 1902.

There were in 1902 196 establishments in the State, as compared with 188 in 1901. Four of the eight new plants were constructed in the Lower Connellsville district, the most recently developed coking field in the State, the total number of completed ovens increasing from 34,906 to 36,609. Of this increase, 1,002 were in the Lower Connellsville district. There were building at the close of 1902 2,332 new ovens, as compared with 832 ovens in the course of construction at the close of 1901. The completed ovens at the close of 1902 included 507 Otto-Hoffman, 75 Semet-Solvay, and 8 Newton-Chambers by-product ovens. Of the 2,332 ovens building at the close of 1902 there were 100 Otto-Hoffman, 100 Semet-Solvay, and 212 Schniewind by-product ovens. Including the ovens which were completed in 1902, but not completed in time to be put in blast during that year, there were 9 establishments in the State, with a total of 599 ovens, which did not produce any coke throughout the entire year.

In the following table are given the statistics of the production of coke in Pennsylvania for the years 1880 to 1902, inclusive:

Statistics of the manufacture of coke in Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	124	9,501	836	4,347,558	2,821,384	$5,255,040	$1.86	65
1881	132	10,881	761	5,393,503	3,437,708	5,898,579	1.70	64
1882	137	12,424	642	6,149,179	3,945,034	6,133,698	1.55	64
1883	140	13,610	211	6,823,275	4,438,464	5,410,387	1.22	65
1884	145	14,285	232	6,204,604	3,822,128	4,783,230	1.25	62
1885	133	14,553	317	6,178,500	3,991,805	4,981,656	1.25	64.6
1886	108	16,314	2,558	8,290,849	5,406,597	7,664,023	1.42	65.2
1887	151	18,294	802	8,938,438	5,832,849	10,746,352	1.84	65.3
1888	120	20,381	1,565	9,673,097	6,545,779	8,230,759	1.26	68
1889	109	22,143	567	11,581,292	7,659,055	10,743,492	1.40	66
1890	106	23,430	74	13,046,143	8,560,245	16,333,674	1.91	65.6
1891	109	25,324	11	10,588,544	6,954,846	12,679,826	1.82	66
1892	109	25,366	269	12,591,345	8,327,612	15,015,336	1.80	66.1
1893	102	25,744	19	9,386,702	6,229,051	9,468,036	1.52	66
1894	101	25,824	118	9,059,118	6,063,777	6,585,489	1.086	66.9
1895	99	26,042	170	14,211,567	9,404,215	11,908,162	1.266	66.2
1896 [a]	158	26,658	154	11,124,610	7,356,502	13,182,859	1.792	66.1
1897 [a]	153	26,910	307	13,538,646	8,966,924	13,727,966	1.53	66.2
1898 [a]	151	27,157	292	16,307,841	10,715,302	16,078,505	1.50	65.7
1899 [b]	150	27,591	1,666	19,930,419	13,577,870	22,881,910	1.69	68.1
1900	177	32,548	2,310	20,239,966	13,357,295	29,692,258	2.22	66
1901	188	34,906	832	21,736,467	14,355,917	27,066,361	1.885	66
1902	196	36,609	2,332	25,017,326	16,497,910	38,451,722	2.33	65.9

[a] Includes coal used, coke produced, and its value in New York.
[b] Includes coal used, coke produced, and its value, in Massachusetts and New York.

The character of the coal used in the manufacture of coke in Pennsylvania since 1890 is shown in the following table:

Character of coal used in the manufacture of coke in Pennsylvania since 1890.

[Short tons.]

Year.	Run-of-mine. Unwashed.	Run-of-mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
1890	11,788,625	303,591	630,195	323,732	13,046,143
1891	9,470,646	256,807	558,106	302,985	10,588,544
1892	11,237,253	159,698	1,059,994	134,400	12,591,345
1893	8.302,307	216,762	739,128	128,505	9,386,702
1894	8,671,534	118,279	204,811	64,494	9,059,118
1895	13,618,376	34,728	440,869	117,594	14,211,567
1896 [a]	9,289,089	273,082	1,463,047	99,392	11,124,610
1897 [a]	11,540,459	301,052	1,441,611	255,524	13,538,646
1898 [a]	14,083,073	350,153	1,472,347	402,268	16,307,841
1899 [b]	16,854,706	366,206	1,824,784	884,723	19,930,419
1900	17,692,623	647,045	1,300,796	599,502	20,239,966
1901	19,689,162	647,209	893,476	506,620	21,736,467
1902	21,615,568	602,287	1,623,624	1,175,847	25,017,326

[a] Includes coal used in New York. [b] Includes coal used in Massachusetts and New York.

PRODUCTION BY DISTRICTS.

In previous chapters of this series it has been customary to consider the production of coke in Pennsylvania according to certain well-defined districts. These divisions are based to some extent upon geographic boundaries, but also upon the quality of the coal mined and the coke produced. Each one has been more fully described in some of the preceding volumes, but the following brief statement regarding the territory included in the different coking districts is repeated here for the sake of convenience.

The Allegheny Mountain district includes the ovens along the line of the Pennsylvania Railroad from Gallitzin eastward over the crest of the Alleghenies to beyond Altoona. The Allegheny Valley district includes the coke works of Armstrong and Butler counties and one of those in Clarion County, the other ovens in the latter county being included in the Reynoldsville-Walston district. What was previously known as the Beaver district included the ovens in Beaver and Mercer counties, but all the ovens in Beaver County have been abandoned, and the operations of the Semet-Solvay ovens in Mercer County are now included in the Pittsburg district. The Blossburg and Broad Top districts embrace the Blossburg and Broad Top coal fields. The ovens of the Clearfield-Center district are chiefly in the two counties from which it derives its name. The Connellsville district is the well-known region of western Pennsylvania, in Westmoreland and Fayette counties, extending from just south of Latrobe to Fairchance. The Lower Connellsville region is entirely in Fayette County and is an extension, southwest, of the Connellsville basin proper. It embraces the developments located in the vicinity of Uniontown. The Greensburg, Irwin, Pittsburg, and Reynoldsville-Walston districts include the ovens near the towns which have given the names to these districts. The Upper Connellsville district, sometimes called the Latrobe district, is near the town of Latrobe.

The Allegheny Valley district may be said to have passed out of existence, as no coke has been made there during the last four years, and it is practically abandoned.

Coke production in Pennsylvania in 1901, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
Allegheny Mountain	[a]16	[b]1,378	0	864,133	548,076	$1,112,682	$2.03	63.4
Allegheny Valley [c]	1	10	15	....	....	....	....	....
Broad Top	5	571	0	187,715	118,949	237,898	2.00	63.4
Clearfield-Center	8	636	0	134,913	86,242	157,648	1.828	63.9
Connellsville	96	[d]21,586	243	15,266,722	10,235,943	19,172,697	1.873	67
Greensburg	6	991	0	406,957	257,785	464,692	1.80	63.3
Irwin	6	750	0	30,699	19,977	32,562	1.63	65
Lebanon Valley	1	0	[f]232	....	....	....	....	....
Lower Connellsville	17	3,251	30	1,666,826	1,116,379	1,991,699	1.784	66.9
Pittsburg	9	[e]1,641	[g]212	1,266,947	813,478	1,690,614	2.078	64.2
Reynoldsville-Walston	7	2,010	0	1,059,107	589,577	1,171,878	1.988	55.7
Upper Connellsville	16	2,082	100	852,448	569,511	1,033,991	1.815	66.8
Total	188	34,906	832	21,736,467	14,355,917	27,066,361	1.885	66

[a] One establishment made coke in open ricks, not ovens.
[b] Includes 160 Otto-Hoffman and 8 Newton-Chambers ovens.
[c] Production included in Pittsburg district.
[d] Includes 50 Semet-Solvay ovens.
[e] Includes 120 Otto-Hoffman and 25 Semet-Solvay ovens.
[f] Otto-Hoffman ovens.
[g] Schniewind ovens.

Coke production in Pennsylvania in 1902, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
Allegheny Mountain	15	[a]1,563	[b]260	965,412	644,053	$1,782,660	$2.768	66.7
Allegheny Valley [c]	2	20	20	....	....	....	....	....
Broadtop	5	571	3	281,320	175,808	594,521	3.38	62.5
Clearfield Center	9	[d]623	120	308,289	198,725	489,637	2.46	64.5
Connellsville	97	[e]21,659	[f]374	15,538,701	10,418,366	23,785,433	2.283	67.05
Greensburg	7	1,240	193	725,744	441,941	1,228,576	2.78	60.9
Irwin	6	691	0	217,404	139,299	329,410	2.36	64.1
Lebanon Valley	2	[g]237	[j]40	0	0	0	.0	.0
Lower Connellsville	21	4,253	705	2,826,242	1,899,111	4,701,068	2.475	67.2
Pittsburg [h]	8	[i]1,591	[k]212	1,488,973	953,863	1,924,942	2.018	64.1
Reynoldsville Walston	7	2,029	0	1,251,765	689,890	1,422,143	2.06	55.1
Upper Connellsville	17	2,132	405	1,413,476	936,854	2,193,332	2.34	66.3
Total	196	36,609	2,332	25,017,326	16,497,910	38,451,722	2.33	65.9

[a] Includes 160 Otto-Hoffman and 8 Newton-Chambers ovens.
[b] Includes 100 Otto-Hoffman ovens.
[c] Production included in Pittsburg district.
[d] Includes 87 ovens and production in Elk County.
[e] Includes 50 Semet-Solvay ovens.
[f] Includes 60 Semet-Solvay ovens.
[g] Otto-Hoffman ovens.
[h] Includes production of ovens in Allegheny Valley district.
[i] Includes 120 Otto-Hoffman and 25 Semet-Solvay ovens.
[j] Semet-Solvay ovens at Chester, in eastern Pennsylvania.
[k] Schniewind ovens at Lebanon.

Allegheny Mountain district.—This district includes all of the coke ovens in the vicinity of Johnstown and those lying along the line of the Pennsylvania Railroad east of Blairsville, Indiana County. It also includes a few plants in Somerset County. The developments in the vicinity of Johnstown include 160 by-product ovens of the Otto-Hoffman type, operated in connection with the works of the Cambria Steel Company. An additional bank of 100 by-product ovens of the same type were being added to this plant at the close of 1902. The production of this district shows a substantial increase, from 548,076 in 1901 to 644,053 tons in 1902, while the value increased in much larger proportion, from $1,112,682 to $1,782,660. The average price per ton received for the product advanced from $2.03 to $2.77, an increase of 74 cents, or 37 per cent.

One bank of 15 ovens was abandoned in 1902, but 260 new ovens were building at the close of the year.

The statistics of the manufacture of coke in the Allegheny Mountain district from 1880 to 1902 are as follows:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	8	291	0	201,345	127,525	$289,929	$2.27	63
1881	9	371	0	225,563	144,430	329,198	2.28	64
1882	10	481	0	284,541	179,580	377,286	2.10	63
1883	10	532	0	200,343	135,342	240,641	1.78	68
1884	12	614	0	241,459	156,290	203,213	1.30	65
1885	11	523	82	327,666	212,242	286,539	1.30	65
1886	10	579	14	351,070	227,369	374,013	1.64	64.8
1887	10	694	150	461,922	297,724	671,437	2.25	64.4
1888	12	950	145	521,047	335,689	479,845	1.43	64.4
1889	16	1,069	20	564,112	354,288	601,964	1.69	63.5
1890	16	1,171	0	633,974	402,514	730,048	1.81	63.5
1891	16	1,201	0	708,523	448,067	782,175	1.75	63
1892	16	1,260	0	724,903	448,522	775,927	1.73	61.9
1893	15	1,260	0	275,865	173,131	264,292	1.53	62.8
1894	15	1,253	0	92,965	58,823	71,161	1.21	63.3
1895	13	1,233	60	271,096	173,965	214,741	1.23	64
1896	13	[a] 1,188	0	408,827	266,473	349,373	1.31	65
1897	13	[a] 1,185	0	417,470	278,578	365,191	1.31	66.7
1898	13	[a] 1,158	[b] 100	572,568	378,410	511,202	1.35	66
1899	13	[c] 1,256	8	730,843	478,340	959,740	2.01	65.5
1900	14	[d] 1,341	0	876,440	557,184	1,260,441	2.26	63.6
1901	[e] 16	[d] 1,378	0	864,133	548,076	1,112,682	2.03	63.4
1902	15	[d] 1,563	[f] 260	965,412	644,053	1,782,660	2.768	66.7

[a] Includes 60 Otto-Hoffman ovens.
[b] Otto-Hoffman ovens.
[c] Includes 160 Otto-Hoffman ovens.
[d] Includes 160 Otto-Hoffman and 8 Newton-Chambers ovens.
[e] One establishment made coke in open ricks.
[f] Includes 100 Otto-Hoffman ovens.

Allegheny Valley district.—This district, which has never been of much importance as a coke producer, is now out of existence. No coke has been made in this district since 1897, and the last bank of ovens was abandoned in 1901. The largest output obtained in any one year was 44,261 tons of coke made in 1887.

Beaver and Blossburg districts.—These districts, like the Allegheny Valley district, have ceased to exist, the last bank of ovens in Beaver County being abandoned in 1898, and the small production in Mercer County has been included with that of Pittsburg. No coke has been made in the Blossburg district since 1895.

Broadtop district.—The ovens in Bedford and Huntington counties, which comprise what is known as the Broadtop coal field, are included in this coking district. This district, like the others of Pennsylvania, experienced renewed activity because of the increased demand for coke in 1902, when the output increased practically 50 per cent, from 118,949 tons in 1901 to 175,808 tons in 1902, while the value increased 150 per cent, from $237,898 to $594,521, the average price per ton advancing from $2 to $3.38. An experimental plant of three Kloman retort ovens was in course of construction in this district at the close of 1902. All of the 571 completed ovens in the district were operated last year.

The statistics of the manufacture of coke in the Broadtop district from 1880 to 1902 are shown in the following table:

Statistics of the manufacture of coke in the Broadtop district, Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	5	188	105	92,894	51,130	$123,748	$2.40	55
1881	5	188	105	111,593	66,560	167,074	2.51	59
1882	5	293	50	170,637	105,111	215,079	2.05	62
1883	5	343	110	220,932	147,154	271,692	1.84	66
1884	5	453	0	227,954	151,959	264,569	1.74	66
1885	5	537	0	190,836	112,073	185,656	1.65	58
1886	5	562	100	171,137	108,294	187,321	1.73	63.3
1887	5	581	0	262,730	164,535	347,061	2.11	62.6
1888	5	591	0	196,015	119,469	286,655	2.40	61
1889	5	589	0	152,090	91,256	186,718	2.05	60
1890	5	482	16	247,823	157,208	314,416	2.00	63
1891	5	448	0	146,008	90,728	197,048	2.17	62
1892	5	448	8	185,600	117,554	216,090	1.84	63.3
1893	5	456	14	136,069	86,752	150,196	1.73	63.8
1894	5	454	14	53,216	34,089	51,815	1.52	64
1895	5	460	0	133,276	85,842	150,224	1.75	64.4
1896	5	480	0	111,145	72,175	126,306	1.75	64.9
1897	5	491	15	106,706	66,949	107,430	1.60	62.7
1898	5	500	4	122,820	80,935	124,882	1.543	65.9
1899	5	519	3	161,196	107,258	197,895	1.84	66.5
1900	5	532	0	179,088	113,448	230,580	2.03	63.3
1901	5	571	0	187,715	118,949	237,898	2.00	63.4
1902	5	571	a 3	281,320	175,808	594,521	3.38	62.5

a Kloman retort ovens.

Clearfield-Center district.—This district derives its name from the two principal counties comprising it, Clearfield and Center. A few ovens constructed in Elk County in 1901 and 1902 have been added to this district. The production of the district in 1902 amounted to 198,725 short tons, an increase of 112,483, or about 130 per cent over 1901, and closely approaching the maximum output made in the district, which was 212,286 tons produced in 1890. The value of the product in 1902 was more than three times that of the preceding year, amounting to $489,637, as compared with $157,648 in 1901. Of the 623 ovens in existence in 1902, 80 were idle.

The statistics of the manufacture of coke in the Clearfield-Center district for the years 1880 to 1902 are as follows:

Statistics of the manufacture of coke in the Clearfield-Center district, Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	1	0	0	200	100	$200	$2.00	50
1881	2	50	0	20,025	13,350	22,695	1.70	67
1882	1	50	0	25,000	17,160	27,406	1.60	69
1883	1	60	0	26,500	18,696	28,844	1.50	71
1884	1	60	0	33,000	23,431	32,849	1.40	71
1885	2	245	0	69,720	48,103	70,331	1.46	69
1886	3	299	20	84,870	55,810	94,877	1.70	66
1887	6	523	10	154,566	97,852	198,095	2.02	63.3
1888	6	601	0	172,999	115,338	174,220	1.51	66.6
1889	6	671	0	195,473	120,734	215,112	1.78	61.7
1890	7	701	0	331,104	212,286	391,957	1.85	64
1891	7	666	0	293,542	183,911	339,082	1.84	63
1892	7	731	0	231,357	147,819	264,422	1.79	63.9
1893	8	695	0	155,119	98,650	171,482	1.74	63.6
1894	8	694	0	61,428	38,825	51,482	1.33	63
1895	8	695	0	155,088	99,469	131,188	1.32	64
1896	7	666	0	183,056	118,155	164,266	1.39	64.5
1897	7	668	0	230,395	153,517	197,139	1.28	66
1898	7	668	0	215,208	137,265	195,836	1.43	63.8
1899	6	450	50	198,110	130,965	234,527	1.79	66.1
1900	7	568	0	212,196	134,828	283,592	2.10	63.5
1901	8	[a] 636	0	134,913	86,242	157,648	1.828	63.9
1902 [b]	9	623	120	308,289	198,725	489,637	2.46	64.5

[a] Includes 50 ovens in Elk County.

[b] Includes 87 ovens and production in Elk County.

Connellsville district.—This district, which produces more coke annually than any other one region in the world, is located in the two counties of Fayette and Westmoreland, a short distance from the city of Pittsburg, which is now the leading iron manufacturing city in the world. This district produces from 40 to 50 per cent of the total coke output of the United States, and something over 60 per cent of the total output of Pennsylvania. As previously stated, the coking operations in 1902 were considerably restricted by the insufficient car supply and lack of motive power on the part of the railroads. Because of this the production of the district increased only slightly in 1902 over that of 1901, the totals for 1901 being 10,235,943 short tons, and for 1902, 10,418,366 tons. The operators in this region were also to some extent at a disadvantage and were unable to derive all of the benefit that otherwise they would have done from the increased demand and high prices for fuel, because of the fact that much of the product was sold at contract prices made in 1901. In other cases where large quantities of coke are delivered to blast furnaces controlled by the operators themselves, or by affiliated organizations, the values are arbitrarily fixed and do not really reflect the market conditions. For this reason the prices of Connellsville coke, which in previous years were considered to some extent the standard for the industry, are becoming less important factors in the trade.

During 1902 there were 97 establishments, having a total of 21,659 ovens, in this district, as compared with 96, having a total of 21,586 ovens, in 1901.

The Connellsville coal is an ideal coal for coking in bee hive ovens, and all but 50 of the ovens in this district are of the bee hive type. The following table, compiled by the Connellsville Courier, at Connellsville, shows the shipments of coke from this region in 1902, by months, in cars and tons, with the average number of cars shipped each working day during the month. These shipments from the Connellsville district, as reported by the Courier, include not only the coke produced in what is designated in this report as the Connellsville district proper, but also the greater part of the production in the Upper and Lower Connellsville districts. The estimates as shown by the Courier give a total production in 1902 of 14,138,740 short tons. The reports to the Survey for the entire region (including the Upper and Lower Connellsville) show a total of 13,254,331 short tons. In 1901 the production, as reported to the Survey, was 11,921,833 short tons, and as reported by the Courier, 12,609,949 short tons.

The following are the statistics of the manufacture of coke in the Connellsville region from 1880 to 1902:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	67	7,211	731	3,367,856	2,205,946	$3,948,643	$1.79	65.5
1881	70	8,208	654	4,018,782	2,639,002	4,301,573	1.63	65.7
1882	72	9,283	592	4,628,736	3,043,394	4,473,789	1.47	65.8
1883	74	10,176	101	5,355,380	3,552,402	4,049,738	1.14	66.3
1884	76	10,543	200	4,829,054	3,192,105	3,607,078	1.13	66.1
1885	68	10,471	48	4,683,831	3,096,012	3,776,388	1.22	66.1
1886	36	11,324	1,895	6,305,460	4,180,521	5,701,086	1.36	66.3
1887	73	11,923	98	6,182,846	4,146,989	7,437,669	1.79	67
1888	38	12,818	1,320	7,191,708	4,955,553	5,884,081	1.19	69
1889	29	14,458	430	8,832,371	5,930,428	7,974,633	1.34	67
1890	28	15,865	30	9,748,449	6,464,156	11,537,370	1.94	66.3
1891	33	17,551	0	7,083,705	4,760,665	8,903,454	1.87	67
1892	31	17,309	0	9,389,549	6,329,452	11,598,407	1.83	67.4
1893	28	17,504	5	7,095,491	4,805,623	7,141,031	1.49	67.7
1894	29	17,829	0	7,656,169	5,192,080	5,405,691	1.04	67.8
1895	29	18,028	80	12,174,597	8,181,179	10,122,458	1.237	67.2
1896	88	[a]18,347	0	8,107,536	5,462,490	10,018,946	1.834	67.4
1897	86	[a]18,467	92	10,243,690	6,860,826	10,662,428	1.55	67
1898	88	[a]18,927	20	12,454,969	8,315,350	12,626,292	1.518	66.8
1899	86	[a]19,294	792	14,974,018	10,390,335	17,075,411	1.64	69.4
1900	98	[a]20,981	686	14,946,659	10,020,907	22,383,432	2.23	67
1901	96	[a]21,586	243	15,266,722	10,235,943	19,172,697	1.873	67
1902	97	[a]21,659	374	15,538,701	10,418,366	23,785,433	2.283	67.05

[a] Includes 50 Semet-Solvay by-product ovens.

The following table, compiled by the Connellsville Courier, of Connellsville, Pa., shows the shipments of coke from the Connellsville region in 1902, by months, in cars and tons, with the average number of cars shipped each working day in the month:

Shipments of coke from the Connellsville region in 1902, by months.

Month.	Cars.	Daily average.	Tons.
January	51,986	1,925	1,173,860
February	42,458	1,769	971,048
March	50,386	1,938	1,133,978
April	53,411	2,054	1,219,928
May	57,523	2,130	1,300,648
June	55,294	2,127	1,234,596
July	56,858	2,106	1,271,045
August	54,889	2,111	1,238,260
September	54,659	2,102	1,246,095
October	52,917	1,960	1,230,860
November	46,250	1,850	1,079,037
December	47,567	1,762	1,039,385
Total	624,198	1,986	14,138,740

The monthly shipments of coke from this region in the years 1897 to 1902, as reported by the Courier, are given in the following table:

Monthly shipments of coke from the Connellsville region in the years 1897–1902.

[Short tons.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.
January	485,624	727,739	779,792	1,001,882	989,367	1,173,860
February	466,206	667,287	699,474	910,729	939,756	971,048
March	521,484	744,987	839,763	1,044,588	1,150,734	1,133,978
April	493,027	701,317	831,964	982,551	1,070,708	1,219,928
May	501,857	680,754	804,023	934,186	1,084,458	1,300,648
June	500,483	636,877	837,123	872,316	1,075,000	1,234,596
July	583,867	646,065	883,735	732,981	1,046,996	1,271,045
August	562,703	662,880	889,078	698,065	1,099,417	1,238,260
September	625,902	644,422	813,190	673,336	1,011,439	1,246,095
October	737,498	731,602	874,357	734,748	1,128,183	1,230,860
November	700,352	844,907	935,608	751,443	1,070,204	1,079,037
December	736,049	771,275	941,657	829,409	943,687	1,039,385
Total	6,915,052	8,460,112	10,129,764	10,166,234	12,609,949	14,138,740

The monthly shipments of Connellsville coke in cars to points of distribution during 1901 and 1902, as reported by the Courier, are as follows:

Monthly shipments of coke from the Connellsville region, in cars, to points of distribution during 1901 and 1902.

[Car loads.]

Month.	Pittsburg.	West.	East.	Total.	Daily average.
1901.					
January	16,393	20,601	9,879	46,873	1,736
February	14,101	20,509	9,576	44,186	1,841
March	16,235	26,786	10,330	53,351	2,052
April	15,170	24,306	9,900	49,376	1,899
May	15,152	25,653	9,190	49,995	1,852
June	14,969	25,456	8,877	49,302	1,972
July	15,073	24,692	9,045	48,810	1,808
August	16,719	24,670	9,353	50,742	1,879
September	16,118	22,619	7,800	46,537	1,861
October	17,114	25,129	9,393	51,636	1,912
November	15,227	25,055	7,856	48,138	1,851
December	14,365	21,380	6,360	42,105	1,620
Total	186,636	286,856	107,559	581,051	1,857
1902.					
January	13,624	21,765	7,923	43,312	1,604
February	14,743	18,268	6,886	39,897	1,662
March	17,587	27,565	9,467	53,989	2,076
April	15,733	21,867	8,174	45,774	1,452
May	19,707	28,698	11,890	60,295	2,233
June	16,228	21,035	12,570	48,833	1,953
July	15,522	22,278	9,755	47,555	1,761
August	19,319	27,886	11,209	58,414	2,246
September	15,580	22,682	8,819	47,140	1,813
October	15,095	20,898	7,255	43,248	1,601
November	18,735	23,986	7,964	50,785	2,031
December	18,158	21,851	7,052	47,061	1,743
Total	200,031	278,779	108,964	586,303	22,175

The total shipments, in cars, for the last fifteen years were as follows:

Total and daily average shipments, in cars, 1888–1902.

Year.	Daily average.	Total cars.	Year.	Daily average.	Total cars.
1888	905	282,441	1896	920	289,137
1889	1,046	326,220	1897	1,181	367,383
1890	1,147	355,070	1898	1,415	441,249
1891	884	274,000	1899	1,676	523,203
1892	1,106	347,012	1900	1,619	504,410
1893	874	270,930	1901	1,857	581,051
1894	900	281,677	1902	1,986	624,198
1895	1,410	441,243			

The following table shows the prices prevailing for Connellsville furnace and foundry coke during the years 1900, 1901, and 1902. The abnormally high prices reported for both grades of coke in 1902 are for coke sold for prompt delivery, the coke sold on contract showing comparatively little change throughout the year:

Month.	Furnace.			
	1900.	1901.	1902.	
			Contract price.	For prompt delivery.
January	$2.75 to $3.50	$1.75	$2.25	$2.50 to $3.50
February	2.75 to 3.50	1.75	2.25	2.50 to 3.00
March	3.25 to 4.25	$1.75 to 2.00	2.25	2.50 to 3.00
April	3.25 to 4.25	2.00	$2.25 to 2.50	2.50 to 3.00
May	3.00 to 3.25	2.00	2.25 to 2.50	....
June	2.50 to 3.00	1.75 to 2.00	2.25 to 2.50	2.50 to 3.50
July	2.00 to 2.50	1.75 to 2.00	2.25	3.00 to 4.00
August	2.00	1.75 to 2.00	2.25	3.50 to 4.00
September	2.00	1.75 to 2.00	3.00	4.00 to 5.00
October	2.00	1.75 to 2.00	3.50 to 4.00	8.00 to 12.00
November	2.00	1.85 to 2.00	3.50 to 4.00	7.00 to 8.00
December	1.75 to 2.00	2.10 to 2.25	3.75 to 4.00	7.00 to 8.00

Month.	Foundry.		
	1900.	1901.	1902.[a]
January	$3.00 to $4.00	$2.00 to $2.25	$2.75 to $3.00
February	3.00 to 4.00	2.25	2.75 to 3.00
March	3.75 to 4.50	2.50	2.75 to 3.00
April	3.25 to 4.50	2.50	2.75 to 3.00
May	3.00 to 3.50	2.50	2.75 to 3.00
June	3.00 to 3.25	2.25 to 2.50	2.75 to 3.00
July	2.75 to 3.00	2.25 to 2.50	2.75 to 3.00
August	2.75	2.25 to 2.50	2.75 to 3.00
September	2.25 to 2.50	2.25 to 2.50	4.00 to 4.50
October	2.25 to 2.50	2.25 to 2.50	4.50 to 5.00
November	2.25 to 2.50	2.25 to 2.50	4.50 to 5.00
December	2.25 to 2.50	2.35 to 2.50	4.50 to 5.00

[a] Contract prices.

Greensburg district.—This district continues to be of steadily growing importance, the production having increased without interruption since 1894 and shown marked advances during the last four years. The production in 1902 amounted to 441,941 short tons, an increase of 184,156 tons over 1901, and four times the output of 1899. The value increased from $464,692 in 1901 to $1,228,576 in 1902, the average price advancing from $1.80 to $2.78. The number of establishments increased from 6 to 7, and the number of completed ovens from 991 to 1,240. There were also 193 new ovens in course of construction at the end of the year.

Statistics of the manufacture of coke in the Greensburg district, Pennsylvania, 1889–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1889	2	50	16	32,070	20,459	$21,523	$1.05	63.8
1890	2	58	0	44,000	30,261	44,290	1.46	68.7
1891	2	58	0	38,188	22,441	36,627	1.63	59
1892	2	58	0	15,005	9,037	13,173	1.46	60.2
1893	3	88	0	29,983	18,393	26,303	1.43	61
1894	3	118	0	27,290	15,872	18,413	1.16	58.2
1895	3	118	0	31,300	20,309	22,340	1.10	65
1896	3	178	0	36,963	24,642	30,928	1.255	66
1897	3	178	0	81,927	52,495	65,619	1.25	64
1898	3	218	0	112,487	64,295	96,443	1.50	57
1899	4	307	240	173,811	110,594	247,421	2.24	63.6
1900	5	680	280	331,305	196,709	442,704	2.25	59.4
1901	6	991	0	406,957	257,785	464,692	1.80	63.3
1902	7	1,240	193	725,744	441,941	1,228,576	2.78	60.9

Irwin district.—This district includes the ovens situated near the town of Irwin, Westmoreland County, and also those located in what may be termed the Irwin basin on the Youghiogheny River. Prior to 1901 most of the coke in the district was produced by the Carnegie Steel Company at Larimer and Douglas. The Larimer ovens were not operated in either 1901 or 1902, and the Douglas ovens were also idle in 1901. The production for the district in 1902 shows a large increase over 1901 on account of the idleness of the Douglas ovens in the former year. The production, however, did not bring the district up to the position it held prior to 1899. The value, however, on account of the general advance in prices, was the largest in the history of the district with the exception of 1889. Fifty-nine ovens were abandoned in 1902, reducing the number in the district from 750 to 691.

Statistics of the manufacture of coke in the Irwin district, Pennsylvania, 1889–1902.

Year	Establishments.	Ovens.		Coal used.	Coke produced.	Total valve of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1889	4	696	0	373,913	243,448	$351,304	$1.44	65
1890	4	661	0	270,476	172,329	256,458	1.49	63.7
1891	4	696	0	323,099	197,082	266,061	1.35	61
1892	4	669	0	328,193	202,809	284,029	1.40	61.8
1893	5	725	0	238,832	150,463	175,609	1.30	63
1894	5	725	0	176,318	110,995	119,764	1.08	63
1895	5	725	0	166,124	103,872	105,609	1.017	62.5
1896	5	696	0	279,104	175,916	275,518	1.566	63
1897	5	696	0	207,704	136,663	189,869	1.39	65.8
1898	5	696	0	332,368	183,176	239,583	1.308	55
1899	5	697	0	223,457	133,085	197,694	1.48	59.6
1900	5	697	0	93,647	61,630	153,743	2.49	65.8
1901	6	750	0	30,699	19,977	32,562	1.63	65
1902	6	691	0	217,404	139,299	329,410	2.36	64.1

Lower Connellsville district.—As previously stated, this district is the extension to the southwest of the Connellsville basin and includes the developments in and around the city of Uniontown. The district has risen rapidly to a position of importance, having in three years become the second producing district in the State. The production in 1902 amounted to 1,899,111 short tons, as against 1,116,379 tons in 1901 and 385,909 tons in 1900, the first year in which any production was reported. The value of the product in 1902 was $4,701,068, as against $1,991,699 the preceding year. That the district will continue to increase in production is shown by the fact that the number of establishments increased from 17 in 1901 to 21 in 1902, and the number of completed ovens from 3,251 to 4,253, and that there were 705 new ovens in the course of construction at the close of last year, as compared with 30 at the close of 1901. This region, which, as stated above, began production in 1900, produced in 1902 more coke than any State outside of Pennsylvania with the exception of Alabama and West Virginia.

The record of the district for the three years during which it has been in existence is shown in the following table:

Statistics of manufacture of coke in the Lower Connellsville district in 1900, 1901, and 1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1900	12	2,033	1,112	579,928	385,909	$792,886	$2.05	66.5
1901	17	3,251	30	1,666,826	1,116,379	1,991,699	1.784	66.9
1902	21	4,253	705	2,826,242	1,899,111	4,701,068	2.475	67.2

Lebanon Valley district.—A new district has been added to the coke-producing sections of Pennsylvania and is designated as the Lebanon Valley district, the principal plant being located at Lebanon, in Lebanon County. None of the ovens, however, had been put in blast at the close of 1902, the statistics for which year show that 237 Otto-Hoffman by-product ovens had been completed before the close of 1902, but not put in blast. A plant of 40 Semet-Solvay ovens, which were building at the close of 1902, at Chester, have also been included in this district. Since the 1st of January, 1903, construction work was begun on another plant of 90 Semet-Solvay ovens in this district. This latter plant will probably not be in active operation until some time in 1904.

Pittsburg district.—A large portion of the coke made in the Pittsburg district is from slack coal obtained from the mines along the slack-water navigation of the Monongahela River, and brought to Pittsburg in barges. Some of the run-of-mine coal is also brought from the fourth pool of the Monongahela River at Pittsburg. The production of 120 Otto-Hoffman ovens, located at Glassport, and of 25 Semet-Solvay ovens, located at Sharon, in Mercer County, are included in this district. The production of the district increased from 813,478 short tons in 1901 to 953,863 tons in 1902. The value increased from $1,690,614 to $1,924,942. The number of completed ovens in 1902 were 40 less than in 1901. There were 232 new ovens in course of construction at the close of 1902, of which 212 were of the Schniewind type.

The statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, for the years 1880 to 1902, inclusive, are stated in the following table:

Statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	21	534	0	194,393	105,974	$254,500	$2.40	55
1881	21	538	0	178,509	96,310	206,965	2.15	54
1882	21	557	0	114,956	64,779	134,378	2.07	56.3
1883	20	542	0	119,310	66,820	126,020	1.89	56
1884	20	535	0	97,367	53,857	99,911	1.87	55
1885	17	416	4	91,101	46,930	72,509	1.55	51.5
1886	18	730	0	228,874	138,646	221,617	1.88	60.6
1887	20	880	235	366,184	177,097	315,546	1.78	48.4
1888	22	980	0	428,899	264,156	350,818	1.33	62
1889	17	600	21	233,571	141,324	283,402	2.00	60.5
1890	14	541	0	149,230	93,984	171,465	1.82	63
1891	13	590	11	154,054	94,160	201,458	2.14	61
1892	15	725	261	292,357	176,365	376,613	2.14	60.3
1893	10	885	0	357,400	216,268	438,801	2.03	60.5
1894	9	779	104	371,569	227,100	351,825	1.55	61
1895	9	973	0	452,845	232,529	547,284	2.35	51.3
1896	11	1,264	[a] 120	583,984	368,070	941,076	2.56	63
1897	9	[b] 1,233	200	832,505	548,981	864,326	1.57	66
1898	10	[c] 1,100	168	836,948	552,742	899,537	1.627	66
1899	10	[c] 1,312	505	954,028	644,467	1,189,117	1.84	67.6
1900	[d] 8	[c] 1,641	0	862,610	570,678	1,418,382	2.48	66.1
1901 [g]	[e] 10	[c] 1,651	[f] 227	1,266,947	813,478	1,690,614	2.078	64.2
1902 [g]	[h] 10	[c] 1,611	[f] 232	1,488,973	953,863	1,924,942	2.018	64.1

[a] Otto-Hoffman by-product ovens.
[b] Includes 120 Otto-Hoffman ovens.
[c] Includes 120 Otto-Hoffman and 25 Semet-Solvay ovens.
[d] Includes one establishment in Mercer County.
[e] Includes two establishments in Mercer County and one in Allegheny Valley district.
[f] Includes 212 Schniewind ovens.
[g] Includes ovens and production in Allegheny Valley district.
[h] Includes two establishments in Mercer County and two in Allegheny Valley district.

Reynoldsville-Walston district.—This district, in Jefferson and Clearfield counties, includes all of the ovens of the Rochester and Pittsburg Railroad, as well as those of the low-grade division of the Allegheny Valley Railway and those connected with the mines of the New York, Erie and Western Railway. The production in 1902 amounted to 689,890 short tons, valued at $1,422,143, as compared with 589,577 short tons, valued at $1,171,878, in 1901.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880 to 1902:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	3	117	0	45,055	28,090	$46,359	$1.65	62
1881	4	125	2	99,489	44,260	80,785	1.85	44
1882	5	177	0	87,314	44,709	80,339	1.80	51
1883	6	229	0	76,580	37,044	65,584	1.77	48
1884	7	321	0	159,151	78,646	113,155	1.44	49
1885	8	600	143	183,806	114,409	153,795	1.35	62
1886	9	783	500	271,037	161,828	217,834	1.35	59.7
1887	11	1,492	134	507,320	316,107	592,728	1.88	62.3
1888	9	1,636	100	404,346	253,662	320,203	1.26	62.7
1889	8	1,747	0	514,461	313,011	436,857	1.40	60.8
1890	8	1,737	0	652,966	406,184	771,996	1.90	62
1891	7	1,747	0	769,100	470,479	744,098	1.58	61
1892	8	1,734	0	683,539	425,250	743,227	1.75	62.2
1893	8	1,755	0	562,033	339,314	586,212	1.73	60.4
1894	8	1,755	0	336,554	207,238	297,596	1.44	61.6
1895	8	1,637	0	504,092	296,820	357,266	1.20	58.9
1896[a]	7	1,852	34	770,104	445,998	673,625	1.51	57.9
1897[a]	6	1,980	0	810,808	491,267	759,609	1.55	60.6
1898[a]	5	1,942	0	1,022,196	600,084	846,121	1.41	58.7
1899[a]	6	1,779	0	1,581,164	972,933	1,793,807	1.84	61.5
1900	7	2,010	0	1,115,923	625,553	1,347,869	2.15	56
1901	7	2,010	0	1,059,107	589,577	1,171,878	1.988	55.7
1902	7	2,029	0	1,251,765	689,890	1,422,143	2.06	55.1

[a] Includes coal used, coke produced, and its value in New York; also in Massachusetts for 1899.

Upper Connellsville district.—This district includes that portion of the Connellsville trough or basin which lies north of a point a short distance south of the town of Latrobe, Westmoreland County. The coal of this vicinity differs somewhat from that of the basin proper, so that in addition to its geographic position there is another reason for separating the production from that of the Connellsville district. The production of this district in 1902 amounted to 936,854 short tons, as compared with 569,511 short tons in 1901. The value increased something over 100 per cent, from $1,033,991 to $2,193,332. One new establishment of 50 ovens, making 17 in all, was added to the equipment of the district in 1902, and there were 405 new ovens in course of construction at the end of the year.

The following are the statistics of the manufacture of coke in the Upper Connellsville region for the years 1880 to 1902:

Statistics of the manufacture of coke in the Upper Connellsville district, Pennsylvania, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	757	0	319,927	229,433	$397,945	$1.73	72
1881	10	986	0	588,924	343,728	548,362	1.60	58
1882	11	1,118	0	650,174	375,918	536,503	1.48	58
1883	11	1,118	0	668,882	389,053	422,174	1.08	58
1884	11	1,118	0	496,894	294,477	311,665	1.06	59
1885	11	1,168	40	555,735	319,297	346,168	1.08	57
1886	12	1,337	29	691,331	442,968	572,073	1.29	64.1
1887	16	1,442	87	717,274	470,233	840,144	1.79	65.6
1888	16	1,977	0	657,966	441,966	617,189	1.40	67
1889	13	1,568	80	635,220	417,263	609,828	1.46	65.6
1890	14	1,569	28	889,277	577,246	1,008,102	1.75	64.9
1891	14	1,724	0	1,000,184	649,316	1,111,056	1.71	65
1892	14	1,843	0	706,171	451,975	691,323	1.53	64
1893	14	1,843	0	499,809	320,793	447,090	1.39	64
1894	14	1,843	0	279,971	176,799	212,595	1.20	63
1895	14	1,849	30	319,285	208,158	251,892	1.21	65
1896	14	1,863	0	617,601	406,112	570,687	1.405	65.7
1897	14	1,863	0	556,941	345,372	444,709	1.29	62
1898	13	1,832	0	638,277	403,045	538,609	1.34	63
1899	13	1,861	68	933,792	609,893	986,298	1.62	65.3
1900	14	1,999	0	1,042,170	690,449	1,378,629	1.996	66.2
1901	16	2,082	100	852,448	569,511	1,033,991	1.815	66.8
1902	17	2,132	405	1,413,476	936,854	2,193,332	2.34	66.3

TENNESSEE.

The coke product of Tennessee is consumed practically in the iron furnaces in the vicinity of Chattanooga and other points in the eastern part of the State. The continued increase in the production of iron and steel in these markets, as in other sections of the country, augmented the demand for coke in 1902, and the production of the State increased nearly 40 per cent, from 404,017 short tons in 1901 to 560,006 tons in 1902, with an advance in value from $952,792 to $1,597,041. The increase in value amounted to $644,259, or about 67 per cent. Two new plants were added to the coke-making equipment of the State in 1902, and one plant, that of the Daisy Coal and Coke Company, was abandoned, making a net gain of one establishment. The number of ovens increased from 2,135 in 1901 to 2,269 in 1902. No by-product retort ovens have been built in this State.

The following are the statistics of the manufacture of coke in Tennessee for the years 1880 to 1902:

Statistics of the manufacture of coke in Tennessee, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	656	68	217,656	130,609	$316,607	$2.42	60
1881	6	724	84	241,644	143,853	342,585	2.38	60
1882	8	861	14	313,537	187,695	472,505	2.52	60
1883	11	992	10	330,961	203,691	459,126	2.25	62
1884	*a* 13	1,105	175	348,295	219,723	428,870	1.95	63
1885	12	1,387	36	412,538	218,842	398,459	1.82	53
1886	12	1,485	126	621,669	368,139	687,865	1.87	59
1887	11	1,560	165	655,857	396,979	870,900	2.19	61
1888	11	1,634	84	630,099	385,693	490,491	1.27	61
1889	12	1,639	40	626,016	359,710	731,496	2.03	57
1890	11	1,664	292	600,387	348,728	684,116	1.96	58
1891	11	1,995	0	623,177	634,318	701,803	1.93	58
1892	11	1,941	0	600,126	354,096	724,106	2.05	59
1893	11	1,942	0	449,511	265,777	491,523	1.85	61
1894	11	1,860	0	516,802	292,646	480,124	1.64	56.6
1895	12	1,903	0	684,655	396,790	754,926	1.90	57.9
1896	15	1,861	100	600,379	339,202	624,011	1.84	56.5
1897	15	1,948	0	667,996	368,769	667,656	1.81	55
1898	15	1,949	40	722,356	394,545	642,920	1.63	54.6
1899	14	2,040	62	779,995	435,308	850,686	1.95	55.8
1900	14	2,107	340	854,789	475,432	1,269,555	2.67	55.6
1901	14	2,135	258	739,246	404,017	952,782	2.358	54.6
1902	15	2,269	116	1,025,864	560,006	1,597,041	2.85	54.6

a One establishment made coke in pits.

The character of the coal used in the manufacture of coke in Tennessee since 1890 is shown in the following table:

Character of coal used in the manufacture of coke in Tennessee, 1890–1902.

[Short tons.]

Year.	Run of mine. Unwashed.	Run of mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
1890	255,359	0	273,028	72,000	600,387
1891	184,556	0	377,914	60,707	623,177
1892	176,453	15,000	367,827	40,846	600,126
1893	179,126	0	137,483	132,902	449,511
1894	166,990	61,841	149,958	138,013	516,802
1895	96,744	59,284	285,906	242,721	684,655
1896	0	206,319	219,231	174,829	600,379
1897	36,485	400,166	119,755	111,590	667,996
1898	37,217	306,969	122,756	255,414	722,356
1899	140,804	267,105	31,805	340,236	779,995
1900	150,697	349,448	24,122	330,522	854,789
1901	224,723	282,129	34,088	198,306	739,246
1902	287,064	334,109	47,161	357,530	1,025,864

UTAH.

As there is but one establishment in the State of Utah engaged in the manufacture of coke, the statistics of production have been included with those of Colorado. The coals of this State are practically identical in character with those of western Colorado.

VIRGINIA.

The production of coke in Virginia has increased each year, without exception, since 1893, and exceeded a total of 1,000,000 tons in 1902 for the first time in the history of the State. The total production last year amounted to 1,124,572 short tons, as compared with 907,130 tons in 1901. The value increased more that 50 per cent, from $1,483,670 to $2,322,228. One of the most interesting features connected with the industry in this State in 1902 was the fact that at the close of the year there were 1,208 new ovens in course of construction, most of these being in Wise County, on the Clinch River branch of the Norfolk and Western Railroad, where active developments both in coal mining and coke making have been going on for the last two or three years. There are two plants in Virginia, one at Covington and the other at Lowmoor, the coal for which is drawn from the New River district in West Virginia. The coal for the ovens at Pocahontas, in Tazewell County, is obtained from mines which extend across the boundary between Virginia and West Virginia, a considerable portion of the coal coming really from the latter State. The openings of the mines, however, are in Virginia, and it has been customary to credit all the coal product, as well as the coke, to that State. The Wise County coke is the only coke made in Virginia from coal mined exclusively in the State. None of the coal made into coke in Virginia during the last three years has been washed before coking. The total amount of coal consumed in the manufacture of coke in Virginia in 1902 was 1,716,110 tons, of which 1,018,148 tons were unwashed run-of-mine and 697,962 unwashed slack.

The following are the statistics of the manufacture of coke in Virginia from 1883 to 1902:

Statistics of the manufacture of coke in Virginia, 1883–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1883	1	200	0	39,000	25,340	$44,345	$1.75	65
1884	1	200	0	99,000	63,600	111,300	1.75	64.3
1885	1	200	0	81,899	49,139	85,993	1.75	60
1886	2	350	100	200,018	122,352	305,880	2.50	61.2
1887	2	350	300	235,841	166,947	417,368	2.50	70.8
1888	2	550	0	230,529	140,199	260,000	1.74	64.7
1889	2	550	250	238,793	146,528	325,861	2.22	61
1890	2	550	250	251,683	165,847	278,724	1.68	66
1891	2	550	250	285,113	167,516	265,107	1.58	58.8
1892	2	594	206	226,517	147,912	322,486	2.18	65.3
1893	2	594	206	194,059	125,092	282,898	2.26	64.5
1894	2	736	100	280,524	180,091	295,747	1.64	64.2
1895	5	832	350	410,737	244,738	322,564	1.32	59.6
1896	7	1,138	101	454,964	268,081	404,573	1.509	58.9
1897	6	1,453	110	574,542	354,067	495,864	1.40	61.6
1898	6	[a]1,564	0	852,972	531,161	699,781	1.317	62
1899	6	[a]1,588	429	994,635	618,707	1,071,284	1.73	62.2
1900	7	[a]2,331	300	1,083,827	685,156	1,464,556	2.137	63.2
1901	7	[a]2,775	0	1,400,231	907,130	1,483,670	1.635	64.7
1902	14	[a]2,974	1,208	1,716,110	1,124,572	2,322,228	2.065	65.5

[a] Includes 56 Newton-Chambers by-product ovens.

The character of the coal used in the manufacture of coke in Virginia since 1890 is shown in the following table:

Character of coal used in the manufacture of coke in Virginia, 1890–1902.

[Short tons.]

Year.	Run of mine. Unwashed.	Run of mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
1890	98,215	0	153,468	0	251,683
1891	107,498	0	177,615	0	285,113
1892	106,010	0	120,507	0	226,517
1893	107,498	0	86,561	0	194,059
1894	103,874	0	176,650	0	280,524
1895	114,802	0	295,935	0	410,737
1896	70,756	0	370,624	13,584	454,964
1897	286,158	0	227,363	61,021	574,542
1898	405,399	0	237,474	210,099	852,972
1899	612,267	0	225,118	157,250	994,635
1900	620,207	0	463,620	0	1,083,827
1901	869,203	0	531,028	0	1,400,231
1902	1,018,148	0	697,962	0	1,716,110

WASHINGTON.

Washington is the only one of the Pacific Coast States producing coal of a quality suitable for the manufacture of coke. The operations are not of special importance, particularly when they are compared with the output of other coke-producing States, but they are of interest as establishing the fact that it is possible to produce a metallurgical coke from the Washington coals. There were 5 establishments in the State, only 3 of which produced coke in 1902, and although the number of completed ovens increased from 148 in 1901 to 231 in 1902, the production decreased from 49,197 short tons to 40,305, with a decrease in value of $239,028 to $199,195. The one establishment which was completed near the close of 1902 did not begin operations until January 12, 1903. The Wilkeson Coal and Coke Company added 50 ovens to its former plant of the same number, but these new ovens were not completed until near the end of the year and did not materially add to the production. All of the coal used in the manufacture of coke in Washington in 1902 was washed run-of-mine, and all the slack, or run-of-mine, used in the last ten years has been washed before coking.

The coke industry in Washington began in 1884, since which time the statistical record has been as follows:

Statistics of the manufacture of coke in Washington, 1884–1902.

Year.	Establishments.	Ovens.		Coal used.	Coal produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1884	1	0	0	700	400	$1,900	$4.75	57.5
1885	1	2	0	544	311	1,477	4.75	57
1886	1	11	21	1,400	825	4,125	5.00	58.9
1887	1	30	0	22,500	14,625	102,375	7.00	65
1888	1	30	100	0	0	0	0	0
1889	1	30	0	6,983	3,841	30,728	8.00	55
1890	2	30	80	9,120	5,837	46,696	8.00	64
1891	2	80	0	10,000	6,000	42,000	7.00	60
1892	3	84	30	12,372	7,177	50,446	7.03	58
1893	3	84	0	11,374	6,731	34,207	5.08	59
1894	3	84	0	8,563	5,245	18,249	3.48	61.2
1895	3	110	0	22,973	15,129	64,632	4.27	65.9
1896	3	120	0	38,685	25,949	104,894	4.04	67
1897	3	120	0	39,124	26,189	115,754	4.42	67
1898	2	90	0	48,559	30,197	128,933	4.27	62.2
1899	2	90	0	50,813	30,372	151,216	4.98	59.8
1900	2	90	0	54,310	33,387	160,165	4.797	61.5
1901	4	148	100	78,393	49,197	239,028	4.858	62.7
1902	5	231	0	68,546	40,305	199,195	4.94	58.8

WEST VIRGINIA.

West Virginia, which for six years prior to 1902 held second place in the rank of coke producers, fell back to third place in 1902, being replaced by Alabama. The production of coke in West Virginia in

1902 amounted to 2,516,505 short tons, as compared with 2,283,700 tons in 1901, a gain of 232,805 tons, or 10.2 per cent. The coke production in West Virginia would probably have been considerably larger and the State would have retained its position as second among the coke-producing States had it not been for the urgent demand for coal at the seaboard, such demand having been caused by the cutting off of the markets usually supplied by anthracite because of the prolonged strike in the anthracite region of Pennsylvania. The scarcity of fuel in New England and at points along the Atlantic seacoast was so pronounced that it was more profitable for the West Virginia operators to supply this market with coal than it was to turn their product into coke, notwithstanding the higher prices obtained for the latter fuel during the year. If normal conditions obtain throughout 1903, we may expect to see West Virginia resume its accustomed place as next to Pennsylvania among the coke producers. The statistics for 1902 show that the number of establishments in the State increased from 112 to 120 and the number of completed ovens from 11,544 to 12,656, and that 2,341 new ovens were in course of construction.

The following table exhibits the statistics of coke production in West Virginia since 1880:

Statistics of the manufacture of coke in West Virginia, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	18	631	40	230,758	138,755	$318,797	$2.30	60
1881	19	689	0	304,823	187,126	429,571	2.30	61
1882	22	878	0	366,653	230,398	520,437	2.26	63
1883	24	962	9	411,159	257,519	563,490	2.19	63
1884	27	1,005	127	385,588	223,472	425,952	1.91	62
1885	27	978	63	415,533	260,571	485,588	1.86	63
1886	29	1,100	317	425,002	264,158	513,843	1.94	62
1887	39	2,080	742	698,327	442,031	976,732	2.21	63.3
1888	51	2,764	318	854,531	525,927	896,797	1.71	61.5
1889	53	3,438	631	1,001,372	607,880	1,074,177	1.76	60
1890	55	4,060	334	1,395,266	833,377	1,524,746	1.83	60
1891	55	4,621	555	1,716,976	1,009,051	1,845,043	1.83	58.8
1892	72	5,843	978	1,709,183	1,034,750	1,821,965	1.76	60.5
1893	75	7,354	132	1,745,757	1,062,076	1,716,907	1.62	60.8
1894	78	7,858	60	1,976,128	1,193,933	1,639,687	1.373	60.4
1895	78	7,834	55	2,087,816	1,285,206	1,724,239	1.34	61.6
1896	84	8,351	28	2,687,104	1,649,755	2,259,999	1.37	61.4
1897	84	8,404	38	2,413,283	1,472,666	1,933,808	1.31	61
1898	87	[a] 8,659	161	3,145,398	1,925,071	2,432,657	1.26	61.2
1899	87	[a] 8,846	[b] 619	3,802,825	2,278,577	3,480,408	1.53	60
1900	106	[c] 10,249	1,306	3,868,840	2,358,499	4,746,633	2.01	60.9
1901	112	[c] 11,544	1,254	3,734,076	2,283,700	4,110,011	1.80	61.1
1902	120	[c] 12,656	2,341	4,078,579	2,516,505	5,833,226	2.318	61.7

[a] Includes 60 Semet-Solvay ovens at Wheeling.
[b] Includes 60 Semet-Solvay ovens building at Wheeling.
[c] Includes 120 Semet-Solvay ovens at Wheeling.

As shown in the following table, by far the larger part (69 per cent in 1902) of the coal used in coke making in West Virginia is slack, and of this slack coal 89 per cent is unwashed:

Character of coal used in the manufacture of coke in West Virginia since 1890.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	324,847	0	930,989	139,430	1,395,266
1891	276,259	0	1,116,060	324,657	1,716,976
1892	298,824	115,397	1,108,353	186,609	1,709,183
1893	324,932	15,240	1,176,656	228,929	1,745,757
1894	162,270	14,901	1,607,735	191,222	1,976,128
1895	405,725	24,054	1,476,003	182,034	2,087,816
1896	407,378	33,096	2,079,237	167,393	2,687,104
1897	373,205	28,145	1,800,528	211,405	2,413,283
1898	713,815	0	2,137,983	293,600	3,145,398
1899	1,336,239	0	2,215,255	251,331	3,802,825
1900	509,960	8,000	3,140,064	210,816	3,868,840
1901	733,786	0	2,705,392	294,898	3,734,076
1902	1,262,393	0	2,517,223	298,963	4,078,579

PRODUCTION BY DISTRICTS.

It has been customary in the preceding reports of this series to consider the coke production by districts, into which the State has been divided. These districts are known, respectively, as the Upper Monongahela, the Upper Potomac, the Kanawha, the New River, and the Flat Top. The first two are in the northern part of the State, and are named from the fact that they are drained by the headwaters of the Monongahela and Potomac rivers. The other three districts are in the southern portion of the State. The New River and Kanawha districts are practically one, separation being made at a point where the New and Gauley rivers combine to form the Kanawha. The Flat Top region is also drained by the upper portion of the New River, and includes the ovens in West Virginia which belong to the Pocahontas coal field. The Flat Top district is by far the most important, and bears the same relation to the production in West Virginia that the Connellsville district bears to that of Pennsylvania. The output from this district averages something over 50 per cent of the total coke product of the State, although its proportion in 1902 was somewhat less than this figure. Some new ovens constructed in Tygarts Valley in 1902 have been added to the Upper Potomac district. The production of coke in 1902 decreased in the Flat Top, Kanawha, and New River regions, and increased in the Upper Monongahela and the Upper Potomac (including Tygarts Valley) districts.

In the following tables are exhibited the statistics of coke production in West Virginia, by districts, during the last two years:

Production of coke in West Virginia in 1901, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
Flat Top	[a] 42	6,049	918	1,899,366	1,160,856	$1,893,581	$1.63	61.1
Kanawha	11	877	50	281,787	164,736	314,473	1.909	58.4
New River	28	2,128	261	657,003	399,373	823,060	2.06	60.8
Upper Monongahela	25	[b] 1,685	0	497,215	317,470	657,232	2.07	63.8
Upper Potomac and Tygarts Valley	6	805	25	398,705	241,265	421,665	1.75	60.5
Total	112	11,544	1,254	3,734,076	2,283,700	4,110,011	1.80	61.1

[a] Includes 1 establishment in Tug River district. [b] Includes 120 Semet-Solvay ovens.

Production of coke in West Virginia in 1902, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
Flat Top	[a] 44	6,940	1,741	1,781,136	1,109,203	$2,189,607	$1.974	62.3
Kanawha	11	872	60	232,145	130,642	354,759	2.715	56.3
New River	27	2,156	175	521,973	317,086	981,753	3.096	60.8
Upper Monongahela	31	[b] 1,698	75	916,322	547,497	1,617,389	2.95	59.7
Upper Potomac and Tygarts Valley	7	990	290	627,003	412,077	689,718	1.67	65.8
Total	120	12,656	2,341	4,078,579	2,516,505	5,833,226	2.318	61.7

[a] Includes 2 establishments in Tug River district. [b] Includes 120 Semet-Solvay ovens.

Pocahontas-Flat Top district.—Until the close of 1902 this district was, next to the Connellsville district of Pennsylvania, the most important coke-producing region of the United States, but the largely increased production of the Lower Connellsville district in 1902 placed that district in advance of West Virginia's chief producer. Like the coal of the Connellsville region, that of the Flat Top district produces a coke which makes an ideal fuel for blast-furnace purposes. Chemically it is superior to the Connellsville, as it is low in mineral contents or ash, and it is regarded by some ironmasters as equal in physical properties to the Connellsville coke. The production of the district has decreased slightly in each of the last two years—from 1,208,838 short tons in 1900 to 1,160,856 tons in 1901 and to 1,109,203 tons in 1902.

The statistics of production of this district since its beginning, in 1886, are as follows:

Statistics of the manufacture of coke in the Flat Top district of West Virginia, 1886–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1886	2	10	38	1,075	658	$1,316	$2.00	61.2
1887	5	348	642	76,274	51,071	100,738	1.97	67
1888	13	882	200	164,818	103,947	183,938	1.77	63
1889	16	1,433	431	387,533	240,386	405,635	1.69	64
1890	17	1,584	252	566,118	325,576	571,239	1.75	57.5
1891	19	1,889	358	537,847	312,421	545,367	1.70	58
1892	30	2,848	933	595,734	353,696	596,911	1.69	59.3
1893	34	4,349	80	746,051	451,503	713,261	1.58	60.5
1894	36	4,648	18	1,229,136	746,762	989,876	1.325	60.7
1895	36	4,648	18	858,913	524,252	656,494	1.25	61
1896	36	4,648	18	1,400,369	852,120	1,100,312	1.291	60.8
1897	36	4,648	18	1,172,206	720,988	868,484	1.20	61.5
1898	36	4,667	27	1,701,404	1,057,626	1,216,059	1.15	62.2
1899	35	4,623	214	1,861,570	1,138,389	1,453,601	1.28	61.1
1900	[a] 38	5,290	666	1,952,274	1,208,838	2,290,947	1.895	61.9
1901	[a] 42	6,049	918	1,899,366	1,160,856	1,893,581	1.63	61.1
1902	[b] 44	6,940	1,741	1,781,136	1,109,203	2,189,607	1.974	62.3

[a] Includes 1 establishment in the Tug River district.
[b] Includes 2 establishments in the Tug River district.

Kanawha district.—The Kanawha district includes all the ovens along the banks of the Kanawha River from its formation by the junction of the New and Gauley rivers to the western limits of the coal fields. The production in this district has decreased each year since 1899 and amounted in 1902 to 130,642 short tons, with a value of $354,759.

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1902 are as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	18	0	6,789	4,300	$9,890	$2.30	63.3
1881	4	18	0	11,516	6,900	16,905	2.45	60
1882	5	138	0	40,782	26,170	62,808	2.40	64
1883	5	147	0	58,735	37,970	88,090	2.32	64.6
1884	6	177	15	60,281	39,000	76,070	1.95	64.6
1885	7	181	63	65,348	37,551	63,082	1.68	57
1886	7	302	170	89,410	54,329	117,649	2.17	60.7
1887	7	548	0	153,784	96,721	201,418	2.08	63
1888	9	572	8	141,641	84,052	146,837	1.75	59
1889	6	474	0	109,466	63,678	117,340	1.84	58
1890	6	474	0	182,340	104,076	196,583	1.89	57
1891	6	474	0	241,427	134,715	276,420	2.05	56
1892	6	506	0	242,627	140,641	284,174	2.02	58
1893	6	506	0	215,108	122,241	237,308	1.94	56.8
1894	6	506	0	176,746	104,160	181,586	1.74	58.9

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880–1902—Continued.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1895	6	506	0	267,520	164,729	$270,879	$1.64	61.6
1896	7	576	10	259,715	157,741	263,210	1.67	60.7
1897	7	576	20	199,312	117,849	187,359	1.59	59.1
1898	8	622	100	225,240	135,867	208,949	1.538	60
1899	8	653	88	323,506	190,337	364,148	1.91	58.8
1900	11	847	80	291,277	165,339	412,636	2.495	56.7
1901	11	877	50	281,787	164,736	314,473	1.909	58.4
1902	11	872	60	232,145	130,642	354,759	2.715	56.3

New River district.—This district includes the ovens along the Chesapeake and Ohio Railroad and the New River from Quinnimont on the east to Nuttallburg on the west. The coal in this district is similar in many respects to that of the Flat Top region, and the coke product is much praised as a blast-furnace fuel. The production in 1902 was 317,086 short tons, as compared with 399,373 short tons in 1901, the decrease being due, as previously stated, to the increased demand for coal at the Atlantic seaboard.

The statistics of the manufacture of coke in the New River district from 1880 to 1902 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	6	468	40	159,032	98,427	$239,977	$2.14	62
1881	6	499	0	219,446	136,423	334,652	2.45	62
1882	6	518	0	233,361	148,373	352,415	2.38	64
1883	6	546	0	264,171	167,795	384,552	2.29	64
1884	8	547	12	219,839	135,335	274,988	2.03	62
1885	8	519	0	244,769	156,007	325,001	2.08	63.8
1886	8	513	5	203,621	127,006	281,778	2.22	62
1887	11	518	50	253,373	159,836	401,164	2.51	63
1888	12	743	0	334,695	199,831	390,182	1.95	60
1889	12	773	0	268,185	157,186	351,132	2.23	58.6
1890	12	773	4	275,458	174,295	377,847	2.17	63
1891	13	787	102	309,073	193,711	426,630	2.20	63
1892	14	965	0	315,511	196,359	429,376	2.19	62
1893	13	947	10	281,600	178,049	355,965	2.00	63
1894	14	1,089	0	222,900	140,842	245,154	1.74	63.2
1895	14	978	0	385,899	244,815	404,978	1.65	63.4
1896	17	1,259	0	425,219	269,372	443,072	1.64	63.3
1897	17	1,225	0	439,103	268,263	419,151	1.56	61.1
1898	18	1,299	4	519,937	317,998	484,001	1.52	61
1899	22	1,444	167	503,160	281,134	533,996	1.90	56
1900	27	1,722	560	568,856	341,527	750,637	2.198	60
1901	28	2,128	261	657,003	399,373	823,060	2.06	60.8
1902	27	2,156	175	521,973	317,086	981,753	3.096	60.8

Upper Monongahela district.—The name of this district is derived from the fact that it is drained by the headwaters of the Monongahela River. The ovens lie along the Baltimore and Ohio Railroad in the counties of Taylor, Harrison, and Marion. It embraces the Clarksburg and Fairmont mining regions, which are the most important of the State. Greater activity was shown in coke making in this region in 1902 than in any other section of the State. The production reached a total of 547,497 short tons, as compared with 317,470 tons in 1901. The value increased from $657,232 in the former year to $1,617,389 in 1902. The production of 120 Semet-Solvay ovens located at Wheeling has been included with this district. Of the 31 establishments in the district, 6, with a total of 232 ovens, were idle throughout the year, and 3 other new concerns had not reached the productive stage before the 1st of January, 1903.

The statistics of coke production in the upper Monongahela district since 1880 are shown in the following table:

Statistics of the manufacture of coke in the upper Monongahela district, West Virginia, 1880–1902.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	8	145	0	64,937	36,028	$68,930	$1.91	55
1881	9	172	0	73,863	43,803	78,014	1.78	59
1882	11	222	0	92,510	55,855	105,214	1.88	60
1883	13	269	0	88,253	51,754	90,848	1.76	59
1884	13	281	100	78,468	49,139	74,894	1.52	63
1885	12	278	0	105,416	67,013	97,505	1.45	63.5
1886	12	275	104	131,896	82,165	113,100	1.38	62.3
1887	15	646	0	211,330	132,192	268,990	2.03	62.5
1888	17	567	110	213,377	138,097	175,840	1.27	64.7
1889	17	674	200	210,083	128,685	171,511	1.33	62.5
1890	18	1,051	50	276,367	167,459	260,574	1.56	60
1891	15	1,081	56	517,615	291,605	462,677	1.58	56
1892	19	1,129	45	441,266	265,363	390,296	1.47	60.1
1893	19	1,158	42	379,506	225,676	295,123	1.31	59
1894	20	1,221	42	280,748	158,623	179,525	1.13	56.5
1895	20	1,260	37	392,297	240,657	265,293	1.10	61.3
1896	22	1,386	0	331,526	206,429	211,272	1.023	62.3
1897	22	1,363	0	289,678	175,165	180,802	1.03	60.5
1898	23	[a] 1,449	30	319,590	183,430	194,277	1.06	57
1899	19	[a] 1,453	[b] 60	607,796	362,872	596,305	1.64	59.7
1900	24	[c] 1,563	0	584,265	355,861	817,340	2.297	60.9
1901	25	[c] 1,685	0	497,215	317,470	657,232	2.07	63.8
1902	31	[c] 1,698	75	916,322	547,497	1,617,389	2.95	59.7

[a] Includes 60 Semet-Solvay ovens at Wheeling.
[b] All Semet-Solvay ovens at Wheeling.
[c] Includes 120 Semet-Solvay ovens at Wheeling.

Upper Potomac district.—The ovens located along the line of the West Virginia Central and Pittsburg Railroad, in the region drained by the upper waters of the Potomac River, are considered in the upper Potomac district. The statistics for 1902 include also the operations of some new ovens recently built in Tygarts Valley, in the near vicinity. The production of this district increased from 241,265 short tons in 1901 to 412,077 tons in 1902. The statistics of the manufacture of coke in the upper Potomac district (including that of Tygarts Valley in 1902) from 1887 to 1902 are shown in the following table:

Statistics of the manufacture of coke in the upper Potomac and Tygarts Valley district, of West Virginia, 1887–1902.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1887	1	20	50	3,565	2,211	$4,422	$2.00	62
1888	1	28	0	9,176	5,835	8,752	1.50	64
1889	2	84	0	26,105	17,945	28,559	1.58	69
1890	2	178	28	94,983	61,971	118,503	1.91	65
1891	2	390	39	111,014	76,599	133,549	1.75	69
1892	3	395	0	114,045	78,691	121,208	1.54	69
1893	3	394	0	123,492	84,607	115,250	1.36	68.5
1894	2	394	0	66,598	43,546	43,546	1.00	65.4
1895	2	442	0	183,187	110,753	126,595	1.14	60.5
1896	2	482	0	270,275	164,093	242,135	1.476	60.7
1897	2	592	0	312,984	190,401	278,012	1.46	60.8
1898	2	622	0	379,227	230,150	329,371	1.43	60.7
1899	3	673	90	506,793	305,845	532,358	1.74	60.3
1900	6	827	0	472,168	286,934	475,073	1.655	60.8
1901	6	805	25	398,705	241,265	421,665	1.75	60.5
1902	7	990	290	627,003	412,077	689,718	1.67	65.7

OTHER STATES.

In the following table are presented the statistics of production in 1900, 1901, and 1902 of those States in which there are but one or two establishments.

Of the several States included in this statement, three of them—Michigan, New York, and Wisconsin—produced coke made from coal mined in other States, while one—Massachusetts—obtains its coal supply from Nova Scotia. All of the ovens in Massachusetts, New York, and Michigan are by-product retort ovens. The statistics of production for Illinois, Wisconsin, and Wyoming for previous years may be found by reference to preceding volumes of Mineral Resources.

Statistics of coke production in 1900, 1901, and 1902 in States having only one or two establishments.

State.	Item.	1900.	1901.	1902.
Illinois .... Indiana .... Massachusetts . Michigan...... New York ..... Wisconsin ..... Wyoming	Establishments	10	11	11
	Ovens built	a 832	b 862	c 898
	Ovens building	d 594	e 609	f 742
	Coke produced ....short tons..	506,730	564,191	598,869
	Value of coke at ovens	$1,454,029	$1,607,476	$2,063,894
	Value of coke at ovens ....per ton..	$2.87	$2.849	$3.446
	Coal used in manufacture of coke...short tons..	708,295	793,187	852,977
	Value of coal used	$1,104,368	$1,288,558	$1,541,618
	Value of coal........per short ton ..	$1.559	$1.625	$1.807
	Yield of coal in coke........per cent..	71.5	71.0	70.2

a Includes 30 Semet-Solvay and 400 Otto-Hoffman ovens.
b Includes 60 Semet-Solvay and 400 Otto-Hoffman ovens.
c Includes 90 Semet-Solvay, 400 Otto-Hoffman, and 15 Schniewind ovens.
d Includes 30 Semet-Solvay and 564 Otto-Hoffman ovens.
e Includes 30 Semet-Solvay, 564 Otto-Hoffman, and 15 Schniewind ovens.
f Includes 70 Semet-Solvay and 564 Otto-Hoffman ovens.

GAS, COKE, TAR, AND AMMONIA.[a]

By Edward W. Parker.

INTRODUCTION.

The development of the use of by-product retort ovens for the manufacture of coke in the United States has created a demand for information as to the total quantity of coal consumed in this country, not only in the manufacture of coke as a primary product, but in the manufacture of gas with coke as a secondary product, and as to the quantity and value of the by-products of tar and ammonia produced at gas works and at by-product recovery coking plants.

In order to comply with this demand, the Geological Survey, in making its annual canvass of the coal-mining and coke-making industries for 1902, has extended its inquiries in order to cover all plants producing gas and coke from coal with the recovery of the tar and ammonia. The completeness of the returns from which the accompanying tables have been compiled is exceedingly gratifying. A somewhat similar canvass was made for this office in 1898 by Dr. William B. Phillips, at which time returns were received from 433 companies manufacturing gas from coal. The statistics for 1902 include reports from 533 companies, including those operating retort-oven coking plants.

The report for 1898 included also the amount of water gas made and sold in that year, and also gas from oil, rosin, wood, etc. No attempt has been made for the present report to secure any reports from gas-producing plants other than those carbonizing coal for that purpose. In a few instances oil is used with the coal and no separation could be made. This production is included in the report for 1902.

In 1898 the 433 companies from which returns were received

[a] The writer desires to express his acknowledgment of the services rendered in the preparation of this report by Miss Belle Hill, of Pittsburg, Pa., who has compiled the accompanying tables from the reports received from the producers.

reported a total of 2,042,698 short tons of bituminous coal carbonized, producing 19,469,464,957 cubic feet of gas. Of this amount 18,431,201,414 cubic feet were sold for illuminating and heating purposes, leaving 1,038,263,543 cubic feet unaccounted for. The gas "unaccounted for" is probably lost through leakage, fire, or other accident. These figures for 1898 do not include the production from 520 by-product coke ovens in which 402,297 tons of coal were carbonized and which yielded 294,445 short tons of coke. No statement as to the actual amount of gas, tar, and ammonia produced at these works was obtained for that year, although it is estimated on a basis of 10 gallons of tar and 20 pounds of sulphate of ammonia to the ton of coal carbonized that the possible production was about 4,023,000 gallons of tar and 7,152,600 pounds of sulphate.

In 1902 the returns from 533 companies, including the operations of 1,663 by-product coke ovens, show that 5,015,511 tons of coal were carbonized, which yielded 30,764,625,332 cubic feet of gas. Of this product 29,079,073,555 cubic feet were sold, leaving 1,685,551,777 cubic feet lost or unaccounted for. About 2,000,000 tons of the total coal carbonized was used in by-product ovens.

Including the estimated output of tar and sulphate of ammonia from retort-oven coke plants in 1898, the total production in that year was (reducing ammonia liquor reported to its equivalent in sulphate): Sulphate of ammonia, 31,102,296 pounds; tar, 28,407,798 gallons.

In 1902 the production of ammonia, reduced to its equivalent in sulphate, was 68,248,686 pounds, and the production of tar 53,171,733 gallons.

The total production of coke in 1898 from gas works and retort-oven plants was 1,510,724 short tons, of which 294,445 short tons was the output of by-product coke ovens. In 1902 the total output of coke from these plants was 3,377,763 short tons, of which 1,403,588 short tons were produced in by-product coke ovens, leaving 1,974,175 tons as the output from gas works in 1902, against 1,216,279 tons in 1898.

The aggregate value of all the products obtained from the distillation of coal in gas works or retort ovens in 1902 was $43,869,440. About two-thirds of this amount, or $29,342,881, was represented by the value of the gas produced. The value of the coke produced was $11,267,608, while the tar was worth, at the works, $1,873,966. Most of the ammonia produced was sold in the form of ammoniacal liquor, which varied widely in the strength of the solution. This strength of solution ranged from 1.72 ounces NH_3 per gallon to 35.83 ounces NH_3 per gallon. The total quantity of ammoniacal liquor sold was 49,490,609 gallons, containing 14,683,374 pounds NH_3, and was worth at the works $1,065,300. In addition to this there was an actual production of 11,276,502 pounds of sulphate, which sold for $319,685.

PRODUCTION OF GAS.

The following table shows the total quantity of gas made from coal by the 533 companies distributed over 44 States and Territories. It will be observed that prices for artificial gas are low in States where natural gas is used largely in the principal cities, as in Illinois, Indiana, Kentucky, Ohio, Pennsylvania, West Virginia, and also in Massachusetts, where a large portion of the gas made is a by-product from coke making in retort ovens.

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of United States in 1902, by States.

State.	Number of establishments.	Quantity of coal carbonized.	Total quantity gas produced.	Gas sold for illuminating purposes.			Gas sold for fuel purposes.			Total gas sold.			Quantity of gas unaccounted for.
				Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Average price per 1,000 cubic feet.	
		Short tons.	*Cubic feet.*	*Cubic feet.*			*Cubic feet.*			*Cubic feet.*			*Cubic feet.*
Alabama	11	*a* 443,612	237,231,300	114,774,600	$180,813	$1.575	83,050,300	$88,542	$1.066	197,824,900	$269,355	$1.36	39,406,400
Arkansas	5	9,030	76,820,600	47,510,900	87,591	1.84	26,498,100	39,403	1.487	74,009,000	126,997	1.716	2,811,600
California	16	28,429	270,421,820	191,757,704	277,031	1.44	66,131,316	95,061	1.437	257,889,020	372,092	1.44	12,532,800
Colorado	5	42,994	431,235,200	191,826,185	266,026	1.386	201,237,867	201,941	1	393,064,052	467,967	1.19	38,171,148
Connecticut	8	80,049	699,338,400	513,439,040	602,417	1.17	182,216,260	202,274	1.11	695,655,300	804,691	1.157	3,683,100
Delaware	3	13,503	138,402,500	89,549,125	90,849	1.014	48,853,375	49,528	1.013	138,402,500	140,377	1.014	....
Georgia	9	42,418	373,511,850	213,621,415	258,601	1.21	138,765,035	146,193	1.053	352,386,450	404,794	1.148	21,125,400
Illinois	43	152,642	1,397,563,470	811,890,246	979,861	1.207	514,903,314	575,535	1.117	1,326,793,560	1,555,396	1.172	70,769,910
Indiana	30	98,434	775,515,720	472,638,499	506,005	1.07	289,193,821	277,429	.959	761,832,320	783,434	1.028	13,683,400
Iowa	16	38,882	360,076,200	199,169,992	269,293	1.35	140,265,142	170,672	1.217	339,435,134	439,965	1.296	20,641,066
Kansas	11	27,093	220,362,030	107,851,995	163,851	1.519	96,618,235	120,322	1.245	204,470,230	284,173	1.39	15,891,800
Kentucky	11	68,793	660,124,980	399,342,665	428,491	1.073	173,498,576	137,388	.79	572,841,241	565,879	.988	87,283,739
Louisiana and Mississippi	5	6,885	50,025,490	31,738,196	65,002	2.048	18,287,294	26,276	1.437	50,025,490	91,278	1.824	....
Maine	7	16,149	194,271,530	122,111,895	169,231	1.385	56,809,955	69,427	1.222	178,921,850	238,658	1.334	15,349,680
Maryland and District of Columbia	8	52,295	502,483,200	437,685,490	473,967	1.083	9,589,500	10,251	1.069	447,274,990	484,218	1.082	55,208,210
Massachusetts	44	*a* 828,386	4,284,388,007	3,880,912,770	2,531,230	.652	226,911,662	258,122	1.137	4,107,824,432	2,789,352	.679	176,563,575
Michigan	30	*a* 220,348	1,322,184,400	673,080,965	746,931	1.109	608,967,235	543,467	.892	1,282,048,200	1,290,398	1.0065	40,136,200
Minnesota and Nebraska	7	63,329	644,866,000	497,434,600	653,765	1.314	109,866,833	139,677	1.27	607,301,433	793,442	1.306	37,564,567
Missouri	21	187,602	1,735,335,540	989,609,300	1,042,983	1.054	581,062,300	491,139	.845	1,570,671,600	1,534,122	.976	164,663,940
Montana, New Mexico, Nevada	5	6,289	58,140,500	34,256,200	73,123	2.13	17,288,783	26,510	1.53	51,544,983	99,633	1.93	6,595,517
New Hampshire and Vermont	6	17,978	177,475 700	163,642,600	223,454	1.365	2,650,000	3,975	1.50	166,292,600	227,429	1.367	11,183,100

New Jersey	16	116,379	1,012,672,627	922,146,025	1,029,372	1.116	86,313,000	117,146	1.357	1,008,459,025	1,146,518	1.136	88,215,602
New York	57	*a* 602,321	5,185,539,256	4,602,635,000	1,931,782	1.071	369,600,850	103,349	1.091	4,972,235,850	5,335,131	1.073	213,303,406
North Carolina	5	4,940	40,220,900	25,736,700	46,181	1.806	7,732,800	10,456	1.352	33,469,500	56,910	1.70	6,751,400
South Carolina	3	14,630	147,705,000	103,755,600	163,070	1.57	27,934,700	35,772	1.28	131,690,300	198,842	1.51	16,014,700
North Dakota, Utah, Wyoming .	3	6,456	63,412,900	32,431,160	61,427	1.89	29,490,840	41,329	1.40	61,922,000	102,756	1.659	1,490,900
Ohio	52	*a* 514,124	4,278,015,250	3,469,403,995	2,807,885	.809	494,099,883	349,289	.707	3,963,503,878	3,157,174	.797	314,511,372
Oregon	4	9,170	74,606,400	71,272,031	122,592	1.72	2,999,566	5,942	1.98	74,271,600	128,534	1.73	334,800
Pennsylvania	29	*a* 734,978	2,296,310,816	2,063,627,623	2,110,750	1.023	134,788,073	80,571	.598	2,198,415,696	2,191,321	.997	97,895,120
Rhode Island	3	50,387	496,295,000	320,649,000	384,630	1.199	152,000,000	167,300	1.10	472,649,000	551,930	1.168	23,646,000
Tennessee	7	57,309	537,807,300	432,383,840	486,508	1.125	97,773,360	105,066	1.074	530,157,200	591,574	1.116	7,650,100
Texas	9	15,257	142,415,600	79,517,831	145,046	1.823	17,942,069	69,433	1.448	127,489,900	214,479	1.682	14,925,700
Virginia	14	*a* 66,981	361,328,023	291,187,286	352,512	1.21	31,391,000	33,966	1.082	322,578,286	386,478	1.198	38,719,737
Washington	7	27,067	233,982,873	165,791,385	280,693	1.69	48,161,065	71,167	1.51	213,955,450	351,860	1.658	20,027,423
West Virginia	7	*a* 233,961	145,538,950	143,426,950	121,395	.846	2,112,000	617	.292	145,538,950	122,012	.838	....
Wisconsin	16	116,411	1,109,000,000	493,479,715	554,299	1.123	552,747,920	486,383	.879	1,046,227,635	1,040,682	.994	62,772,365
Total	533	5,015,511	30,764,625,332	23,401,318,526	23,688,963	1.012	5,677,755,029	5,653,918	.996	29,079,073,555	29,342,881	1.009	1,685,551,777

a Includes coal coked in by-product coke ovens.

Of the total amount of gas produced in the United States in 1902, 1,685,551,777 cubic feet, or 5.48 per cent, were lost by leakage or accident. The marketed product amounted to 29,079,073,555 cubic feet, of which 23,401,318,526 cubic feet, or 80.45 per cent, was sold for illuminating purposes, and 5,677,755,029, or 19.55 per cent, for fuel. As a usual thing the gas sold for illuminating purposes brought higher prices than the fuel gas, but there were a few instances where fuel gas was sold at high enough figures to make the average price for this gas in the State higher than illuminating gas. The price of illuminating gas varied from 65.2 cents per 1,000 cubic feet in Massachusetts to $2.13 in Montana, Nevada, and New Mexico. Fuel gas ranged from 29.2 cents in West Virginia to $1.98 in Oregon. The average prices of fuel and illuminating gas in 1902 for the country as a whole show a difference of only 1.6 cents per 1,000 cubic feet, the former being 99.6 cents and the latter $1.012. There were, however, very decided differences in the prices in some of the individual States—West Virginia, for instance, having an average of 84.6 cents for illuminating gas and 29.2 cents for fuel gas.

The following table shows the total quantity of gas produced in each State, less the amount wasted or lost, and the amount and percentage of illuminating and fuel gas sold:

Quantity of illuminating and fuel gas sold in 1902, by States.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Percentage.	Quantity.	Percentage.
	Cubic feet.	*Cubic feet.*		*Cubic feet.*	
Alabama	197,824,900	114,774,600	58.02	83,050,300	41.98
Arkansas	74,009,000	47,510,900	64.19	26,498,100	35.81
California	257,889,020	191,757,704	74.35	66,131,316	25.65
Colorado	393,064,052	191,826,185	48.82	201,237,867	51.18
Connecticut	695,655,300	513,439,040	73.81	182,216,260	26.19
Delaware	138,402,500	89,549,125	64.70	48,853,375	35.30
Georgia	352,386,450	213,621,415	60.62	138,765,035	39.38
Illinois	1,326,793,560	811,890,246	61.18	514,903,314	38.82
Indiana	761,832,320	472,638,499	62.04	289,193,821	37.86
Iowa	339,435,134	199,169,992	58.68	140,265,142	41.32
Kansas	204,470,230	107,851,995	52.74	96,618,235	47.26
Kentucky	572,841,241	399,342,665	67.96	173,498,576	32.04
Louisiana and Mississippi	50,025,490	31,738,196	63.44	18,287,294	36.56
Maine	178,921,850	122,111,895	68.25	56,809,955	31.75
Maryland and District of Columbia	447,274,990	437,685,490	97.85	9,589,500	2.15
Massachusetts	4,107,824,432	3,880,912,770	94.47	226,911,662	5.53
Michigan	1,282,048,200	673,080,965	52.50	608,967,235	47.50
Minnesota and Nebraska	607,301,433	497,434,600	81.91	109,866,833	18.09
Missouri	1,570,671,600	989,609,300	63.00	581,062,300	37.00
Montana, New Mexico, and Nevada	51,544,983	34,256,200	66.45	17,288,783	33.55
New Hampshire and Vermont	166,292,600	163,642,600	98.40	2,650,000	1.60
New Jersey	1,008,459,025	922,146,025	91.44	86,313,000	8.56

Quantity of illuminating and fuel gas sold in 1902, by States—Continued.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Percentage.	Quantity.	Percentage.
	Cubic feet.	*Cubic feet.*		*Cubic feet.*	
New York	4,972,235,850	4,602,635,000	92.56	369,600,850	7.44
North Carolina	33,469,500	25,736,700	76.89	7,732,800	23.11
South Carolina	131,690,300	103,755,600	78.78	27,934,700	21.22
North Dakota, Utah, and Wyoming	61,922,000	32,431,160	52.37	29,490,840	47.63
Ohio	3,963,503,878	3,469,403,995	87.53	494,099,883	12.47
Oregon	74,271,600	71,272,034	95.95	2,999,566	4.05
Pennsylvania	2,198,415,696	2,063,627,623	93.87	134,788,073	6.13
Rhode Island	472,649,000	320,649,000	67.84	152,000,000	32.16
Tennessee	530,157,200	432,383,840	81.56	97,773,360	18.44
Texas	127,489,900	79,547,831	62.39	47,942,069	37.61
Virginia	322,578,286	291,187,286	90.27	31,391,000	9.73
Washington	213,955,450	165,791,385	77.48	48,164,065	22.52
West Virginia	145,538,950	143,426,950	98.55	2,112,000	1.45
Wisconsin	1,046,227,635	493,479,715	48.60	552,747,920	51.40
Total	29,079,073,555	23,401,318,526	80.45	5,677,755,029	19.55

In the following table the States are arranged according to rank in the amount of gas produced from coal in 1902. New York stands first, with a production of 5,185,539,000 cubic feet; Massachusetts second, with 4,284,388,000 cubic feet; Ohio third, with 4,278,015,000 cubic feet, and Pennsylvania fourth, with 2,296,311,000 cubic feet. In 1898 these four States also stood at the head of the list, but Massachusetts in that year was fourth in rank, with Pennsylvania second, and Ohio third. The construction of the plant of 400 Otto-Hoffman ovens at Everett, near Boston, by the New England Coke and Gas Company, which were completed in 1899, is responsible for an increase in the production of that State of 160 per cent, and places it next to New York in producing rank, notwithstanding the fact that there was one less company making gas in 1902 than in 1898. The following table also shows the quantity and percentage of the gas sold in each State, and the quantity and percentage of the gas wasted or unaccounted for in each State.

Rank of States in gas production and the quantity sold and unaccounted for in 1902, by States.

Rank.	State.	Total production.	Gas sold.		Gas unaccounted for.	
			Quantity.	Per cent.	Quantity.	Per cent.
		Cubic feet.	Cubic feet.		Cubic feet.	
1	New York	5,185,539,256	4,972,235,850	96.07	213,303,406	3.93
2	Massachusetts	4,284,388,007	4,107,824,432	95.87	176,563,575	4.13
3	Ohio	4,278,015,250	3,963,503,878	92.65	314,511,372	7.35
4	Pennsylvania	2,296,310,816	2,198,415,696	95.73	97,895,120	4.27
5	Missouri	1,735,335,540	1,570,671,600	90.51	164,663,940	9.49
6	Illinois	1,397,563,470	1,326,793,560	94.93	70,769,910	5.07
7	Michigan	1,322,184,400	1,282,048,200	96.96	40,136,200	3.04
8	Wisconsin	1,109,000,000	1,046,227,635	94.34	62,772,365	5.66
9	New Jersey	1,042,672,627	1,008,459,025	96.72	34,213,602	3.28
10	Indiana	775,515,720	761,832,320	98.23	13,683,400	1.87
11	Connecticut	699,338,400	695,655,300	99.45	3,683,100	.55
12	Kentucky	660,124,980	572,841,241	86.77	87,283,739	13.23
13	Minnesota and Nebraska	644,866,000	607,301,433	94.17	37,564,567	5.83
14	Tennessee	537,807,300	530,157,200	98.57	7,650,100	1.43
15	Maryland and District of Columbia	502,483,200	447,274,990	89.00	55,208,210	11.00
16	Rhode Island	496,295,000	472,649,000	95.23	23,646,000	4.77
17	Colorado	431,235,200	393,064,052	91.15	38,171,148	8.85
18	Georgia	373,511,850	352,386,450	94.34	21,125,400	5.67
19	Virginia	361,328,023	322,578,286	89.27	38,749,737	10.73
20	Iowa	360,076,200	339,435,134	94.26	20,641,066	5.74
21	California	270,421,820	257,889,020	95.36	12,532,800	4.64
22	Alabama	237,231,300	197,824,900	83.39	39,406,400	16.61
23	Washington	233,982,873	213,955,450	91.44	20,027,423	8.56
24	Kansas	220,362,030	204,470,230	92.79	15,891,800	7.21
25	Maine	194,271,530	178,921,850	92.09	15,349,680	7.91
26	New Hampshire and Vermont	177,475,700	166,292,600	93.69	11,183,100	6.31
27	South Carolina	147,705,000	131,690,300	89.16	16,014,700	10.84
28	West Virginia	145,538,950	145,538,950	100.00	....	......
29	Texas	142,415,600	127,489,900	89.52	14,925,700	10.48
30	Delaware	138,402,500	138,402,500	100.00	....	......
31	Arkansas	76,820,600	74,009,000	96.34	2,811,600	3.66
32	Oregon	74,606,400	74,271,600	99.55	334,800	.45
33	North Dakota, Utah, and Wyoming	63,412,900	61,922,000	97.65	1,490,900	2.35
34	Montana, New Mexico, and Nevada	58,140,500	51,544,983	88.66	6,595,517	11.34
35	Louisiana and Mississippi	50,025,490	50,025,490	100.00	....	......
36	North Carolina	40,220,900	33,469,500	83.21	6,751,400	16.79
......	Total	30,764,625,332	29,079,073,555	94.52	1,685,551,777	5.18

PRODUCTION OF COKE.

The total quantity of coke produced at gas works and in retort or by-product recovery ovens in 1902 was 3,377,763 short tons, of which 1,974,175 tons were made in gas works as a by-product and 1,403,588 tons were produced in retort ovens. In 1898 the production of coke from such plants amounted to 1,510,724 short tons, of which 1,216,279 tons were produced in gas works and 294,445 tons from retort ovens.

The total quantity of coal carbonized or coked at the gas works and by-product coke works of the United States in 1902 amounted to 5,015,511 short tons, of which 1,935,348 tons were coked at the by-product works, leaving 3,080,163 tons as the quantity carbonized at the gas works. In 1898 the total amount of coal carbonized was 2,444,995 short tons, of which 2,042,698 tons were coked in gas works and 402,297 tons in by-product ovens.

Many coal-gas companies are engaged in the electric-light business, and coke produced at the gas works, as well as considerable quantities of tar, is used for firing in the electric-light plants. Other coal-gas producers are also producers of water gas, and the coke from the coal benches is used for firing the water-gas plant. Some coke is also used in the carbonization of coal at some of the coal-gas works. It will be noted, therefore, that not all the coke produced at the gas works in the United States is sold, as a large amount of it is consumed at the works where it is produced. In this report the total production is given as nearly as possible, placing upon the quantity consumed the same value as that received for the quantity sold.

The following table gives the production of coke at gas works and in by-product coke ovens in 1902 by States, arranged according to their producing importance:

Rank of States in production of coke in gas works and by-product ovens.

Rank.	State.	Quantity.	Yield per ton of coal.	Value per ton.	Total value.
		Short tons.	*Per cent.*		
1	Massachusetts	575,901	69.5	$3.49	$2,009,889
2	Pennsylvania	502,743	68.4	2.939	1,477,774
3	New York	406,629	67.5	3.04	1,234,840
4	Ohio	339,815	66.09	2.59	879,677
5	Alabama	309,726	69.8	3.24	1,004,140
6	West Virginia	174,093	74.4	2.86	498,208
7	Michigan	148,488	67.4	4.18	620,669
8	Missouri	121,630	64.8	3.24	394,440
9	Illinois	94,834	62.1	4.02	381,071
10	Wisconsin	80,420	69.0	3.898	313,504
11	New Jersey	75,448	64.8	4.09	308,801
12	Indiana	65,191	66.2	3.68	240,222
13	Connecticut	50,360	62.9	4.54	228,644
14	Kentucky	46,567	67.7	2.64	122,818
15	Minnesota and Nebraska	41,453	65.5	4.38	181,568
16	Maryland and District of Columbia	37,279	71.3	3.00	111,867
17	Virginia	36,748	54.8	2.76	101,538
18	Tennessee	36,189	63.1	3.61	130,762
19	Rhode Island	30,587	60.7	4.19	128,285
20	Colorado	30,053	69.9	3.22	96,949
21	Georgia	25,691	60.6	3.15	80,997
22	Iowa	25,158	64.7	5.00	125,770
23	Washington	17,958	66.3	4.03	72,326
24	California	17,182	60.4	8.33	143,130
25	Kansas	16,000	59.0	3.24	51,893
26	New Hampshire and Vermont	9,796	54.5	4.95	48,523
27	Maine	9,272	57.4	5.05	46,827

Rank of States in production of coke in gas works and by-product ovens—Continued.

Rank.	State.	Quantity.	Yield per ton of coal.	Value per ton.	Total value.
		Short tons.	*Per cent.*		
28	South Carolina	9,193	62.8	$4.80	$44,129
29	Texas	9,162	60.0	5.30	48,581
30	Delaware	9,046	66.9	3.06	27,690
31	Oregon	5,974	65.1	4.22	25,197
32	Arkansas	5,552	61.48	3.877	21,526
33	Louisiana and Mississippi	4,125	59.9	3.12	12,885
34	North Dakota, Utah, and Wyoming	3,680	57.0	5.87	21,600
35	Montana, New Mexico, and Nevada	3,430	54.5	5.61	19,230
36	North Carolina	2,390	48.4	4.87	11,638
	Total	3,377,763	67.3	3.336	11,267,608

PRODUCTION OF COAL TAR.

The total production of tar from gas works and by-product ovens in 1902 amounted to 53,171,733 gallons, valued at $1,873,966, or 3.524 cents per gallon. In 1898 the production from gas works alone was 24,384,798 gallons, worth $902,400, or 3.7 cents per gallon. The price in 1902 varied from 2.7 cents in Alabama to 10 cents in Oregon. The lowest price reported in 1898 was 2.23 cents in Indiana, and the highest price was 10.17 cents in Montana and New Mexico. From this it will be seen that, on the whole, the value of the tar produced has not changed materially since 1898.

The largest production of tar in 1902 was in Massachusetts, with New York second, Ohio third, and Pennsylvania fourth. In 1898 New York held first place, with Pennsylvania, Ohio, and Massachusetts following in the order named.

The following table gives the production of coal tar in 1902, arranged in the order of producing importance:

Rank of States in coal-tar production.

Rank.	State.	Quantity.	Yield per ton of coal.	Value per gallon.	Total value.
		Gallons.	*Gallons.*	*Cents.*	
1	Massachusetts	7,985,640	9.64	3.00	$239,954
2	New York	7,076,743	11.75	2.89	204,312
3	Ohio	6,422,820	12.49	3.90	251,016
4	Pennsylvania	6,268,805	8.53	3.04	190,527
5	Alabama	3,816,275	8.6	2.70	103,114
6	Missouri	2,459,658	13.1	4.36	107,314
7	West Virginia	2,360,952	10	3.30	77,985
8	Michigan	2,321,867	10.5	3.24	75,290
9	Wisconsin	1,928,033	16.56	3.47	66,896
10	Illinois	1,852,781	12.1	4.50	84,003
11	New Jersey	1,351,126	11.6	3.37	45,514
12	Indiana	1,054,271	10.7	3.77	39,763
13	Kentucky	826,046	12	4.01	33,161
14	Connecticut	762,578	9.5	4.70	36,239
15	Tennessee	717,174	12.5	3.875	27,791

Rank of States in coal-tar production—Continued.

Rank.	State.	Quantity.	Yield per ton of coal.	Value per gallon.	Total value.
		Gallons.	*Gallons.*	*Cents.*	
16	Minnesota and Nebraska	709, 231	11. 2	3. 68	$26, 088
17	Colorado	576, 192	13. 4	5. 00	28, 900
18	Maryland and District of Columbia	569, 483	10. 9	3. 18	18, 141
19	Rhode Island	550, 300	10. 9	3. 60	19, 970
20	Virginia	461, 318	6. 88	4. 40	20, 493
21	Iowa	445, 522	11. 46	4. 56	20, 327
22	Georgia	378, 127	8. 9	3. 90	14, 738
23	Kansas	301, 761	11. 1	4. 60	13, 958
24	California	261, 766	9. 2	6. 00	15, 803
25	Washington	255, 963	9. 4	7. 70	19, 676
26	Delaware	221, 917	16. 4	5. 50	12, 179
27	Texas	218, 943	14. 35	9. 50	20, 842
28	New Hampshire and Vermont	217, 995	12. 12	5. 40	11, 829
29	Maine	209, 630	12. 9	4. 66	9, 781
30	South Carolina	139, 559	9. 5	3. 60	5, 027
31	Arkansas	115, 505	12. 79	6. 40	7, 400
32	Oregon	99, 312	10. 83	10. 00	9, 931
33	North Dakota, Utah, and Wyoming	68, 950	10. 68	6. 70	4, 623
34	Louisiana and Mississippi	66, 500	9. 66	5. 10	3, 420
35	Montana, New Mexico, and Nevada	57, 790	9. 1	9. 80	5, 689
36	North Carolina	41, 200	8. 34	5. 50	2, 272
	Total	53, 171, 733	10. 6	3. 524	1, 873, 966

For convenience in making a comparative analysis, the following table of coal-tar production in 1898 is reprinted in this report, the States being arranged in order of production:

Rank of States in coal-tar production in 1898.

Rank.	State.	Quantity.	Yield per ton of coal.	Value per gallon.	Total value.
		Gallons.	*Gallons.*	*Cents.*	
1	New York	4, 799, 740	11. 03	3. 83	$184, 012
2	Pennsylvania	4, 163, 103	13. 58	2. 63	109, 317
3	Ohio	3, 901, 258	13. 59	3. 09	120, 603
4	Massachusetts	2, 518, 219	14. 30	5. 36	134, 901
5	Wisconsin	1, 267, 258	12. 70	2. 31	29, 224
6	Michigan	685, 589	11. 51	3. 65	24, 993
7	Illinois	674, 758	11. 51	3. 08	20, 751
8	Rhode Island	646, 130	12. 75	4. 91	31, 741
9	Indiana	624, 482	10. 36	2. 23	13, 948
10	Kentucky	592, 400	12. 00	2. 64	15, 629
11	Connecticut	438, 476	9. 39	5. 88	25, 791
12	Tennessee	393, 445	11. 40	3. 34	13, 143
13	New Jersey	325, 921	12. 88	3. 77	12, 303
14	California	272, 448	10. 12	6. 12	16, 681
15	Missouri	267, 905	10. 41	5. 14	13, 765
16	Georgia	262, 911	11. 25	4. 19	11, 007
17	West Virginia	231, 806	13. 22	2. 62	6, 078
18	Iowa	224, 010	10. 04	3. 99	8, 934
	Other States	2, 094, 939	11. 18	5. 23	109, 579
	Total	24, 384, 798	12. 55	3. 70	902, 400

In explanation of this table for 1898 it must be said that in determining the total production of coal tar all the returns were added together, but in determining the yield of tar per ton of coal due regard was given to the fact that some companies reported coal carbonized but did not report the amount of tar made from this coal. This amount of coal was therefore deducted from the total amount carbonized before an estimate was made of the yield of tar per ton of coal. The actual amount of coal carbonized in making the 24,384,798 gallons of tar was 1,942,963 tons, inasmuch as there was no tar returned from 99,735 tons of coal carbonized. The actual yield of tar per ton of coal, based on the returns made, was 12.55 gallons, obtained by dividing the number of tons of coal used in making tar into the total number of gallons of tar reported.

The census report for 1900[a] states that there were 14 establishments devoted to the manufacture of coal-tar products. The total value of the manufactured products from these 14 establishments was $1,322,094. In addition to these there were 8 establishments in which coal tar was used as a raw material, but in which the manufacture of coal-tar products was of secondary importance. The value of the coal-tar products in these 8 establishments was $99,626. Of these 22 establishments, 6 were located in Pennsylvania, 3 in Missouri, 3 in New York, and the other 10 were distributed among Louisiana, Tennessee, Ohio, California, Minnesota, Massachusetts, and New Jersey.

In 1890, according to the Eleventh U. S. Census, the value of the coal-tar products manufactured in the United States amounted to $687,591.

PRODUCTION OF AMMONIA.

Of the 533 companies from which reports were received in 1902, there were only 106 which reported the recovery of ammonia either in the form of ammoniacal liquor or as sulphate. These 106 companies reported a total production of 49,490,609 gallons of ammonia liquor, which sold for $1,065,300, and 11,276,502 pounds of sulphate, which sold for $319,685, a total value for the ammonia sold of $1,384,985. The total quantity of coal carbonized, or coked, at the works operated by these 106 companies in 1902 was 4,077,478 short tons. The companies which produced ammonia liquor used 3,436,312 tons of coal, and 641,166 tons were carbonized by the companies selling their ammonia as sulphate. From this it appears that the average yield per short ton of coal carbonized was 14.4 gallons of liquor and 17.6 pounds of sulphate.

The returns showed that ammonia liquor is sold in several ways. Some companies reported the production in liquor ounces, selling at a

[a] Munroe, Charles E., and Chatard, Thomas M., Report on chemicals: Twelfth Census U. S., 1900, vol. 10, Manufactures, pt. 4.

certain price per 100 liquor ounces of a specified strength; others reported production in gallons, sales being made at a certain price per pound for pure ammonia (NH_3); others reported the production in gallons of ammonia liquor at so much per gallon, giving the strength of liquor.

The strength of liquor was reported by some producers in ounces, by others in degrees Twaddell, and by others in percentage of anhydrous ammonia (NH_3). The figures have been reduced to a common basis, and the strength of liquor is given in the following table in ounces, which is the most common form. The returns are grouped in this table according to the strength of ammonia liquor produced, and not by States. This has been done to avoid the disclosure of the operations of any individual producers.

In the report on this subject prepared by Dr. William B. Phillips and covering the year 1898, the total amount of ammonia liquor sold by 70 establishments from which returns were received was reported at 25,749,792 gallons, which sold for $284,148. This production, reduced to its equivalent in sulphate of ammonia, is estimated to have been 23,949,696 pounds (of sulphate). The sulphate equivalent of the 49,490,609 gallons of liquor sold in 1902 was 56,972,184 pounds, which added to the 11,276,502 pounds of sulphate separately reported would be equal to a total production of 68,248,686 pounds of sulphate last year.

The report of Doctor Phillips above referred to contains a description of the methods of determining the amount of ammonia in gas liquor and a table of analyses of gas liquors taken from different parts of the works in which the liquor was being produced.

Production and value of ammoniacal liquor at gas and by-product coke works of United States in 1902.

Coal used.	Quantity of ammonia liquor made and sold.	Strength of liquor.					Value of liquor as reported.	
		In ounces.	Equivalent to anhydrous ammonia (NH_3).		Equivalent to sulphate of ammonia.			
			Ounces per gallon.	Total in pounds.	Ounces per gallon.	Total in pounds.	Total.	Per gallon.
Short tons.	*Gallons.*							*Cents.*
9,038	374,400	4.94	1.72	40,248	6.67	156,162	$1,329	0.355
31,400	600,000	5.00	1.74	65,250	6.75	253,170	2,100	.350
46,890	1,792,800	5.21	1.81	202,810	7.02	786,903	10,936	.610
11,595	362,355	5.60	1.95	44,162	7.56	171,349	1,631	.450
150,848	6,394,500	5.78	2.01	803,309	7.80	3,116,839	29,415	.460
491,831	16,725,179	6.00	2.09	2,184,725	8.10	8,476,733	112,601	.670
52,910	1,578,890	6.20	2.16	213,150	8.37	827,022	14,309	.900
11,937	319,749	7.00	2.435	48,662	9.45	188,809	1,599	.500

Production and value of ammoniacal liquor at gas and by-product coke works of United States in 1902—Continued.

Coal used.	Quantity of ammonia liquor made and sold.	Strength of liquor.					Value of liquor as reported.	
		In ounces.	Equivalent to anhydrous ammonia. (NH_3).		Equivalent to sulphate of ammonia.			
			Ounces per gallon.	Total in pounds.	Ounces per gallon.	Total in pounds.	Total.	Per gallon.
Short tons.	*Gallons.*							*Cents.*
233,069	8,263,801	7.48	2.60	1,342,868	10.10	5,210,328	48,756	0.590
31,313	857,895	7.57	2.63	141,016	10.20	547,142	4,289	.500
42,827	186,062	8.00	2.78	32,328	10.80	125,433	2,232	1.200
19,106	382,120	8.50	2.96	70,692	11.47	274,285	5,086	1.330
64,093	1,977,248	9.00	3.13	386,799	12.15	1,501,473	16,861	.802
75,957	1,198,525	10.00	3.48	260,679	13.50	1,011,435	17,629	1.470
12,006	60,766	10.10	3.51	13,330	13.63	51,720	498	.820
78,705	1,982,159	10.80	3.76	465,377	14.58	1,805,663	41,326	2.080
7,392	75,430	11.00	3.827	18,042	14.85	70,003	1,320	1.750
7,240	131,442	12.00	4.17	34,257	16.17	132,917	873	.664
39,379	39,409	15.45	5.375	13,239	20.85	51,367	4,288	10.880
104,680	1,218,639	16.00	5.57	424,238	21.60	1,646,043	21,006	1.720
44,663	55,890	17.25	6.00	20,959	23.28	81,321	7,154	12.800
15,000	15,254	18.00	6.26	5,968	24.30	23,156	610	4.000
11,652	134,000	20.00	6.96	58,290	27.00	226,165	6,840	5.100
2,923	39,000	38.00	13.22	32,223	51.29	125,025	585	1.500
9,685	96,850	40.00	13.92	84,260	53.99	326,929	1,453	1.500
4,896	8,000	42.00	14.61	7,305	56.69	28,343	650	8.125
19,577	36,679	48.00	16.70	38,284	64.79	148,542	2,568	7.000
13,904	32,080	50.00	17.39	34,867	67.47	135,284	2,001	6.240
32,949	84,316	52.00	18.09	95,330	70.19	369,880	6,970	8.260
37,044	100,445	56.00	19.48	122,291	75.58	474,489	10,299	10.250
3,982	2,458	58.00	20.18	3,100	78.29	12,028	172	7.000
5,645	2,424	59.16	20.58	3,118	79.86	12,098	234	9.650
280,927	648,714	60.00	20.87	846,167	80.99	3,283,128	76,438	11.780
166,917	540,404	62.00	21.57	728,532	83.69	2,826,704	72,400	13.390
26,399	54,736	62.64	21.79	74,544	84.54	289,231	3,722	6.800
139,056	416,219	64.00	22.26	579,065	86.39	2,246,772	50,150	12.050
13,596	24,666	65.60	22.82	35,180	88.55	136,498	3,330	13.500
200,015	227,315	67.80	23.59	335,147	91.53	1,300,370	35,405	15.580
12,666	1,080	68.16	23.71	1,600	91.99	6,208	133	12.310
183,826	638,353	71.00	24.70	986,544	95.84	3,827,791	94,021	14.730
9,363	9,811	72.00	25.05	15,360	97.19	59,597	638	6.500
24,138	40,195	80.00	27.83	69,914	107.98	271,266	4,528	11.260
212,356	648,882	90.00	30.92	1,253,950	119.97	4,865,326	128,415	19.790
433,146	1,087,726	100.00	34.79	2,393,026	134.99	9,284,941	216,363	19.900
9,771	23,743	103.00	35.83	53,169	139.03	206,296	2,137	9.000
3,436,312	49,490,609	....	....	14,683,374	....	56,972,184	1,065,300	2.130
[a] 641,166	....	....	....	....	....	[a] 11,276,502	[a] 319,685	....
[b] 4,077,478	....	....	....	....	....	[b] 68,248,686	[b] 1,384,985	....

[a] Actual production of sulphate of ammonia.

[b] 106 companies.

AGGREGATE PRODUCTION AND VALUE.

In the following table are shown in condensed form the quantity and value of the gas and by-products obtained from gas works and retort coke oven plants in the United States in 1902, by States.

The aggregate value of these products in 1902 was $43,869,440. The aggregate value of the products from gas works in 1898 was $26,300,394.

Production of gas and by-products in United States in 1902, by States.

State.	Gas produced and used for illuminating and fuel purposes.	By-products.			Gas unaccounted for.
		Tar.	Ammonia liquor.	Coke.	
	Cubic feet.	*Gallons.*	*Gallons.*	*Net tons.*	*Cubic feet.*
Alabama and Georgia	550,211,350	4,194,402	1,128,542	335,417	60,531,800
Arkansas	74,009,000	115,505	....	5,552	2,811,600
California and Colorado	650,953,072	837,958	1,177,644	47,235	50,703,948
Connecticut and Rhode Island	1,168,304,300	1,312,878	1,169,227	80,947	27,329,100
Delaware and New Jersey	1,146,861,525	1,573,043	149,242	84,494	34,213,602
Illinois	1,326,793,560	1,852,781	193,926	94,834	70,769,910
Indiana	761,832,320	1,054,271	192,266	65,191	13,683,400
Iowa and Wisconsin	1,385,662,769	2,373,555	242,794	105,578	83,413,431
Kansas	204,470,230	301,761	....	16,000	15,891,800
Kentucky	572,841,241	826,046	1,889,650	46,567	87,283,739
Louisiana and Mississippi	50,025,490	66,500	....	4,125	....
Maine, New Hampshire, and Vermont	345,214,450	427,625	259,802	19,068	26,532,780
Maryland and District of Columbia	447,274,990	569,483	48,272	37,279	55,208,210
Massachusetts	4,107,824,432	7,985,640	2,181,495	575,901	176,563,575
Michigan	1,282,048,200	2,321,867	2,063,926	148,488	40,136,200
Minnesota and Nebraska	607,301,433	709,231	70,226	41,453	37,564,567
Missouri	1,570,671,600	2,459,658	5,553,649	121,630	164,663,940
Montana, New Mexico, and Nevada	51,544,983	57,790	....	3,430	6,595,517
New York	4,972,235,850	7,076,743	11,859,944	406,629	213,303,406
North Carolina	33,469,500	41,200	....	2,390	6,751,400
South Carolina	131,690,300	139,559	....	9,193	16,014,700
North Dakota, Utah, and Wyoming	61,922,000	68,950	....	3,680	1,490,900
Ohio	3,963,503,878	6,422,820	12,407,594	339,815	314,511,372
Oregon and Washington	288,227,050	355,275	18,280	23,932	20,362,223
Pennsylvania	2,198,415,696	6,268,805	7,122,014	502,743	97,895,120
Tennessee	530,157,200	717,174	711,041	36,189	7,650,100
Texas	127,489,900	218,943	....	9,162	14,925,700
Virginia and West Virginia	468,117,236	2,822,270	1,051,075	210,841	38,749,737
Total	29,079,073,555	53,171,733	49,490,609	3,377,763	1,685,551,777

Value of gas and by-products produced in the United States in 1902, by States.

States.	Total value of illuminating and fuel gas.	Value of by-products.				Total value of all products.
		Tar.	Ammonia liquor and sulphate of ammonia.	Coke.	Total.	
Alabama and Georgia	$674,149	$117,852	$219,468	$1,085,137	$1,422,457	$2,096,606
Arkansas	126,997	7,400	....	21,526	28,926	155,923
California and Colorado	840,059	44,703	5,888	240,079	290,670	1,130,729
Connecticut and Rhode Island	1,356,621	56,209	5,924	356,929	419,062	1,775,683
Delaware and New Jersey	1,286,895	57,693	14,827	336,491	409,011	1,695,906
Illinois	1,555,396	84,003	15,047	381,071	480,121	2,035,517
Indiana	783,434	39,763	11,772	240,222	291,757	1,075,191
Iowa and Wisconsin	1,480,647	87,223	24,046	439,274	550,543	2,031,190
Kansas	284,173	13,958	....	51,893	65,851	350,024
Kentucky	565,879	33,161	12,389	122,818	168,368	734,247
Louisiana and Mississippi	91,278	3,420	....	12,885	16,305	107,583
Maine, New Hampshire, and Vermont	466,087	21,610	3,144	95,350	120,104	586,191
Maryland and District of Columbia	484,218	18,141	4,799	111,867	134,807	619,025
Massachusetts	2,789,352	239,954	344,149	2,009,889	2,593,992	5,383,344
Michigan	1,290,398	75,290	58,506	620,669	754,465	2,044,863
Minnesota and Nebraska	793,442	26,088	6,579	181,568	214,235	1,007,677
Missouri	1,534,122	107,314	38,378	394,440	540,132	2,074,254
Montana, New Mexico, and Nevada	99,633	5,689	....	19,230	24,919	124,552
New York	5,335,131	204,312	147,383	1,234,840	1,586,535	6,921,666
North Carolina	56,940	2,272	....	11,638	13,910	70,850
South Carolina	198,842	5,027	....	44,129	49,156	247,998
North Dakota, Utah, and Wyoming	102,756	4,623	....	21,600	26,223	128,979
Ohio	3,157,174	251,016	97,832	879,677	1,228,525	4,385,699
Oregon and Washington	483,394	29,607	536	97,523	127,666	611,060
Pennsylvania	2,191,321	190,527	234,958	1,477,774	1,903,259	4,094,580
Tennessee	591,574	27,791	7,925	130,762	166,478	758,052
Texas	214,479	20,842	....	48,581	69,423	283,902
Virginia and West Virginia	508,490	98,478	131,435	599,746	829,659	1,338,149
Total	29,342,881	1,873,966	1,384,985	11,267,608	14,526,559	43,869,440

IMPORTS OF COAL-TAR PRODUCTS.

Comparatively little progress in the manufacture of chemical products from coal tar has been made in this country. Although we are producing over 50,000,000 gallons of coal tar annually, the principal uses made thereof are in the manufacture of roofing paper, the creosoting of lumber, and for the preparation of street-paving material, while at the same time we are importing millions of dollars' worth of chemicals obtained from coal tar as a raw material. The coal tar produced in this country in 1902 was worth at first hand $1,873,966. In the fiscal year ended June 30, 1902, the coal-tar products imported into the United States were worth, at points of shipment, $7,494,340. The duty paid on these imports amounted to $1,594,799, making the total cost, exclusive of freight, other expenses, and jobbers' profits, $9,089,139. In the fiscal year ended June 30, 1903, the value of these imports was $7,690,885, duty $1,692,445, total $9,383,330. A conservative estimate would place the total value of these products in the wholesale markets of this country at $12,000,000 in both 1902 and 1903.

The following table shows the value of the coal-tar products imported into the United States and the duty paid thereon in each fiscal year since 1896, inclusive:

Coal-tar products imported into the United States during the fiscal years 1896–1903.

Fiscal year.	Salicylic.		Alizarine and colors or dyes, natural and artificial.		Aniline salts.		Coal-tar colors or dyes, not specially provided for.	
	Value.	Duty.	Value.	Duty.	Value.	Duty.	Value.	Duty.
1896	$138,013	Free.	$994,395	Free.	$662,459	Free.	$2,918,333	$729,583
1897	201,980	Free.	1,023,425	Free.	812,884	Free.	3,163,182	790,796
1898	28,688	$6,794	886,349	Free.	1,087,704	Free.	3,723,288	1,098,532
1899	57,192	18,536	700,786	Free.	743,130	Free.	3,900,099	1,170,030
1900	89,175	24,069	771,336	Free.	537,812	Free.	4,792,103	1,437,631
1901	76,786	22,227	713,392	Free.	589,535	Free.	4,034,171	1,210,251
1902	57,852	21,913	1,028,327	Free.	631,467	Free.	4,911,668	1,473,500
1903	19,012	7,827	660,464	Free.	789,553	Free.	5,252,611	1,575,783

Fiscal year.	Coal-tar, all preparations, not colors or dyes.		Coal-tar products, not medicinal, not dyes, known as benzol, toluol, etc.		Total.	
	Value.	Duty.	Value.	Duty.	Value.	Duty.
1896	....	....	....	....	$4,713,200	$729,583
1897	....	....	....	....	5,201,471	790,796
1898	$134,416	$26,883	$228,037	Free.	6,088,482	1,132,209
1899	221,101	44,220	393,602	Free.	6,015,910	1,232,786
1900	274,946	54,989	397,780	Free.	6,863,152	1,516,689
1901	342,116	68,423	383,559	Free.	6,139,559	1,300,901
1902	496,928	99,386	368,098	Free.	7,494,340	1,594,799
1903	544,176	108,835	425,069	Free.	7,690,885	1,692,445

PETROLEUM.[a]

By F. H. Oliphant.

[The barrel used in this report, unless otherwise specified, is the United States standard barrel, containing 42 Winchester gallons.]

IMPORTANT FEATURES OF THE YEAR.

The following are the most conspicuous features in the production, sale, and export of crude petroleum and its products in the United States for the year 1902:

(1) The production of crude petroleum was greater than that of any previous year.

(2) The great increase was due principally to the development of an inferior grade of petroleum in Texas, California, and Louisiana.

(3) There was a slight decrease in the production of the Appalachian field and a slight increase in the Lima-Indiana field, caused by the increased production in the State of Indiana.

(4) The general average price paid for the crude produced was less than in any year since 1898, although the average price for the better grades of petroleum produced in the Appalachian and the Lima-Indiana fields was 4 cents greater in 1902 than in 1901.

(5) Stocks held in the Appalachian and Lima-Indiana fields showed a considerable decrease, principally in the Appalachian field.

(6) The amount of refined and crude petroleum exported in 1902 was slightly less than that of 1901. There was an increase in the amount of crude petroleum and residuum exported, a decrease in illuminating petroleum, and an increase in lubricating petroleum. While the quantity of exports of all grades decreased only 1.37 per cent, the value decreased 5.62 per cent. The home consumption has been increasing more rapidly in the last three years than it did in former years.

[a] Credit should be given for much of the statistical information as to the United States in this report to the Oil City Derrick, and to Miss Belle Hill for the careful compilation of most of the tables. Other special acknowledgments are made in the body of the report.

(7) No new pools were discovered in 1902. Indications point to the existence of a new source of petroleum supply in Alaska.

INCREASE IN PRODUCTION OF UNITED STATES.

The total production of crude petroleum in the United States in 1902 was 88,766,916 barrels, being larger than in any previous year. It was larger by 19,377,722 barrels, or 27.92 per cent, than the production of 1901. As compared with the year 1900 it was 39.52 per cent greater. The greatest portion of the increase in 1902 came from Texas and California, the former amounting to 13,690,000 barrels, a gain of 311.6 per cent; the latter to 5,197,938 barrels, a gain of 59.16 per cent, as compared with their respective productions in 1901. The increase in Indiana in 1902 was 1,723,810 barrels, amounting to about 30 per cent, as compared with 1901. As 1902 is the first year in which Louisiana has produced and sold crude petroleum, no comparison can be made; the production amounted to 548,617 barrels. Kansas made a very remarkable record for 1902, as the increase in production was 152,598 barrels, or about 85 per cent. Kentucky and Tennessee increased their production in 1902 by 48,072 barrels, or 35.02 per cent, Indian Territory increased 27,000 barrels, and Wyoming 853 barrels, as compared with 1901.

The largest decrease in production in 1902 as compared with 1901 was in West Virginia, where it amounted to 663,781 barrels, or 4.68 per cent. Ohio in its two fields showed a decrease of 633,852 barrels, a decline of 2.93 per cent. Pennsylvania showed a decrease of 561,498 barrels, or 4.45 per cent. In New York the decrease was 86,888 barrels, or 7.2 per cent. Colorado showed a decrease of 63,619 barrels, or 13.81 per cent.

The quality of the petroleum produced in Texas, Louisiana, and California is generally much inferior to that produced in the Appalachian and the Lima-Indiana fields, as the quantity of naphtha and of illuminating and lubricating petroleum secured is much less. The greater portion of it is valuable as fuel in its natural state, or after a part of the more volatile constituents have been removed; it is particularly acceptable as such in the Southwest and West, where coal has to be transported many miles.

PERCENTAGES OF PRODUCTION, BY FIELDS.

The following table (p. 11) shows the percentages of production in the Appalachian, Lima-Indiana, and all of the other fields combined for the years 1896 to 1902, inclusive.

Percentages of total crude petroleum produced in the several fields, 1896-1902.

Field.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Appalachian	55.73	58.26	57.29	57.94	57.05	48.45	36.07
Lima-Indiana	41.43	37.71	36.70	35.44	34.20	31.61	26.31
All other	2.84	4.03	6.01	6.62	8.75	19.94	37.62
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

An inspection of the above table reveals the fact that for the last three years there has been a constant decline in the proportionate production of crude petroleum in the Appalachian and Lima-Indiana fields, and a very rapid increase in the production of the fields yielding lower grade or fuel oils. In 1899 only 6.62 per cent was produced outside of these two older fields; in 1902 the outside production was 37.62 per cent. Of the 37.62 per cent credited in the above table to all other fields, California produced about 15.75 per cent and Texas 20.37 per cent, leaving only about 1.5 per cent for the remainder of the sections outside the Pennsylvania and Lima-Indiana fields.

The production in the States of Texas, Louisiana, and California of an inferior grade of petroleum in large quantities required for its consumption new markets and new conditions of transportation that were unknown to the older fields, and demanded a large amount of capital to be suddenly invested in tanks, pipe lines, tank cars, and tank vessels. The markets and transportation for this new production have been secured to a very large extent, and most of the problems connected with its production and transportation have been solved. During the last year its consumption for fuel purposes and as an enricher of manufactured gas has been very largely increased.

DECREASE IN PRICE, BUT INCREASE IN TOTAL VALUE.

The average price paid for all of the crude petroleum marketed in the United States in 1902 was 80.19 cents per barrel, as compared with 95.7 cents in 1901, a decrease of 15.51 cents per barrel, or 16 per cent. The gross amount received for the total product in 1902 was only $4,761,575 greater than that received in 1901, although the increase in output was 27.92 per cent greater. This was due to the large increase in the quantities of the cheaper grades of petroleum, which were marketed mostly as a fuel oil and at lower prices.

The average price paid for what is known as Pennsylvania petroleum, which is nearly 95 per cent of the production of the Appalachian field, was $1.254 in 1902 as compared with $1.21 in 1901, a gain of 4.4 cents per barrel. There was also a gain of nearly 4 cents per barrel in the price paid for the Lima-Indiana petroleum in 1902 over that of 1901. On the other hand, the price paid for California petroleum in 1902 decreased 21.8 cents per barrel as compared with 1901. The price of Texas petroleum decreased from 28.4 cents per barrel in 1901 to 22.11

cents in 1902, or 6.29 cents per barrel. The value of Texas petroleum in 1902 was the lowest quoted in the markets, while as high as $10.85 per barrel was the value quoted for a very limited production of a superior lubricating petroleum produced in Mecca, Ohio.

INCREASE IN NUMBER OF WELLS DRILLED.

The total number of wells drilled in the Appalachian and the Lima-Indiana fields in 1902 was 14,182. Of this number 2,856 were dry or failed to find petroleum in paying quantities, leaving 11,326 as the number of productive wells as compared with 9,912 productive wells completed in 1901. The proportion of productive wells to dry holes was as 80 to 20 in 1902, as compared with 78 to 22 in 1901.

The total number of wells completed in the United States in 1902 is not far from 15,800. Of this number 12,640 were productive wells.

At an average cost of $1,500 each, these wells represent an investment of $23,700,000, or about 34 per cent of the gross receipts for all the petroleum produced in 1902.

DECREASE IN EXPORTS.

The exports of petroleum and its products exceeded one billion gallons in 1902 for the second time in the history of the industry; the first time was in the year 1901. The number of gallons exported in 1902 was 1,064,233,601, not quite so large as in 1901, when the exports amounted to 1,079,074,519 gallons; the value of the petroleum exports in 1902 was $68,597,143, as compared with $72,784,912 in 1901—a decrease of 1.37 per cent in quantity and of about 5.62 per cent in value.

While the quantity of naphtha and illuminating petroleum shows a decline in 1902 as compared with 1901, all of the other export products, including lubricating petroleum, crude, and residuum, show a gain. The gain in American lubricating petroleum is marked, and its superior qualities are becoming more generally recognized in many of the foreign markets.

NO NEW POOLS DISCOVERED.

The work of the year 1902 was generally confined to the development of the known pools, as no new ones of any importance were developed. The Sour Lake pool, in Texas, was considerably enlarged, as was the Jennings pool, in Louisiana.

There was a large amount of new work and some extensions were developed in the Lima-Indiana field in Indiana, generally in those localities where the natural gas had been exhausted.

Toward the close of 1902 an important well was completed in Alaska, near Controller Bay, which may be the forerunner of a new development in that far-off region.

In the body of this report detailed conditions of the petroleum industry for 1902 are more fully set forth under separate headings.

PRODUCTION AND VALUE.

PRODUCTION BY STATES AND FIELDS.

In the following table is given a statement of the total quantity and the total value of all crude petroleum produced in the United States in 1901 and 1902, by States and important districts:

Total quantity and value of crude petroleum produced in the United States and average price per barrel in 1901 and 1902.

State and district.	1901.			1902.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
	Barrels.			*Barrels.*		
California	8,786,330	$4,974,540	$0.566	13,984,268	$4,873,617	$0.348
Colorado	460,520	461,031	1.00	396,901	484,683	1.22
Illinois	250	1,250	5.00	200	1,000	5.00
Indiana	5,757,086	4,822,826	.8377	7,480,896	6,526,622	.872
Indian Territory	10,000	7,125	.7125	37,000	32,190	.87
Kansas	179,151	154,373	.862	331,749	292,464	.88
Kentucky and Tennessee	137,259	111,527	.813	185,331	141,044	.76
Louisiana	....	....	....	548,617	188,985	.344
Michigan, Missouri, Oklahoma Territory	2,335	2,600	1.1135	857	1,816	2.12
New York	1,206,618	1,460,008	1.21	1,119,730	1,530,852	1.367
Ohio:						
Eastern and southern	5,470,850	6,619,342	1.21	5,136,366	6,471,821	1.26
Lima	16,176,293	13,911,612	.86	15,877,730	14,284,072	.899
Mecca-Belden	940	2,617	2.78	135	1,466	10.86
Total	21,648,083	20,533,571	.948	21,014,231	20,757,359	.988
Pennsylvania:						
Franklin	55,162	220,648	4.00	50,555	199,432	3.945
Pennsylvania	12,568,806	15,208,255	1.21	12,012,125	15,064,861	1.254
Smiths Ferry	1,410	1,706	1.21	1,200	1,800	1.50
Total	12,625,378	15,430,609	1.222	12,063,880	15,266,093	1.265
Texas	4,393,658	1,247,351	.284	18,083,658	3,998,097	.2211
West Virginia:						
West Virginia	14,164,662	17,139,241	1.21	13,498,685	17,006,469	1.26−
Petroleum, Volcano	[a] 12,464	33,483	2.687	[a] 14,660	33,848	2.309
Total	14,177,126	17,172,724	1.211	13,513,345	17,040,317	1.261
Wyoming	5,400	37,800	7.00	6,253	43,771	7.00
Grand total	69,389,194	66,417,335	.957+	[b] 88,766,916	71,178,910	.8019

[a] Production of light oil in Petroleum included with West Virginia's production.
Production of light oil in Volcano included with West Virginia's production.

[b] In addition to this quantity, 76,538 barrels were produced in Kentucky, valued at $41,353, 489 barrels in Missouri, valued at $842, and 431,359 barrels in Texas, valued at $176,634, which were tanked and unsold by the producing companies. The total quantity produced but not sold in 1902 was 508,386 barrels, valued at $218,829; the total production in 1902, marketed and unmarketed, was therefore 89,275,302 barrels, valued at $71,397,739.

The increase or decrease in the production by States, as well as the percentages of increase or decrease in 1902 compared with 1901, are shown in the following table:

Total production of crude petroleum and percentage of increase or decrease, by States, in 1902, as compared with 1901.

State.	Production.		Increase.	Decrease.	Percentage.	
	1901.	1902.			Increase.	Decrease.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Per cent.*	*Per cent.*
California	8,786,330	13,984,268	5,197,938		59.16	
Colorado	460,520	396,901		63,619		13.81
Illinois	250	200		50		20.00
Indiana	5,757,086	7,480,896	1,723,810		29.94	
Indian Territory	10,000	37,000	27,000		270.00	
Kansas	179,151	331,749	152,598		85.18	
Kentucky and Tennessee	137,259	185,331	48,072		35.02	
Louisiana		548,617	548,617			
Michigan, Missouri, Oklahoma Territory	2,335	857		1,478		63.29
New York	1,206,618	1,119,730		86,888		7.20
Ohio	21,648,083	21,014,231		633,852		2.93
Pennsylvania	12,625,378	12,063,880		561,498		4.45
Texas	4,393,658	18,083,658	13,690,000		311.60	
West Virginia	14,177,126	13,513,345		663,781		4.68
Wyoming	5,400	6,253	853		15.74	
Total	69,389,194	88,766,916	19,377,722		27.92	

Louisiana for the first time appears in the two preceding tables, although the pool was opened up toward the close of 1901; but no ales and deliveries were made during that year, hence there is no statement of the production in 1901.

The State of Texas leads in increased production, closely followed by California.

The State of Colorado decreased 63,619 barrels in 1902, after showing a gain of 143,135 barrels in 1901.

Of the States in the older fields, Indiana is conspicuous by making a gain of 1,723,810 barrels in its output of Trenton-rock oil, which more than offset the decline in the yield of the same grade of oil in northwestern Ohio.

Indian Territory and Kansas are properly in the same field, and both show large gains, amounting taken together to nearly 95 per cent in 1902 as compared with 1901. Kentucky and Tennessee are also conspicuous for their increased production, which amounts to 48,072 barrels, or 35.02 per cent. Wyoming also shows a slight increase.

The State of New York has been declining in production for the last two years, and the percentages for 1901 and 1902 are almost the same.

Ohio, with two fields, one in the Lima-Indiana and the other in the Appalachian region, shows a slight decline, which was heaviest in the latter field. The entire decrease, however, was less than 3 per cent.

Pennsylvania did remarkably well in the old producing fields, no new pools being found. The decrease was only 4.45 per cent in 1902 as compared with 1901, while there was 4.77 per cent of a decrease in the comparison of 1901 with the year 1900. The decrease of 4.68 per cent in the production of West Virginia in 1902, as compared with 1901, is rather a surprise, when the extent of comparatively new area drilled over is considered. It is much better, however, than the decrease of 12.46 per cent which was recorded for 1901.

The regularity of the production for the last six years in the Appalachian and the Lima-Indiana fields is remarkable. The combined production of these two fields is still more remarkable. Given in the nearest million barrels, the quantity appears as follows: In 1897, 58 millions; in 1898, 53; in 1899, 53; in 1900, 58; in 1901, $55\frac{1}{2}$; in 1902, $57\frac{1}{3}$.

These figures illustrate the remarkable "staying qualities" of large areas of productive territory after production has settled down to the regular drainage of the oil-bearing sand, and when the gushers have ceased to contribute any large quantities of new production to the general yield.

The following table shows the order of production of the several States of the United States, the quantity produced by each, and their percentages of the whole in 1902:

Rank of petroleum-producing States and Territories, with quantity produced and percentage of each, in 1902.

State.	Quantity.	Percentage.	State.	Quantity.	Percentage.
	Barrels.			*Barrels.*	
Ohio	21,014,231	23.67	Kansas	331,749	0.38
Texas	18,083,658	20.37	Kentucky and Tennessee	185,331	.21
California	13,984,268	15.75	Indian Territory	37,000	
West Virginia	13,513,345	15.23	Wyoming	6,253	
Pennsylvania	12,063,880	13.59	Michigan, Missouri, and Oklahoma	857	.05
Indiana	7,480,896	8.42	Illinois	200	
New York	1,119,730	1.26			
Louisiana	548,617	.62	Total	88,766,916	100.00
Colorado	396,901	.45			

The production of petroleum in the principal fields of the United States from 1897 to 1902, inclusive, was as follows:

Production of petroleum in the United States, 1897–1902, by fields.

[Barrels of 42 gallons.]

Field.	1897.	1898.	1899.	1900.	1901.	1902.
Appalachian	35,230,271	31,717,425	33,068,356	36,295,433	33,618,171	32,018,787
Lima-Indiana	22,805,033	20,321,323	20,225,356	21,758,750	21,933,379	23,358,626
Southern California	1,903,411	2,257,207	2,642,095	4,324,484	8,786,330	13,984,268
Colorado	384,934	444,383	390,278	317,385	460,520	396,901
Kansas	81,098	71,980	69,700	74,714	179,151	331,749
Texas	65,975	546,070	669,013	836,039	4,393,658	18,083,658
Wyoming	3,650	5,475	5,560	5,450	5,400	6,253
Louisiana	....	....	....	....	....	548,617
Other	1,144	370	492	8,274	12,585	38,057
Total	[a]60,475,516	[a]55,364,233	[a]57,070,850	[b]63,620,529	69,389,194	88,766,916

[a] In addition to this amount, 4,377 barrels of crude oil were produced in Kentucky and Tennessee in 1897, 19,125 barrels in 1898, and 13,578 barrels in 1899, for which, as none was sold or used, no value could be given.

[b] Includes 41,405 barrels of oil sold in Kentucky and Tennessee in 1900 but produced in previous years.

Petroleum and natural gas combined rank next to pig iron and coal in the list of values of the crude mineral products of the United States in 1902, as is shown in the following table:

Value of the petroleum and natural gas produced in 1902 and their combined value, by States and Territories.

State or Territory.	Value of petroleum.	Value of natural gas.	Value of petroleum and natural gas.
Pennsylvania	$15,266,093	$14,352,223	$29,618,316
Ohio	20,757,359	2,355,308	23,112,667
West Virginia	17,040,317	5,390,181	22,430,498
Indiana	6,526,622	7,081,344	13,607,966
California	4,873,617	120,648	4,994,265
Texas	3,998,097	14,953	4,013,050
New York	1,530,852	346,431	1,877,283
Kansas	292,464	824,431	1,116,895
Colorado	484,683	1,900	486,583
Kentucky and Tennessee	141,044	365,611	506,655
Louisiana	188,985	....	188,985
Wyoming	43,771	....	43,771
Indian Territory	32,190	360	32,550
South Dakota	....	10,280	10,280
Michigan, Missouri, and Oklahoma	1,816	2,154	3,970
Illinois	1,000	1,844	2,844
Total	71,178,910	30,867,668	102,046,578

PRODUCTION OF CRUDE PETROLEUM IN UNITED STATES FROM 1859 TO 1902, INCLUSIVE.

In the following table will be found a statement of the production of crude petroleum in the United States from the beginning of production, marked by the drilling of the Colonel Drake well in 1859, up to and including the production of 1902, the table being by years and States:

Production of crude petroleum in the United States, 1859–1902, by years and by States.

[Barrels of 42 gallons.]

Year.	Pennsylvania and New York.	Ohio.	West Virginia.	California.	Kentucky and Tennessee.	Colorado.	Indiana.
1859	2,000						
1860	500,000						
1861	2,113,609						
1862	3,056,690						
1863	2,611,309						
1864	2,116,109						
1865	2,497,700						
1866	3,597,700						
1867	3,347,300						
1868	3,646,117						
1869	4,215,000						
1870	5,260,745						
1871	5,205,234						
1872	6,293,194						
1873	9,893,786						
1874	10,926,945						
1875	8,787,514	[a]200,000	[a]3,000,000	[a]175,000			
1876	8,968,906	31,763	120,000	12,000			
1877	13,135,475	29,888	172,000	13,000			
1878	15,163,462	38,179	180,000	15,227			
1879	19,685,176	29,112	180,000	19,858			
1880	26,027,631	38,940	179,000	40,552			
1881	27,376,509	33,867	151,000	99,862			
1882	30,053,500	39,761	128,000	128,636	[b]160,933		
1883	23,128,389	47,632	126,000	142,857	4,755		
1884	23,772,209	90,081	90,000	262,000	4,148		
1885	20,776,041	661,580	91,000	325,000	5,164		
1886	25,798,000	1,782,970	102,000	377,145	4,726		
1887	22,356,193	5,022,632	145,000	678,572	4,791	76,295	
1888	16,488,668	10,010,868	119,448	690,333	5,096	297,612	
1889	21,487,435	12,471,466	544,113	303,220	5,400	316,476	33,375
1890	28,458,208	16,124,656	492,578	307,360	6,000	368,842	63,496
1891	33,009,236	17,740,301	2,406,218	323,600	9,000	665,482	136,634
1892	28,422,377	16,362,921	3,810,086	385,049	6,500	824,000	698,068
1893	20,314,513	16,249,769	8,445,412	470,179	3,000	594,390	2,335,293
1894	19,019,990	16,792,154	8,577,624	705,969	1,500	515,746	3,688,666
1895	19,144,390	19,545,233	8,120,125	1,208,482	1,500	438,232	4,386,132
1896	20,584,421	23,941,169	10,019,770	1,252,777	1,680	361,450	4,680,732
1897	19,262,066	21,560,515	13,090,045	1,903,411	322	384,934	4,122,356
1898	15,948,464	18,738,708	13,615,101	2,257,207	5,568	444,383	3,730,907
1899	14,374,512	21,142,108	13,910,630	2,642,095	18,280	390,278	3,848,182
1900	14,559,127	22,362,730	16,195,675	4,324,484	62,259	317,385	4,874,392
1901	13,831,996	21,648,083	14,177,126	8,786,330	137,259	460,520	5,757,086
1902	13,183,610	21,014,231	13,513,345	13,984,268	185,331	396,901	7,480,896
Total	628,401,456	283,751,317	131,701,296	41,834,473	633,212	6,852,926	45,836,215

[a] Includes all production prior to 1876.
[b] Includes all petroleum produced in Kentucky and Tennessee prior to 1883.

Production of crude petroleum in the United States, 1859–1902, by years and by States—Continued.

Year.	Illinois.	Kansas.	Texas.	Missouri.	Indian Territory.	Wyoming.	Louisiana.	United States.
1859								2,000
1860								500,000
1861								2,113,609
1862								[a] 3,056,690
1863								2,611,309
1864								2,116,109
1865								2,497,700
1866								3,597,700
1867								3,347,300
1868								3,646,117
1869								4,215,000
1870								5,260,745
1871								5,205,234
1872								6,293,194
1873								9,893,786
1874								10,926,945
1875								[b] 12,162,514
1876								9,132,669
1877								13,350,363
1878								15,396,868
1879								19,914,146
1880								26,286,123
1881								27,661,238
1882								30,510,830
1883								23,449,633
1884								24,218,438
1885								21,858,785
1886								28,064,841
1887								28,283,483
1888								27,612,025
1889	1,460	500	48	20				35,163,513
1890	900	1,200	54	278				45,823,572
1891	675	1,400	54	25	30			54,292,655
1892	521		45	10	80			50,509,657
1893	400	18,000	50	50	10			48,431,066
1894	300	40,000	60	8	130	2,369		49,344,516
1895	200	44,430	50	10	37	3,455		52,892,276
1896	250	113,571	1,450	43	170	2,878		[c] 60,960,361
1897	500	81,098	65,975	19	625	3,650		[c] 60,475,516
1898	360	71,980	546,070	10		5,475		[c] 55,364,233
1899	360	69,700	669,013	[b] 132		5,560		[c] 57,070,850
1900	200	74,714	836,039	[d] 1,602	6,472	5,450		63,620,529
1901	250	179,151	4,393,658	[e] 2,335	10,000	5,400		69,389,194
1902	200	331,749	18,083,658	[e] 857	37,000	6,253	548 617	88,766,916
Total	6,576	1,027,493	24,596,224	5,399	54,554	40,490	548,617	1,165,290,248

[a] In addition to this quantity, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 in the Pennsylvania fields; also a large quantity in West Virginia and Tennessee.

[b] Includes all production prior to 1876 in Ohio, West Virginia, and California.

[c] In addition to this quantity, 4,325 barrels of crude oil were produced in Kentucky and Tennessee in 1896, 4,377 barrels in 1897, 19,125 barrels in 1898, and 13,578 barrels in 1899, for which, as none was sold or used, no value could be given.

[d] Includes the production of Michigan.

[e] Includes production of Michigan and small production in Oklahoma Territory.

The total output of crude petroleum since it was first discovered in quantity in 1859 by Colonel Drake on the waters of Oil Creek, near Titusville, Pa., to the end of 1902, amounted to 1,165,290,248 barrels. Allowing 5.6 cubic feet for 1 barrel, this quantity of petroleum would occupy 6,525,625,389 cubic feet of space, which would require a cube 1,868½ feet on each side to contain it. It would fill a tank, whose base is one mile square, to a height of 234 feet. It would likewise fill 38,843 tanks containing 30,000 barrels each. Allowing 90 feet for the diameter of tanks of this size, if they were placed so that their sides would touch, they would reach a distance of 662 miles; or again, if 2½ feet be allowed for the height of a barrel, and if these barrels filled with all the domestic oil that has been produced were laid so that their heads would touch, they would encircle the earth 2.28 times. If we estimate 3½ barrels of petroleum as equal to 1 ton of average coal, we have a fuel equivalent represented by 332,940,071 tons of coal.

Of the grand total of the crude petroleum produced in the United States from the beginning in 1859 to the end of 1902, Pennsylvania and New York produced 53.9 per cent, Ohio 24.3 per cent, West Virginia 11.3 per cent, Indiana 3.9 per cent, California 3.6 per cent, Texas 2.1 per cent, leaving .9 per cent to be supplied by the States of Kansas, Colorado, Louisiana, Illinois, Missouri, Indian Territory, Wyoming, Michigan, and Oklahoma Territory.

DECREASE IN APPALACHIAN FIELD.

This field embraces all the districts producing what is popularly known as "Pennsylvania oil." It extends from Wellsville, in New York State, on the northeast, down through western Pennsylvania into West Virginia, includes a large portion of southeastern Ohio, and extends across the States of Kentucky and Tennessee into Alabama. The production in Kentucky is becoming more important each year. That of Tennessee has remained almost stationary for the last ten years, being confined to one locality near its northern border. Alabama has not yet produced any merchantable amount of petroleum. For the last two years all of the States in this field have shown a decreased production, except Kentucky and Tennessee, whose production, due principally to the former, is combined. In 1901 the decline was heaviest in West Virginia; in 1902 it was heaviest in New York. The total decrease in all of the States producing in the Appalachian field in 1902 was only 1,599,384 barrels, or 4.76 per cent. as compared with 2,677,262 barrels, or 7.37 per cent, in 1901.

The following table gives the production of the Appalachian States in 1901 and 1902, with the percentage of their increase or decrease. A part of the production in Ohio comes from another field, known as the Lima-Indiana field, but is not included in this table:

Production of petroleum in the Appalachian field in 1901 and 1902, by States, showing increase or decrease.

State.	Production.		Increase.	Decrease.	Percentage.	
	1901.	1902.			Increase.	Decrease.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Per cent.*	*Per cent.*
New York	1,206,618	1,119,730	....	86,888	....	7.20
Pennsylvania	12,625,378	12,063,880	....	561,498	....	4.45
West Virginia	14,177,126	13,513,345	....	663,781	....	4.68
Southeastern Ohio	5,471,790	5,136,501	....	335,289	....	6.13
Kentucky and Tennessee	137,259	185,331	48,072	....	35.02	....
Total	33,618,171	32,018,787	....	1,599,384	....	4.76

INCREASE IN LIMA-INDIANA FIELD.

This field embraces a portion of northwestern Ohio and central Indiana. The petroleum in this field comes from the Trenton limestone and carries a small percentage of sulphur. The petroleum from the Appalachian field is found almost entirely in sandstone, and is generally known as "white-sand oil;" it is free from sulphur, produces a larger percentage of illuminating oil, and is more easily refined. There was a decrease in 1902 in the production in that portion of this field lying in Ohio, which was more than offset by the increased production in Indiana. The net increase amounted to 1,425,247 barrels, or about 6.5 per cent.

The increase in this field was slightly less than the decrease in the Appalachian field. Combining the two there was a deficiency of only 174,137 barrels in the aggregate output of the Lima-Indiana and the Appalachian fields in 1902 as compared with 1901.

Production of petroleum in the Lima-Indiana field in 1901 and 1902.

State.	Production.		Increase.	Decrease.	Percentage.	
	1901.	1902.			Increase.	Decrease.
	Barrels.	*Barrels.*				
Ohio	16,176,293	15,877,730	....	298,563	....	1.845
Indiana	5,757,086	7,480,896	1,723,810	....	29.94	....
Total	21,933,379	23,358,626	1,425,247	....	6.498	....

WELLS AND STOCKS IN APPALACHIAN AND LIMA-INDIANA FIELDS.

In the following tables are shown the number of wells completed and of dry holes in the Appalachian and Lima-Indiana fields for the years 1901 and 1902:

Number of wells completed and of dry holes in the Appalachian and Lima-Indiana fields in 1901 and 1902.

1901.

Month.	Appalachian.		Lima-Indiana.		Total both fields.	
	Completed.	Dry.	Completed.	Dry.	Completed.	Dry.
January	589	167	340	35	929	202
February	506	160	268	23	774	183
March	479	134	261	45	740	179
April	589	172	381	47	970	219
May	673	167	451	59	1,124	226
June	692	186	453	61	1,145	247
July	655	183	421	46	1.076	229
August	727	200	416	51	1,143	251
September	729	214	479	53	1,208	267
October	712	175	514	63	1,226	238
November	766	215	541	61	1,307	276
December	592	145	386	46	978	191
Total	7,709	2,118	4,911	590	12,620	2,708

1902.

Month.	Appalachian.		Lima-Indiana.		Total both fields.	
	Completed.	Dry.	Completed.	Dry.	Completed.	Dry.
January	582	169	436	58	1,018	227
February	455	132	325	44	780	176
March	514	158	411	44	925	202
April	579	186	418	46	997	232
May	648	161	547	60	1,195	221
June	745	214	656	81	1,401	295
July	685	166	614	55	1,299	221
August	725	149	638	65	1,363	214
September	730	194	650	78	1,380	272
October	713	176	627	84	1,340	260
November	729	209	648	64	1,377	273
December	617	217	490	46	1,107	263
Total	7,722	2,131	6,460	725	14,182	2,856

Although it is shown in the preceding tables that there was a slight decrease in the production of the two fields in 1902 as compared with 1901, the number of wells completed increased from 12,620 in 1901 to 14,182 in 1902. This increase occurred almost entirely in the Lima-Indiana field, which showed a gain of 1,547 wells over the previous year, while the increase in the Appalachian region was only 13. The productive wells in both these fields in 1902 was 80 per cent of the total number drilled. as compared with 78.6 per cent in 1901 and 80.6 per cent in 1900. The total number of wells operated in 1902 is placed at 118,500.

The combined stocks at the close of 1902 of the Appalachian and the Lima-Indiana fields showed a decrease of 4,347,648 barrels as compared with the quantity in stock at the close of 1901. The decrease was principally in the Appalachian field. The stock held in the Lima-Indiana field was only 453,880 barrels less at the close of 1902 than at the close of 1901. The gross amount of stocks in both fields at the close of 1902 was very nearly the same as that of 1899, as will be seen in the following table:

Stocks of petroleum held by pipe lines at close of 1899, 1900, 1901, and 1902 in the Appalachian and Lima-Indiana fields.

[Barrels of 42 gallons.]

	1899.	1900.	1901.	1902.
National Transit Co	7,615,626	8,174,506	5,069,782	1,456,556
Southwest Pennsylvania Pipe Line Co	1,560,443	1,368,892	865,477	505,270
Eureka Pipe Line Co	1,593,080	1,401,201	1,465,606	1,440,810
Buckeye Pipe Line Co. (Macksburg oil)	674,583	591,899	476,491	606,492
Cumberland Pipe Line Co	....	....	128,574	279,493
Southern Pipe Line Co	396,256	471,599	391,892	326,448
Crescent Pipe Line Co	73,633	103,808	126,052	87,822
New York Transit Co	756,120	533,030	330,666	184,804
Tidewater Pipe Co	294,265	334,308	345,643	418,564
Producers and Refiners' Oil Co	140,966	148,769	139,868	283,154
Elk Oil Co	597	595	628	2,093
Emery Pipe Line Co	25,102	20,252	22,470	25,483
United States Pipe Line Co	33,148	25,857	57,271	82,198
Other lines	287,372	300,832	215,072	42,497
Total stocks Appalachian field	13,451,191	13,475,548	9,635,492	5,741,624
Total Lima-Indiana stocks	10,545,927	14,988,928	17,760,306	17,306,426
Total both fields	23,997,118	28,464,476	27,395,798	23,048,050

EXPORTS.

The following tables are the official statement of the Bureau of Statistics of the quantity and value of petroleum and its products (mineral oils) exported from the ports and districts in the United States for the year ending December 31, 1902, as compared with the preceding year:

Exports of mineral oils from the United States in 1901 and 1902.

Port and kind.	1901.		1902.	
CRUDE.	*Gallons.*		*Gallons.*	
Delaware	93,061,901	$4,434,836	98,306,742	$4,768,012
New York	2,559,109	184,444	499,616	28,898
Philadelphia	29,027,920	1,395,854	26,837,777	1,382,816
Galveston	2,276,787	20,061	18,430,353	109,326
Other districts	82,285	2,349	1,159,235	41,959
Total	127,008,002	6,037,544	145,233,723	6,331,011

Exports of mineral oils from the United States in 1901 and 1902—Continued.

Port and kind.	1901.		1902.	
NAPHTHA.	*Gallons.*		*Gallons.*	
Boston and Charlestown	1,752	$346		
Delaware	1,290	168		
New York	11,724,631	1,140,450	10,598,990	$945,247
Philadelphia	8,986,200	504,019	7,152,106	290,458
Galveston	2,098	277	297,174	4,275
Other districts	968,763	96,287	1,634,367	152,791
Total	21,684,734	1,741,547	19,682,637	1,392,771
ILLUMINATING.				
Baltimore	39,479,316	2,774,106	40,426,380	2,812,779
Boston and Charlestown	495,900	49,053	594,132	57,329
Delaware	1,500	133	6,000	519
New York	526,294,414	35,236,879	459,963,722	30,522,742
Philadelphia	251,104,714	14,655,485	262,096,870	14,619,604
Galveston	100	15	2,824,883	81,778
Other districts	10,103,549	775,042	12,888,991	984,304
Total	827,479,493	53,490,713	778,800,978	49,079,055
LUBRICATING AND PARAFFIN.				
Baltimore	711,817	95,993	1,143,772	135,297
Boston and Charlestown	146,317	25,295	127,727	22,454
New York	53,082,986	7,786,256	54,028,524	8,128,534
Philadelphia	19,090,007	1,970,680	24,633,086	2,170,108
Galveston	50	16		
Other districts	2,274,761	381,885	2,267,394	415,761
Total	75,305,938	10,260,125	82,200,503	10,872,154
RESIDUUM.				
Boston and Charlestown	36,440	1,830	11,550	1,018
New York	10,444,350	500,779	9,013,116	241,757
Philadelphia	16,499,742	722,518	23,865,428	619,527
Galveston	84	10	5,114,465	46,270
Other districts	615,736	29,846	311,201	13,580
Total	27,596,352	1,254,983	38,315,760	922,152
Grand total	1,079,074,519	72,784,912	1,064,233,601	68,597,143

RECAPITULATION BY KINDS.

Crude petroleum	127,008,002	6,037,544	145,233,723	6,331,011
Naphtha	21,684,734	1,741,547	19,682,637	1,392,771
Illuminating oil	827,479,493	53,490,713	778,800,978	49,079,055
Lubricating oil and paraffin	75,305,938	10,260,125	82,200,503	10,872,154
Residuum	27,596,352	1,254,983	38,315,760	922,152
Total	1,079,074,519	72,784,912	1,064,233,601	68,597,143

RECAPITULATION BY PORTS.

Baltimore	40,191,133	2,870,099	41,570,152	2,948,076
Boston and Charlestown	680,409	76,524	733,409	80,801
Delaware	93,064,691	4,435,137	98,312,742	4,768,531
New York	604,105,490	44,848,808	534,103,968	39,867,178
Philadelphia	324,708,583	19,248,556	344,585,267	19,082,513
Galveston	2,279,119	20,379	26,666,875	241,649
Other districts	14,045,094	1,285,409	18,261,188	1,608,395
Grand total	1,079,074,519	72,784,912	1,064,233,601	68,597,143

It will be seen that the exports of petroleum and its products in 1902 were 1,064,233,601 gallons, which is 14,840,918 gallons less than the number of gallons exported in 1901. New York continues to be the leading port of export. Philadelphia is second, and has been gradually gaining on the metropolis.

Of the total quantity exported, 56 per cent was loaded at New York, 30 per cent at Philadelphia, 8.6 per cent at ports in Delaware, 3.7 per cent at Baltimore, leaving about 1.7 per cent to be supplied by Boston and Charlestown, Galveston, and other districts. The great demand for American petroleum and its products, at home and abroad, attests their superiority and plainly shows that the product of no other country can compete with ours as a universal illuminant and lubricant.

Exports of mineral oils from the United States, 1887–1902.

[Gallons.]

Year.	Crude.	Naphtha.	Illuminating.	Lubricating and paraffin.	Residuum.	Total.	
						Quantity.	Value.
1887	80,643,839	12,344,669	464,702,903	20,340,820	2,989,098	581,021,329	$45,231,988
1888	77,387,799	13,466,234	450,801,683	24,280,826	1,861,104	567,797,646	47,563,749
1889	84,144,196	13,958,985	548,496,241	27,754,239	1,837,794	676,191,455	52,792,473
1890	95,368,525	12,406,586	547,542,569	31,896,146	1,828,900	689,042,726	51,657,302
1891	94,926,424	11,398,085	526,972,018	33,068,716	932,692	667,297,935	45,351,957
1892	104,012,829	16,351,340	586,406,366	33,805,128	329,574	740,905,237	42,283,163
1893	114,609,343	16,249,389	705,674,917	34,762,754	460,614	871,757,017	41,117,814
1894	114,268,611	14,831,967	726,726,687	38,975,128	59,766	894,862,159	40,463,088
1895	115,954,128	12,757,940	677,500,647	46,769,565	143,850	853,126,130	56,223,425
1896	117,921,276	13,420,769	749,305,844	50,629,143	507,990	931,785,022	62,764,278
1897	121,488,726	13,430,320	795,919,525	51,228,284	12,230,902	994,297,757	59,057,547
1898	114,915,082	17,026,626	761,152,107	63,968,341	29,418,454	986,480,610	52,551,048
1899	117,683,967	17,904,015	724,562,993	69,329,188	21,544,278	951,024,441	64,982,249
1900	137,501,160	18,262,744	730,585,487	68,997,715	19,776,370	975,123,476	73,276,282
1901	127,008,002	21,684,734	827,479,493	75,305,938	27,596,352	1,079,074,519	72,784,912
1902	145,233,723	19,682,637	778,800,978	82,200,503	38,315,760	1,064,233,601	68,597,143

This table indicates the remarkably steady and growing trade in the export of crude petroleum for a series of years, that of 1901 and 1902 being unusually large. Comparing the separate exports for the years 1901 and 1902 there is a considerable falling off in the naphtha and illuminating products in 1902, and an increase in the amount of crude, lubricating, and residuum products. The quantity of crude produced in the Appalachian and the Lima-Indiana fields combined from which the exports are chiefly derived, also continues with remarkable regularity. The great increase in the crude production is in the fields of the Southwest and West, of which at present only a comparatively small amount is converted into the finer grades. There were, however, 18,430,353 gallons of crude exported from Texas ports during the year 1902, amounting to nearly 13 per cent of the total crude exported from all ports.

Exports of mineral oil from the United States in years 1899–1902, by months.

Month.	1899.		1900.	
	Gallons.		*Gallons.*	
January	62, 385, 776	$3, 817, 129	75, 338, 676	$6, 339, 185
February	51, 759, 280	3, 403, 331	64, 291, 406	5, 507, 351
March	85, 273, 703	5, 291, 534	75, 095, 173	6, 494, 982
April	66, 873, 657	4, 267, 075	68, 346, 204	6, 035, 136
May	87, 216, 379	5, 210, 928	83, 872, 727	6, 744, 936
June	87, 214, 749	5, 481, 991	79, 031, 621	5, 772, 984
July	81, 171, 542	5, 245, 519	89, 688, 610	6, 266, 480
August	100, 220, 318	6, 565, 691	102, 998, 938	7, 303, 116
September	92, 676, 402	7, 007, 626	90, 605, 804	6, 440, 542
October	86, 562, 810	6, 583, 145	92, 141, 804	6, 109, 079
November	83, 678, 752	6, 632, 253	75, 243, 820	5, 134, 598
December	65, 991, 073	5, 476, 027	78, 468, 693	5, 127, 893
Total 12 months	951, 024, 441	64, 982, 249	975, 123, 476	73, 276, 282

Month.	1901.		1902.	
	Gallons.		*Gallons.*	
January	86, 664, 193	$5, 819, 985	95, 043, 650	$6, 064, 804
February	65, 538, 129	4, 539, 727	66, 481, 793	4, 390, 794
March	75, 197, 239	5, 417, 085	88, 483, 621	5, 512, 559
April	87, 932, 625	6, 251, 802	88, 970, 138	5, 775, 468
May	98, 677, 736	6, 576, 904	90, 324, 733	6, 048, 791
June	85, 156, 212	5, 538, 986	96, 997, 150	5, 869, 983
July	99, 415, 209	6, 373, 491	86, 633, 444	5, 662, 837
August	93, 502, 384	6, 268, 383	89, 853, 637	5, 563, 917
September	102, 177, 175	6, 738, 977	82, 268, 037	4, 953, 792
October	91, 267, 756	6, 464, 608	100, 990, 406	6, 557, 263
November	95, 652, 943	6, 296, 115	83, 554, 869	5, 485, 884
December	97, 892, 918	6, 498, 849	94, 632, 123	6, 711, 051
Total 12 months	1, 079, 074, 519	72, 784, 912	1, 064, 233, 601	68, 597, 143

The following table exhibits the total production of crude petroleum in 1902, in barrels and in gallons, also the separate derivatives exported and their value, together with their sum and value. This amount represents approximately 45 per cent of the total refined product that was obtained from the crude petroleum in the United States:

Quantity of crude petroleum produced in, and quantities and values of petroleum products exported from, the United States during each of the calendar years from 1871 to 1902, inclusive.

Year ending December 31—	Production.		Exports.			
	Barrels (of 42 gallons).	Gallons.	Mineral, crude (including all natural oils, without regard to gravity).		Mineral, refined or manufactured. Naphtha, benzine, gasoline, etc.	
			Gallons.		*Gallons.*	
1871	5,205,234	218,619,828	11,278,589	$2,171,706	8,396,905	$895,910
1872	6,293,194	264,314,148	16,363,975	2,761,094	8,688,257	1,307,058
1873	9,893,786	415,539,012	19,543,740	2,565,171	10,250,497	1,266,962
1874	10,926,945	458,931,690	14,430,851	1,428,494	10,616,644	997,355
1875	12,162,514	510,825,588	16,536,800	1,738,589	14,048,726	1,392,192
1876	9,132,669	383,572,098	25,343,271	3,343,763	13,252,751	1,502,498
1877	13,350,363	560,715,246	28,773,233	3,267,309	19,565,909	1,938,672
1878	15,396,868	646,668,456	24,049,604	2,169,790	13,431,782	1,077,402
1879	19,914,146	836,394,132	28,601,650	2,069,458	19,524,582	1,367,996
1880	26,286,123	1,104,017,166	36,748,116	2,772,400	15,115,131	1,344,529
1881	27,661,238	1,161,771,996	40,430,108	3,089,297	20,655,116	1,981,197
1882	30,510,830	1,281,454,860	45,911,154	3,373,302	16,969,839	1,304,041
1883	23,449,633	984,884,586	59,018,537	4,439,097	17,365,314	1,195,035
1884	24,218,438	1,017,174,396	79,679,395	6,102,810	13,676,421	1,132,528
1885	21,858,785	918,068,970	81,435,609	6,240,685	14,729,469	1,160,999
1886	28,064,841	1,178,723,322	76,346,480	5,068,409	14,474,951	1,264,736
1887	28,283,483	1,187,906,286	80,650,286	5,141,833	12,382,213	1,049,043
1888	27,612,025	1,159,705,050	77,549,452	5,454,705	13,481,706	1,083,429
1889	35,163,513	1,476,867,546	85,189,658	6,134,002	13,984,407	1,208,116
1890	45,822,672	1,924,552,224	96,572,625	6,535,499	12,462,636	1,050,613
1891	54,291,980	2,280,263,160	96,722,807	5,365,579	11,424,993	868,137
1892	50,509,136	2,121,383,712	104,397,107	4,696,191	16,393,284	1,037,558
1893 a	48,412,666	2,033,331,972	111,703,508	4,567,391	17,304,005	1,074,710
1894 a	49,344,516	2,072,469,672	121,926,349	4,415,915	15,555,754	943,970
1895 a	52,892,276	2,221,475,592	111,285,264	5,161,710	14,801,224	910,988
1896 a	b 60,960,361	2,560,335,162	110,923,620	6,121,836	12,349,319	1,059,542
1897	b 60,475,516	2,539,971,672	121,488,726	5,020,968	13,430,320	994,781
1898	b 55,364,233	2,325,297,786	114,915,082	4,764,111	17,026,626	1,053,231
1899	b 57,070,850	2,396,975,700	117,683,967	5,957,829	17,904,015	1,557,607
1900 c	63,620,529	2,672,062,218	137,501,160	7,310,270	18,262,744	1,648,069
1901	69,389,194	2,914,346,148	127,008,002	6,037,544	21,684,734	1,741,547
1902	d 88,766,916	3,728,210,472	145,233,723	6,331,011	19,682,637	1,392,771

a Exports are for fiscal years from 1893 to 1896, inclusive.

b In addition to this quantity 4,325 barrels of crude oil were produced in Kentucky and Tennessee in 1896, 4,377 barrels in 1897, 19,125 barrels in 1898, and 13,578 barrels in 1899, for which, as none was sold or used, no value could be given.

c Includes 41,405 barrels of oil sold in Kentucky and Tennessee in 1900, but produced in previous years.

d In addition to this quantity, 508,386 barrels were produced, but not marketed.

Quantity of crude petroleum produced in, and qualities and values of petroleum products exported from, the United States, etc.—Continued.

Year ending December 31—	Exports.			
	Mineral, refined or manufactured.			
	Illuminating.		Lubricating (heavy paraffin, etc.).	
	Gallons.		*Gallons.*	
1871	132,178,843	$33,493,351	240,228	$92,408
1872	118,259,832	29,456,453	438,425	180,462
1873	207,595,988	41,357,686	1,502,503	517,466
1874	206,562,977	30,168,747	993,068	269,886
1875	203,678,748	28,168,572	938,052	265,837
1876	220,831,608	44,089,066	1,157,929	370,431
1877	307,373,842	51,366,205	1,914,129	577,610
1878	306,212,506	36,855,798	2,525,545	698,182
1879	365,597,467	32,811,755	3,168,561	713,208
1880	286,131,557	29,047,908	5,607,009	1,141,825
1881	444,666,615	42,122,683	5,053,862	1,165,605
1882	428,424,581	37,635,981	8,821,536	2,034,487
1883	440,150,660	39,470,352	10,108,394	2,193,245
1884	433,851,275	39,450,794	11,985,219	2,443,385
1885	445,880,518	39,476,082	12,978,955	2,659,210
1886	485,120,680	39,012,922	13,948,367	2,689,464
1887	485,242,107	37,007,336	20,582,613	3,559,280
1888	455,045,784	37,236,111	24,510,437	4,215,449
1889	551,769,666	41,215,192	27,903,267	4,638,724
1890	550,873,438	39,826,086	32,090,537	4,766,850
1891	531,445,099	34,879,759	33,310,264	4,999,978
1892	589,418,185	31,826,545	34,026,855	5,130,643
1893 [a]	642,239,816	31,719,404	32,432,857	4,738,892
1894 [a]	730,368,626	30,676,217	40,190,577	5,449,000
1895 [a]	714,859,144	34,706,844	43,418,942	5,867,477
1896 [a]	716,455,565	48,630,920	50,525,530	6,556,775
1897	795,919,525	46,229,579	51,228,284	6,478,479
1898	761,152,107	38,542,082	63,968,341	7,385,054
1899	724,562,993	48,466,200	69,329,188	8,344,735
1900	730,585,487	53,933,556	68,997,715	9,542,618
1901	827,479,493	53,490,713	75,305,938	10,260,125
1902	778,800,978	49,079,055	82,200,503	10,872,154

[a] Exports are for fiscal years from 1893 to 1896, inclusive.

Quantity of crude petroleum produced in, and qualities and values of petroleum products exported from, the United States, etc.—Continued.

Year ending December 31—	Exports.			
	Residuum (tar, pitch, and all other, from which the light bodies have been distilled).		Total.	
	Gallons.		*Gallons.*	
1871	101,052	$10,450	152,195,617	$36,663,825
1872	568,218	56,618	144,318,707	33,761,685
1873	1,377,180	117,595	240,369,908	45,924,880
1874	2,504,628	177,794	235,108,168	33,042,276
1875	2,323,986	169,671	237,526,312	31,734,861
1876	2,863,896	239,461	263,449,455	49,545,219
1877	4,256,112	390,077	361,883,225	57,539,873
1878	3,126,816	220,835	349,346,253	41,022,007
1879	4,827,522	273,050	421,719,782	37,235,467
1880	3,177,630	198,983	346,779,443	34,505,645
1881	3,756,018	197,321	514,561,719	48,556,103
1882	4,265,352	275,263	503,492,462	44,623,074
1883	6,502,524	465,350	533,145,429	47,763,079
1884	5,303,298	327,599	544,495,608	49,457,116
1885	5,713,908	334,767	560,784,459	49,671,743
1886	1,993,824	109,673	591,884,302	48,145,204
1887	2,989,098	141,350	601,846,317	46,898,842
1888	1,870,596	116,009	572,457,975	48,105,703
1889	1,858,458	97,265	680,705,456	53,293,299
1890	1,830,612	91,905	693,829,848	52,270,953
1891	1,002,414	61,382	673,905,577	46,174,835
1892	403,032	38,220	744,638,463	42,729,157
1893[a]	541,044	41,661	804,221,230	42,142,058
1894[a]	211,008	14,704	908,252,314	41,499,806
1895[a]	137,508	13,063	884,502,082	46,660,082
1896[a]	204,960	14,330	890,458,994	62,383,403
1897	12,230,902	333,740	994,297,757	59,057,547
1898	29,418,454	806,570	986,480,610	52,551,048
1899	21,544,278	655,878	951,024,441	64,982,249
1900	19,776,370	841,769	975,123,476	73,276,282
1901	27,596,352	1,254,983	1,079,074,519	72,784,912
1902	38,315,760	922,152	1,064,233,601	68,597,143

[a] Exports are for fiscal years from 1893 to 1896, inclusive.

Production of petroleum in the Appalachian oil field, 1889–1902, by States.

[Barrels of 42 gallons.]

Year.	Pennsylvania and New York.	West Virginia.	Southeastern Ohio.	Kentucky and Tennessee.	Total.
1889	21,487,435	544,113	318,277	5,400	22,355,225
1890	28,458,208	492,578	1,116,521	6,000	30,073,307
1891	33,009,236	2,406,218	424,323	9,000	35,848,777
1892	28,422,377	3,810,086	1,193,414	6,500	33,432,377
1893	20,314,513	8,445,412	2,602,965	3,000	31,365,890
1894	19,019,990	8,577,624	3,184,310	1,500	30,783,424
1895	19,144,390	8,120,125	3,694,624	1,500	30,960,639
1896	20,584,421	10,019,770	3,366,031	1,680	33,971,902
1897	19,262,066	13,090,045	2,877,838	322	35,230,271
1898	15,948,464	13,615,101	2,148,292	5,568	31,717,425
1899	14,374,512	13,910,630	4,764,934	18,280	33,068,356
1900	14,559,127	16,195,675	5,478,372	62,259	36,295,433
1901	13,831,996	14,177,126	5,471,790	137,259	33,618,171
1902	13,183,610	13,513,345	5,136,501	185,331	32,018,787

This table shows a decrease in the production in 1902 as compared with that of 1901 of 1,599,384 barrels, the equivalant of 4.76 per cent, which was greatest proportionally in southeastern Ohio. Were it not for the increase of 1,562 wells drilled in 1902, as compared with 1901, this slight decrease would not be so conspicuous. The only division showing an increase was Kentucky and Tennessee.

PRODUCTION OF APPALACHIAN FIELD, BY MONTHS AND YEARS.

In the following table is given the production of crude petroleum in the Appalachian oil field from 1896 to 1902, by months:

Production of crude petroleum in the Appalachian oil field, 1896–1902, by months and years.

[Barrels of 42 gallons.]

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
January	2,728,031	2,754,788	2,816,744	2,492,679	2,918,175	3,003,285	2,614,845
February	2,529,007	2,663,433	2,466,179	2,285,466	2,595,900	2,567,288	2,253,491
March	2,711,228	2,935,595	2,864,640	2,736,784	3,004,813	2,916,677	2,629,104
April	2,933,627	2,809,175	2,689,463	2,642,830	2,950,469	2,862,813	2,664,668
May	2,888,642	2,902,598	2,714,522	2,825,254	3,148,944	2,963,001	2,759,717
June	2,916,158	2,990,516	2,595,599	2,796,098	3,068,693	2,751,409	2,598,349
July	2,972,141	3,035,361	2,573,112	2,845,149	3,100,319	2,921,520	2,825,398
August	2,871,258	3,115,402	2,668,438	3,001,267	3,198,715	2,941,578	2,728,825
September	2,831,647	3,035,348	2,579,174	2,839,983	3,002,998	2,644,103	2,769,060
October	2,901,921	3,078,088	2,581,690	2,920,530	3,245,506	2,814,972	2,860,506
November	2,745,896	2,983,642	2,527,950	2,863,429	3,009,503	2,590,781	2,609,453
December	2,942,346	2,926,325	2,639,914	2,818,887	3,051,398	2,640,744	2,705,371
Total	33,971,902	35,230,271	31,717,425	33,068,356	36,295,433	33,618,171	32,018,787

AVERAGE DAILY PRODUCTION OF APPALACHIAN FIELD, 1896–1902, BY MONTHS AND YEARS.

In the following table is given the average daily production in the Appalachian oil field from 1896 to 1902, by months and years:

Average daily production of crude petroleum in the Appalachian oil field each month, 1896–1902, by months and years.

[Barrels of 42 gallons.]

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
January	88,000	88,864	90,863	80,422	94,135	96,880	84,350
February	87,206	95,123	88,076	81,618	92,711	91,689	80,482
March	87,458	94,696	92,407	88,283	96,929	94,086	84,810
April	97,787	93,639	89,648	88,092	98,349	95,427	88,822
May	93,181	93,632	87,565	91,137	101,579	95,581	89,023
June	97,205	99,684	86,519	93,202	102,290	91,714	86,612
July	95,875	97,915	83,003	91,779	100,010	94,243	91,142
August	92,621	100,497	86,079	96,815	103,184	94,890	88,027
September	94,388	101,178	85,972	94,664	100,100	88,137	92,302
October	93,610	99,293	83,280	94,210	104,694	90,806	92,274
November	91,529	99,455	84,264	95,446	100,317	86,359	86,982
December	94,914	94,398	85,158	90,932	98,432	85,185	87,270
Average	92,819	96,521	86,897	90,598	99,440	92,105	87,723

Average monthly prices of Appalachian crude petroleum in 1901 and 1902.

[Per barrel of 42 gallons.]

Month.	1901.				1902.			
	Tiona.	Pennsylvania.	Corning.	Newcastle.	Tiona.	Pennsylvania.	Corning.	Newcastle.
January	\$1.34½	\$1.19½	\$1.02½	\$0.94½	\$1.30	\$1.15	\$0.98	\$0.90
February	1.40	1.25	1.08	1.00	1.30	1.15	.98	.90
March	1.44	1.29	1.12	1.04	1.30	1.15	.98	.90
April	1.35½	1.20½	1.03½	.95½	1.32½	1.17½	1.00½	.92½
May	1.22⅝	1.07⅝	.90⅝	.82⅝	1.35	1.20	1.03	.95
June	1.20	1.05	.88	.80	1.35⅜	1.20⅜	1.03⅜	.95⅜
July	1.28⅜	1.13⅜	.96⅜	.88⅜	1.37	1.22	1.05	.97
August	1.40	1.25	1.08	1.00	1.37	1.22	1.05	.97
September	1.40⅜	1.25⅜	1.08⅜	1.00⅜	1.37	1.22	1.05	.97
October	1.45	1.30	1.13	1.05	1.43⅛	1.28⅛	1.11⅛	1.03⅛
November	1.45	1.30	1.13	1.05	1.53¼	1.38¼	1.21¼	1.13¼
December	1.36	1.21	1.04	.96	1.64	1.49	1.29½	1.33¾
Average	1.36	1.21	1.04	.96	1.38¾	1.23¾	1.06½	.99½

KANSAS.

Condition of the industry.—There was a large quantity of new and productive territory developed in this State, operations being quite active in the latter part of 1902. Although no wells of the gusher class have been found, there has been a large percentage of profitable wells drilled, which produce from 10 to 35 barrels per day. These wells are comparatively shallow, ranging from 750 to 850 feet in depth, and the drilling is inexpensive, as it is usually accomplished by what is known as a portable rig. The Kansas petroleum and natural-gas field is located in the southeastern portion of the State, in the counties of Neosho, Allen, Chautauqua, Montgomery, and Wilson.

Formerly the production came almost entirely from Wilson County, in the vicinity of Néodesha, but the year 1901 developed the existence of the Chanute pool, in Neosho County, and the Humboldt pool, in Allen County.

The production in all of the new pools in the State has suffered for want of transportation, which was remedied about the beginning of the year 1903 by the construction of a pipe line connecting the Chanute and Humboldt pools with the refinery at Neodesha.

Oil-bearing formations.—The petroleum, as well as the natural gas, is found principally in a dark sand, known generally as a "sugar sand," which is usually 15 to 20 feet in thickness, the wells reaching this formation usually at about 800 feet. This sand is not always found—that is, it does not extend uniformly throughout all this portion of southeastern Kansas, but is subject to irregularities, so that the productive pools are found surrounded by barren territory. The general dip of the strata in this portion of the State is from west to northwest, subject to slight folds that are not generally apparent at the surface, but have been proved by leveling and careful measurement of the depth of the top of the producing horizon.

All of the petroleum in southeastern Kansas comes from what is generally known as the Cherokee shales, a stratum about 450 feet thick, resting on the floor of the Mississippian or Eocarboniferous limestone, capped by the Fort Scott limestone. The most productive sand is found at from 50 to 75 feet above the base of the lower limestone.

In certain districts in Kansas this Cherokee shale contains most valuable deposits of bituminous coal. In the oil and gas region it is made up principally of shale with thin beds of sandstone and limestone, near the bottom of which the principal oil and gas bearing sand is encountered.

Above the Fort Scott limestone there is a series of shales known as the Pleasonton shales, about 250 feet in thickness, which in localities carry workable seams of coal, and which are in turn capped by several series of limestone, alternating with shale and sandstone. The gradual dip of 15 feet to the mile to the west-northwest, as well as the general elevation of the surface in that direction, soon buries the Carboniferous measures under the Permian, which in turn are capped by the Cretaceous.

PRODUCTION IN KANSAS.

The production for 1902 was 331,749 barrels; that for 1901 was 179,151 barrels, a gain of 152,598 barrels, or 85 per cent. The number of producing wells in 1902 was 391; of this number 83 could not be operated, owing to want of transportation facilities. In the year 1901 there were only 160 wells operated. From the present outlook there will be a much larger production secured in the future, since this is a reasonably sure territory and the wells are not expensive, as they are shallow, only requiring one string of casing, and there is an abundance of natural-gas fuel and a good supply of water.

Indications seem to show that there will be in the near future a continuous production extending from Allen County, through Neosho, Wilson, and Montgomery counties, into Indian Territory.

The total production of oil in Kansas, so far as records have been obtained, is as follows:

Production of petroleum in Kansas, 1889–1902.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1889	500	1896	113,571
1890	1,200	1897	81,098
1891	1,400	1898	71,980
1892	....	1899	69,700
1893	18,000	1900	74,714
1894	40,000	1901	179,151
1895	44,430	1902	331,749

The value of the petroleum produced in Kansas in 1902 was $292,464, an average of 88 cents per barrel. The average price per barrel received in 1901 was 84 cents.

The following table gives the total output, the daily average production, and the average daily production per well in Kansas from 1897 to 1902:

Total and average daily production of wells in Kansas, 1897–1902.

[Barrels of 42 gallons.]

Production.	1897.	1898.	1899.	1900.	1901.	1902.
Production in year	81,097.71	71,979.65	69,700.34	74,714	179,151	331,749
Average daily production	222.19	197.20	190.96	204.7	490.8	908.9
Average daily well production	3.58	2.63	2.48	2.14	3.5	....

The following table gives the monthly production in Kansas from 1898 to 1902:

Production of crude petroleum in Kansas, 1898–1902, by months.

[Barrels of 42 gallons.]

Month.	1898.	1899.	1900.	1901.	1902.
January	7,602	5,843	5,061	9,466	19,684
February	6,384	5,531	4,442	9,675	18,079
March	6,562	5,956	4,901	13,000	19,377
April	6,973	5,374	4,828	14,435	19,523
May	6,186	5,788	5,242	18,706	18,468
June	6,570	5,581	5,334	16,469	19,142
July	5,259	5,701	6,455	16,427	20,373
August	5,537	6,633	7,373	13,996	22,475
September	4,723	6,112	6,356	14,274	23,575
October	5,457	5,956	8,408	18,411	38,156
November	5,224	5,622	7,259	16,618	54,490
December	5,503	5,603	9,055	17,674	58,407
Total	71,980	69,700	74,714	179,151	331,749

WELL RECORDS IN KANSAS.

Number of producing oil wells in Kansas at close of each year, 1897–1902.

County.	December 31—					
	1897.	1898.	1899.	1900.	1901.	1902.
Allen		1				86
Chautauqua		3	3	4	6	10
Montgomery	1	1	1	1	2	16
Neosho	16	17	16	25	51	170
Wilson	54	64	65	78	100	108
Woodson					1	1
Total	71	86	85	108	160	[a] 391

[a] This total includes 83 wells which were not pumped in 1902.

Well record in Kansas in 1902.

County.	Wells productive at close of 1901.	Productive wells drilled in 1902.	Abandoned in 1902.	Productive wells at close of 1902.	Dry holes drilled in 1902.
Allen		86		86	9
Chautauqua	6	4		10	
Montgomery [a]	2	14		16	1
Neosho	51	119		170	15
Wilson	100	22	14	108	12
Woodson	1			1	
Total	160	245	14	[b] 391	37

[a] Two gas wells in Montgomery County produced some oil in 1902; wells not included in this table.
[b] Of this total, 83 wells were not pumped in 1902.

INDIAN TERRITORY.

Condition of the industry.—Operations in the northern portion of this Territory adjoining Kansas have been quite active during the last year. The southern border of the petroleum-producing area in that State has been gradually extended into the Territory, and a continuous producing belt has been fully established. Operations have been retarded owing to the governmental conditions imposed upon persons securing leases from the Indians who own the land in fee. A number of grades of petroleum, from the heaviest to the lightest, have been developed at various depths, from shallow and from deep wells. The only pool operated was that belonging to the Osage Nation, the oil from which has been transported by rail to Neodesha, Kans., and there refined. Other developments await further adjustment, in the near future, of the laws regulating the leasing of oil lands to operators. It is therefore expected that the year 1903 will develop a large amount of production, as many wells are now shut in that are known to be producers of considerable importance.

The total production of crude petroleum in Indian Territory was 37,000 barrels in the year 1902, valued at $32,190, or 87 cents per barrel at wells. This petroleum was produced from 13 wells located in Osage Nation, six of which were drilled in the year 1902.

Owing to restrictions in the laws of the Creek Nation no petroleum was shipped from this field during 1902. There were 9 wells in this field in 1902, 5 of which were drilled in 1902. Two wells were drilling at the close of 1902. Of 7 wells in this field 4 are shallow, being only 537 to 560 feet deep; 3 are 1,350 feet deep. The first sand was found at 560 feet and was 10 feet thick; the second sand was found at 1,400 feet and was 25 feet thick. Gas is also found with the oil, the pressure being very strong, but it has not yet been tested. Very few wells are finished in shape to show their production, but those which are finished show a production of about 25 barrels a day. The oil is thin, is of amber color, is light in gravity, and contains a large percentage of illuminating petroleum.

No petroleum was produced and shipped from the Cherokee Nation in 1902. However, operations were resumed early in 1903, and a pipe line is being laid from the wells to the railroad. The oil is black, with asphaltum base; its gravity is from 23° to 30° Baumé; about 20 per cent of it is illuminating, and about 60 per cent is lubricating oil. The sands are light gray and chocolate color, and are found at from 65 to 250 feet in depth. They contain no sulphur.

The total number of wells, of both oil and gas, in the Indian Territory at the close of 1902 was 29, 13 of which were drilled in 1902. In addition to these, 5 were in process of drilling at the close of 1902.

The following are the conditions for leasing the Cherokee allotted lands for operating for petroleum and natural gas, established by the Secretary of the Department of the Interior, Washington, D. C.

All leases must follow the form approved by the Interior Department and must provide that only so much of the surface of land described as may be necessary to carry on the work contemplated shall be occupied by the lessees. All lessees must give bond guaranteeing payment of royalties and rents. The bond schedule follows:

Forty to 80 acres, $1,000; 80 to 120 acres, $1,500; 120 to 160, $2,000. Each 40 acres above 160, $500 additional. The Secretary can raise the amount if he deems it necessary. No lease shall be sublet, transferred, or assigned without the consent and approval of the Secretary of the Interior. All leases shall provide for the payment of advanced annual royalties in sums not less than 15 cents per acre per annum for one and two years, 30 cents for three and four years, 75 cents for fifth and each succeeding year for the term the lease is to run. All leases should provide for the payment of a royalty of 10 per cent of the value of all crude oil extracted from said land to be paid monthly, on or before the 25th of the month succeeding that in which it is produced, and the average value of the oil during the month in which it is produced shall constitute the criterion for paying the royalty.

The royalty on natural gas shall be fixed by the Secretary at the end of each year, or oftener in his discretion. All lessees will be required to keep full and correct accounts of their operations and make report thereof promptly at the end of each month to the lessor and Secretary. The right is given to prospect for, extract, pipe, store, refine, and remove all such oil and natural gas, to use as much land as is necessary, also right to obtain enough water from the land, and to use natural gas or oil for fuel to carry on operations. The lessor is given free use of gas to light his residence. If the lessee fails to pay the per acre royalty sixty days after it is due, the lease becomes void. The lessee must agree to exercise diligence in sinking wells for oil or gas and operate same in a workmanlike manner. He must commit no waste, and must surrender property at the termination of his lease. He shall not remove any buildings or improvements except tools, boilers, pipe lines, pumps, drills, engines, tanks, and machinery. The lessee shall not allow any nuisance committed on the property or any intoxicating liquor sold or given away. He must plug abandoned wells so as to effectually shut off all water above the oil-bearing horizon. Amounts due for royalties shall be a lien on implements, tools, and movable machinery. If the lessee make reasonable and bona fide effort to find and produce oil in paying quantities and such effort is unsuccessful, he may at any time thereafter, with the approval of the Secretary of the Interior, surrender and wholly terminate the lease upon the full payment and performance of all existing obligations, provided, however, that the approval of such surrender by the Secretary will be required only during the time his approval of the alienation of the land is required.

PRODUCTION IN INDIAN TERRITORY.

The following table shows the production of petroleum in Indian Territory from 1891 to 1902, inclusive.

Production of petroleum in Indian Territory, 1891–1902.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1891	30	1897	625
1892	80	1898	....
1893	10	1899	....
1894	130	1900	6,472
1895	37	1901	10,000
1896	170	1902	37,000

COLORADO.

Condition of the industry.—There was great activity in the State throughout the year 1902. The superior quality of the petroleum recently developed at Boulder, and its ready sale formed the incentive for a large amount of drilling over widely separated portions of Northern Colorado. Boulder, Fort Collins, and the older Florence field were the principal localities in which operations were active. To a smaller extent operations were active in Pueblo, Archuleta, and Rio Blanco counties; also in Routt County, and at Raton, near the southern boundary, in the northwestern portion of the State.

The general results of the operations can not be considered satisfactory, as no productive well has been developed outside of the pools at Florence and Boulder and their immediate neighborhood. The finding of a productive well, known as the Otero well, 4 miles north of Boulder, has lengthened the field considerably.

An important deep-test well was drilled in the Florence field south of the city, which, at the great depth of 3,650 feet, developed a very prolific oil pay below that found in the other wells. The old No. 49 well, drilled in 1890, continues to produce 40 barrels per day. This well for several years after it was first opened produced at the rate of 350 barrels per day, and has placed nearly 1,000,000 barrels of petroleum to its credit.

Three pay streaks are usually developed in this field, the first at about 1,200 feet in depth, the second at from 1,600 to 2,000 feet, and the third at from 2,600 to 2,800 feet.

The formation credited with producing the petroleum in this pool and that of the Boulder district, is the Fort Pierre group of the Montana Cretaceous. The Florence pool furnished nearly 98 per cent of the total production in the State in 1902. The petroleum is of a dark-green color, of good quality, and with a gravity of 31° to 32° Baumé. The productive wells drilled in this pool in 1902 numbered 15. There were 26 dry holes, and 6 abandoned wells. At the close of 1902 there were 72 producing wells in the Florence pool and 4 in the Boulder pool.

PRODUCTION IN COLORADO

The production in 1902 was 396,901 barrels, valued at $484,683, an average of $1.22 per barrel, as compared with 460,520 barrels in 1901, valued at $461,031, or $1 per barrel, a decrease of 63,619 barrels in quantity and an increase of $23,652 in value. The production of the Boulder pool amounted to only 11,800 barrels, which is a disappointment, as the general average of the wells as reported should produce more than double this quantity. Toward the close of 1902 the shipments from this pool were very close to 130 barrels per day. The quality of the petroleum from the Boulder pool is superior to that of any other west of the Mississippi River. Its gravity when fresh is 42.5° Baumé, and it is similar to Pennsylvania petroleum in the percentages of its refined products. The development of a large supply of fairly good crude petroleum in Colorado and Wyoming would, owing to their location in the United States, be desirable because of the long distances the petroleum has now to be shipped by railroads to reach the western markets. The demand for refined petroleum is growing at a rapid rate in the great inland section of this country, and will probably continue to increase for many years.

In the following table will be found a statement of the production of crude oil in Colorado from 1887 to 1902:

Production of crude oil in Colorado, 1887–1902.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1887	76,295	1896	361,450
1888	297,612	1897	384,934
1889	316,476	1898	444,383
1890	368,842	1899	390,278
1891	665,482	1900	317,385
1892	824,000	1901	460,520
1893	594,390	1902	396,901
1894	515,746		
1895	438,232	Total	6,852,926

WYOMING.

Condition of the industry.—There is in this State a considerable amount of petroleum developed, which at present lacks a market.

The known petroleum fields are widely distributed over the State from the southwest to the northeast corner.

The most active work during the year was in Uinta and Sweetwater counties in the southwestern portion of the State. At Spring Valley, in the first-named county, the Union Pacific Railroad drilled for water early in 1901, and unexpectedly developed a deposit of very remarkably pure petroleum, an analysis of which is shown on a following page. A number of wells drilled in this county failed to produce more than a small quantity of this high-grade petroleum.

The only regular production in the State comes from 10 wells drilled by the Pennsylvania Company at Salt Creek in the northeastern part of Natrona County, 50 miles north of Casper, where a small refinery is located, the oil being hauled from the field to the refinery in tank wagons. Operations in this field showed a considerable increase, amounting to 850 barrels, in 1902 over 1901. There are numerous petroleum seeps in the western central portion of Natrona County and an outcrop of oil-bearing sandstone in the Rattlesnake Range.

About 4,000 barrels of heavy petroleum were produced by an English syndicate in the Popo Agie district, near the center of Fremont County, from spouting wells recently drilled in that locality, which was used principally for fuel and lubrication in drilling new wells. There are a number of gushers in this district, several of which were completed in 1901 and 1902; the remainder are much older, having been drilled in 1884, but they still flow petroleum naturally when the gate is opened. The specific gravity of this petroleum is from 22° to 25° Baumé; it flashes at 95° F., and ignites at about 135° F. There is a prospective field near Newcastle, in Weston County, which awaits development. Near Bonanza, in Bighorn County, a well was recently completed which gave indications of being a fair producer of a superior grade of petroleum said to produce 50 per cent of illuminating oil.

The problem that now confronts most of the operators in this State is the question of transportation and market for a large quantity of the heavy oil which is known to exist in quantity in several localities. They are far away from any large population or manufacturing districts or lines of transportation leading directly to consumers. It must also be remembered that Wyoming is abundantly supplied with bituminous coal of good quality. All of these conditions operate to retard the more active development of petroleum in this State.

PRODUCTION IN WYOMING.

There were produced in 1902 in Wyoming 6,253 barrels of crude petroleum, valued at $43,771. The wells which produced this oil are 10 in number and located in Natrona County. There are 55 feet of producing sand of fine texture. There has been no perceptible diminution in any of the wells since they commenced producing.

Production of petroleum in Wyoming, 1894–1902.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1894	2,369	1900	5,450
1895	3,455	1901	5,400
1896	2,878	1902	[a] 6,253
1897	3,650	Total	40,490
1898	5,475		
1899	5,560		

[a] In addition to this quantity 4,000 barrels were produced in the Popo Agie oil district in Fremont County and used for lubricating and fuel purposes in the development of oil wells, and also the Union Pacific well at Spring Valley produced about 2,500 gallons; but as there was no market for this production it was not included in the table.

The following analysis of the Spring Valley petroleum has been made by Dr. F. Salathe.

Analysis of Spring Valley, Wyoming, crude petroleum, by Dr. F. Salathe.

Constituent.	Per cent.
Naphtha 60° F. (gasoline and benzine)	27.00
Water white kerosene 45° B., 145° flash, 172° fire	25.50
Signal and headlight, 40° B., 300° fire	7.00
Lubricating [a] reduced stock 23.5° B	40.50
Total	100.00

[a] Amount of paraffin in reduced stock, 18.5 per cent.

Color of crude, olive green.

Specific gravity, 0.8329.

Flashes at a temperature below 60° F.

Distillation of Spring Valley crude petroleum, by Wilbur C. Knight.

Number.	Temperature.	Specific gravity.	Remarks.
1	77° to 130° C	0.7230	Oil at 15° C.
2	130° to 170° C	.7540	Do.
3	170° to 200° C	.7800	Do.
4	200° to 259° C	.8040	Do.
5	259° to 292° C	.8190	Do.
6	292° to 320° C	.8340	Do.
7	320° to 350° C	.8470	Oil at 18° C.
8	350° to 370° C	.8580	Oil at 22° C.
9	370° to 380° C	.8640	Do.
10 [a]	380° to 400° C	.8880	Do.

[a] A little more than 5 per cent. This oil is practically gasoline, kerosene, and paraffin. Estimates of the percentages of paraffin range from 10 per cent to 15 per cent. Both the gasoline and kerosene are of excellent quality.

Color, light green.

Specific gravity, 0.8176 (42° B.). This sample was taken from the first strike, and is a lighter oil than was found at a greater depth.

Flashes at a temperature below 55° F.

MISSOURI.

During 1902 some little excitement was created by the discovery of oil at Belton, Cass County. There are three companies in the district, but very little oil was produced and sold in 1902. The oil is high-grade lubricating, and is worth $3 a barrel at the well. The wells, 7 in number, are shallow, being from 341 to 490 feet deep. Gas is also produced, and the town of Belton is partly supplied with this fuel for heating and lighting. The following analysis of the oil from these wells, by Professor Frankforter, of the University of Minnesota, shows it to be a high-grade lubricating oil:

Analysis of petroleum from Belton, Mo.

Constituent.	Per cent.
Light oil between kerosene and gasoline	10
Burning oil (kerosene)	19
Lubricating oil with paraffin base	53
Residuum consisting of 10 per cent tar and 8 per cent paraffin, with only a trace of inorganic matter	18
Total	100

The production from this new district added somewhat to the small quantity that has for many years been produced, and still continues to be produced, from a well located in Bates County. There are numerous indications of petroleum in the Eocarboniferous limestone in the neighborhood of Joplin and elsewhere in this State.

Production of petroleum in Missouri, 1889–1902, to which that of other States has been added since 1898.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1889	20	1896	43
1890	278	1897	19
1891	25	1898	10
1892	10	1899	[a] 132
1893	50	1900	[a] 1,602
1894	8	1901	[b] 2,335
1895	10	1902	[b] 857

[a] Includes the production of Michigan.
[b] Includes the production of Michigan and Oklahoma Territory.

MICHIGAN.

The production of petroleum in this State fell off in 1902, compared with the production of 1901, both of which were insignificant.

The source is the Corniferous limestone which has produced petroleum for many years in Canada. The production in Michigan is at Port Huron.

OKLAHOMA TERRITORY.

There are many natural petroleum seeps in this Territory, but nothing in the way of established production of petroleum was reported for 1902. There is some oil produced in this Territory quite near the line of Indian Territory. In addition, numerous springs and wells in this Territory have indications of petroleum. Liquid and solid asphalt have also been found in shafts and water wells. Guthrie, Lawton, Fort Sill, Richards, and Granite have all more or less natural vents, showing both petroleum and natural gas, and in all probability a few years will see this Territory placed on the list of regular producers.

ALABAMA.

Numerous tests throughout this State during the years 1901 and 1902 have thus far failed to find petroleum in paying quantities, although some of these tests have found shows of oil and slight flows of natural gas. A number of wells were put down in Washington and Mobile counties, in the southwestern portion of the State, which were unsuccessful in finding anything but traces of petroleum. Wells were also drilled in Madison, Clarke, Walker, and Calhoun counties, in the northern portion of the State, which did not find any petroleum of commercial value. Operations are still in progress in Madison County. The well in Calhoun County, near Piedmont, was drilled to a depth of 1,454 feet, at which point the hole was plugged. Some natural gas was developed between 800 and 1,000 feet.

LOUISIANA.

Condition of the industry.—The year 1902 gave this State a distinctive place among those producing petroleum. Although there was some production in 1901, there were no sales of petroleum, and therefore no credit could be given. The production and sales in 1902 amounted to 548,617 barrels, valued at $188,985, at the rate of 34.4 cents per barrel. There was a large amount of drilling in the search for petroleum over a considerable area in the southwest portion of the State. The most successful development was near Jennings, 90 miles east of Beaumont, Tex., and 190 miles west of New Orleans. Several promising wells also were drilled near Welch, 12 miles west of Jennings. More or less developments, showing petroleum and natural gas in small quantities, were made at Calcasieu, Lake Charles, Cowley, Lafayette, and Sulphur. In drilling test wells several other localities have developed outbursts of natural gas, accompanied by slight showings of petroleum. The first well of importance was drilled near Jennings, the pool being 6 miles northeast of that station, in Acadia Parish.

In August, 1901, at a depth of 1,822 feet, a bed of loose sand containing petroleum was tapped. This well flowed spasmodically large quantities of petroleum and sand to a height many feet above the top of the derrick. Owing to an accident, this original well had to be abandoned. There were at the close of 1902 4 pumping wells and 1 flowing well in the Jennings pool, 4 wells preparing to pump, and 2 drilling wells, a total of 11 operations. The difficulty in this pool is the strong gas pressure and the loose sand saturated with petroleum, which clogs up the casing so completely as to shut off all outflow. This difficulty has been overcome to a great extent by the perforation of the lower joint of the casing or by inserting a perforated liner at the bottom. No solid material is encountered in drilling wells at this locality, the formation consisting of series of sand-clay and "gumbo." The petroleum is about 26° Baumé in gravity and is superior in quality to that produced at Beaumont and Sour Lake. Dry holes have been developed to the east and south of the productive area.

About 12 miles west of Jennings the pool at Welsh is located. There is every indication that a producing area has been developed at this point, as several wells have found petroleum, although the same difficulty found at Jennings exists here also, namely, a bed of loose sand associated with the petroleum, which has thus far interfered with the output of the wells.

Tankage has been erected at both Jennings and Welsh, and at Jennings the pool has been connected by a pipe line with the railroad and also with tide water. A market has thus been secured, as the sugar refineries and other manufactories located along the coast and up the Mississippi River have in many instances discarded coal for fuel oil.

From the indications existing in many localities over a large portion of southwestern Louisiana, it is reasonable to predict that this State will in a few years produce a large quantity of petroleum.

PRODUCTION.

The following table shows the production in 1902:

Production of petroleum in Louisiana in 1902, by months.

Month.	Barrels.	Month.	Barrels.
May	25,000	October	81,257
June	60,000	November	70,707
July	75,000	December	75,036
August	92,894	Total	548,617
September	68,723		

The average price was $0.3445 per barrel. This oil was produced from five wells, all of which were completed in 1902.

TEXAS.

Condition of the industry.—The close of the year 1902 almost completed the second anniversary of the discovery made by the great Lucas well on the Coastal Plain of Southeastern Texas, within a few miles of tide water. Since that event not less than $10,000,000 has been invested in wells, pipe lines, refineries, and tank vessels. Over 24,000,000 barrels of petroleum have been brought to the surface from the heretofore unknown reservoirs in the vicinity.

The production in 1902 including that stored in tanks was 18,515,017 barrels. Of this total about 7,300,000 barrels were tanked, leaving 11,215,007 barrels as the quantity consumed locally or shipped from the State. This amount of production places this State second in the list, next to Ohio, which is first, in the order of production by States.

This large production has had its far-reaching influence throughout the petroleum producing regions of the entire world. The sudden development of this large amount of petroleum, requiring the storing, the transportation, and the marketing of this quantity in so limited a time, is certainly a monument to the ability and enterprise of those engaged in the industry.

The present known deposits of petroleum and the numerous possibilities that underlie both the great Coastal Plain and the elevated localities far inland make it impossible to measure its future possibilities in the way of developments. This wonderful reservoir of cheap fuel must increase the present industrial activity and invite many new industries which will add materially to the prosperity of this already prosperous State.

The chief market for this petroleum in 1902 was as fuel, much the largest portion being distributed by tank cars on the railroads and a considerable part being used as a manufactured gas enricher. A very considerable quantity was transported by pipe lines from Beaumont and Sour Lake to Port Arthur and Sabine Pass, where it was loaded into tank vessels and transported to New York, Philadelphia, and New Orleans; smaller quantities were transported coastwise to Morgan City, Bell Isle, and Gretna, La., also to Tampa, Fla., and to Havana, Cuba. A very considerable quantity, also, was shipped in large tank vessels to Plymouth, and Dover, England, principally for use as a fuel after the more volatile portions had been removed; a portion also was marketed abroad as a gas oil for enriching manufactured gas, for which latter purpose it has been very successfully applied.

At the seaports of Port Arthur and Sabine Pass, the former being 18 and the latter 25 miles south of the Beaumont pool, several extensive refineries have been erected for the separation of the more volatile constituents from the crude petroleum. About 30 per cent of the lighter products are removed by distillation, which leaves a safe export petroleum. The main bulk of the lighter products find a market as gas oil after a comparatively small percentage has been converted into illuminating petroleum. The general average specific gravity of Beaumont petroleum is 22° Baumé equal to 0.92. The lowest temperature at which this petroleum gives off an inflammable vapor, or the flash point, is 120° to 160° F., the difference being due to the length of time it has been exposed to the air.

BEAUMONT DISTRICT.

GENERAL CONDITIONS.

During the first six months in the year 1902 the wells in the Beaumont pool continued to flow naturally and to produce large quantities of petroleum. A very destructive conflagration, involving the loss of $200,000 worth of material and temporarily interfering with the production, occurred in the early part of the year.

The presence of a large amount of water in the oil-producing sand about the 1st of August began seriously to affect the production of the wells. This water was forced into the strata by the rotary system of drilling, as numerous wells were being drilled. Salt water, in some instances, also made its appearance in considerable quantity.

About the 1st of July many of the wells in this pool ceased to flow naturally, as the pressure from the natural gas had been exhausted by the numerous wells so closely crowded together. For several months these wells were revived by the artificial method of pumping natural gas or air into the space in the rock above the oil.

This was practiced with success until the main body of the oil was reduced to a lower level in the wells and the space became too large for individual wells to be helped in this way. Toward the close of the year pumping was generally resorted to, although there were a few spouters which were probably connected with an untapped reservoir of gas and which continued to gush out the petroleum in considerable quantities after many of the original gushers had begun pumping. A number of wells have been drilled deeper to a lower pay. The remaining oil must be won by the slower methods of pumping, as the gas pressure has been exhausted. The pumping wells average between 300 and 400 barrels per day.

As nearly as can be ascertained about 110 wells were pumping at the close of 1902, 20 were being connected up and drilled deeper, and 10 new wells were being drilled. Over 380 wells have been drilled in this pool since the discovery of the original well January 10, 1901, by Capt. A. F. Lucas. At this date this remarkable well began to spout unexpectedly, forcing out the water and over 1,000 feet of 4-inch tubing, and sending a solid column of petroleum 6 inches in diameter to a height of 160 feet after wrecking the top of the derrick. Until it was capped and the flow shut in on January 19, the production of this well for the nine days it was uncontrolled was not less than 75,000 barrels per day.

PHYSICAL CONDITIONS OF THE BEAUMONT DISTRICT.

About 4 miles southwest of the city of Beaumont a slight mound, known as Spindle Top, rises from the monotonous coastal plain. Early explorers were attracted to this locality by the existence of several small flows of natural gas, which had been known since the early occupation of the country. There were also three springs on the mound, the water of which was more or less charged with acid and sulphate of iron. Small crystals of native sulphur were also found on the surface by the early explorers. The elevation of this mound is only about 15 feet above the general surface of the plain; its general contour is elliptical; the longer axis is about 3,300 feet and its breadth about 2,500 feet, and its area is less than 180 acres. The elevation of the summit is about 40 feet above the level of the sea. This area has produced all of the petroleum credited to the Beaumont district, and it is surrounded by a circle of dry holes, several of which have been drilled to a depth of from 2,500 to 3,000 feet, at that depth failing to find the productive strata or any indications of it.

In past years, before the Lucas well was put down, two attempts to drill wells were made, and one of these wells was located only 200 feet from the Lucas gusher. By a series of mishaps these holes were lost, and the project was for the time abandoned.

SOUR LAKE DISTRICT.

DEVELOPMENT OF THE DISTRICT.

One of the most important events of the year was that of fully determining the existence of a large pool of petroleum at Sour Lake, in Hardin County, 20 miles northwest of Beaumont, which in quality closely resembles the petroleum produced in the Beaumont pool.

A number of shallow wells, probably five in all, were drilled in this locality previous to 1901. The earliest development dates back to 1893. Three of them found a small amount of heavy petroleum of 16° gravity in a loose sand at about 230 feet. During the summer of 1901 the J. M. Guffey Company drilled a well in this locality that gave spasmodic flows of loose sand and mud accompanied with considerable petroleum and some gas at a depth of about 900 feet. Several pockets of gas were found that gave temporary flows in this manner, completely filling the casing for 700 feet or more. It was finished at 1,200 feet. In November a well was completed to a depth of 1,500 feet for the Great Western Oil Company, by Mr. Neil Sinclair, contractor, which encountered more or less loose sand alternating with clay and beds of gravel. Between 850 and 880 feet a sand was encountered which gave a big flow of hot salt water impregnated with sulphur; the water was at a temperature of 100° and was accompanied with some petroleum. At 1,040 feet four distinct petroleum sands were encountered, each about 10 feet thick and separated by a hard crystalline sand. The lowest of these sands contained some petroleum, followed by another flow of hot salt water over 100° in temperature. Then followed shale with boulders and some petroleum at 1,080 to 1,090 feet. From 1,090 to 1,400 feet there were hard and soft sands, the upper portion being very fine, and finally the last 100 feet was a series of beds of iron pyrites 5 to 10 feet in thickness, separated by beds of clay. None of these measures contained any signs of petroleum.

About the middle of March, 1902, the Great Western Oil Company secured a gusher at a depth of 683 feet, located near the original wells about 400 yards north of the hotel building at Sour Lake. After penetrating 40 feet of very nice oil sand, upon which the 8-inch casing rested, the 6-inch casing was pulled back and the well began to flow vigorously.

Three times after it was cleared it flowed a solid 8-inch stream 25 feet above the top of the derrick. This well is like the first one, except that it has much more vigorous, spasmodic flows, accompained with loose sand, which interrupts the flow of the petroleum and renders it difficult to keep the bore hole unobstructed. This sand has to be bailed out, and the valve closed for a time; then when the valve is suddenly opened the well will flow furiously.

During the year 1902 a number of wells had been completed, which produced from 500 to 10,000 barrels per day, the value of the field being thus fully established, although more or less trouble was experienced from choking of the wells by loose sand and boulders.

By the close of 1902 the J. M. Guffey Company had completed a pipe line connecting this district with Beaumont and another line was in process of construction. It is confidently predicted that this pool will add very greatly to the production of Texas in 1903, as the area now known is eight times as large as that of Spindle Top and the limits have not yet been reached.

SARATOGA DISTRICT.

Twelve miles northwest of Sour Lake the Saratoga pool is located, in which a few fair producers have been developed, whose production per day has been estimated at from 25 to 500 barrels of oil of a specific gravity of about 18° Baumé. Only a limited amount of tankage has been erected in this district, and the capacity of the wells has not been fully established. Their depth is from 980 to 1,020 feet.

Indications seem to warrant the probability that this pool will be a prominent factor in the future, as it is operated so far by large and conservative companies who have had experience and will avoid the wasteful methods of development practiced in the Spindle Top pool.

CORSICANA DISTRICT.

This pool is located at Corsicana, Navarro County, 200 miles northwest of Beaumont. Since 1897 it has produced over 500,000 barrels of a very superior crude petroleum very different from that found elsewhere in the State.

The output has shown a slight decrease in the last two years, and fewer wells have been drilled.

The greater portion of the petroleum comes from a depth of 1,010 to 1,040 feet in a loose-grained quartz sand, in which foraminifera or microscopic fossils are found. This bed of sand ranges from 15 to 30 feet in thickness, and is capped by an almost continuous deposit of Ponderosa clay and marl. There are a few limestone concretions found near the surface. The original wells produced from 10 to 30 barrels per day when first opened up, and they are now producing about one-half of that amount.

The area of the original field, as now developed, begins just southeast of Corsicana, near the old reservoir, and extends in a general northern direction, taking in a large portion of the town and extending almost north for 4 miles, with an average of width of over 1 mile, the western boundary being very close to the line of the Southern Pacific Railroad. This field is fully equipped with all the modern appliances, including gas engines in some instances, for producing petroleum in an economical manner.

During the early part of 1901 a field of heavy petroleum was developed 5 miles due east of Corsicana, and also at Powell, 3 miles farther east on the St. Louis, Arkansas and Texas Railroad. Some of these wells that produced over 100 barrels per day when first opened up are now producing only from 3 to 8 barrels per day.

Most of the wells find this heavy petroleum at a depth of 700 feet. A few to the east have found heavy petroleum at a depth of 400 feet.

The following analysis is given of Corsicana crude petroleum of 0.8206 specific gravity, by Mr. F. C. Thiele, in the Oil, Paint, and Drug Reporter:

Analysis of Corsicana petroleum.

	Per cent.	Specific gravity.
Naphtha	10.8	0.710
Kerosene (illuminating product principally)	54.5	.796
Residuum	34.7	.905
Total	100	....

BEXAR COUNTY DISTRICT.

Only a small quantity of heavy petroleum was produced in this pool in 1902. It came from wells 600 to 800 feet in depth near San Antonio and supplied a small local demand.

NACOGDOCHES COUNTY DISTRICT.

Numerous shallow wells were drilled prior to 1895 near Oil Springs in Nacogdoches County some 12 miles southeast of the town of Nacogdoches. There has been a considerable outlay in drilling wells, establishing receiving tanks, and building a pipe line, all of which has been practically abandoned. Only a very limited quantity supplying a local demand is now marketed.

PETROLEUM-PRODUCING LOCALITIES OF TEXAS, BY COUNTIES.

The localities in which petroleum has thus far been developed in Texas, in greater or less quantity and of different density and composition, are arranged by the following alphabetical list of counties. The list is taken from Bulletin No. 18 of the University of Texas.

ANDERSON COUNTY:
New Palestine. Sand impregnation.

BASTROP COUNTY:
Near Elgin.

BELL COUNTY:
Western part.
Small quantities near Belton.

BEXAR COUNTY:
Dulnig Place, 7 miles south of San Antonio.
J. Linn Survey, 10 miles south of San Antonio.

BRAZORIA COUNTY:
Kaiser Mound, near Columbia.

BREWSTER COUNTY:
Six miles east of Terlingua, in bituminous shale.

BROWN COUNTY:
Brownwood.

BURLESON COUNTY:
Near Rita.

CALDWELL COUNTY:
Near Lockhart.

CLAY COUNTY:
Two miles from Hurnville, north of Henrietta.

COLEMAN COUNTY:
Near Trickham.

COOKE COUNTY:
Muenster, west.

CORYELL COUNTY:
Gatesville.

DENTON COUNTY:
Reported 6 miles from Denton.

DUVAL COUNTY:
Piedras Pintas, near Benavides.

EDWARDS COUNTY:
Reported near Rocksprings.

EL PASO COUNTY:
Twenty miles north of Vanhorn, in small amount.

GONZALES COUNTY:
Near Ottine.

GRIMES COUNTY:
Near Keith.
Lamb Springs neighborhood.

HARDIN COUNTY:
Saratoga.
Sour Lake.

JACK COUNTY:
Ten miles north of Jacksboro.

JEFFERSON COUNTY:
- The Beaumont field.

LIVE OAK COUNTY:
- Atascosa Creek, 12 miles north of Oakville.

MCCULLOCH COUNTY:
- Near Milburn.

MCLENNAN COUNTY:
- Near Waco.

MCMULLEN COUNTY:
- Crowther.

MEDINA COUNTY:
- Near Dunlay.

MONTAGUE COUNTY:
- St. Jo, east.

NACOGDOCHES COUNTY:
- Oil Springs, 6 miles south of Melrose.
- Chireno.

NAVARRO COUNTY:
- The Corsicana field.
- The Powell field.
- Frost.

NUECES COUNTY:
- Puerto-Richard King's Ranch.

PALO PINTO COUNTY:
- Near Strawn.
- One mile north of Mineral Wells.

PECOS COUNTY:
- Fifteen miles northeast of Fort Stockton.
- Twenty-two miles north of Fort Stockton.

REEVES COUNTY:
- Pecos Valley, above and below Pecos City.
- Nine miles north of Toyah.

SAN AUGUSTINE COUNTY:
- San Augustine.

SHELBY COUNTY:
- Near Timpson.

TARRANT COUNTY:
- Near Fort Worth.

TRAVIS COUNTY:
- Walnut Creek, 9 miles north of Austin.

WILSON COUNTY:
- Sutherland Springs.

PRODUCTION OF PETROLEUM IN TEXAS.

The production of petroleum in Texas since 1889 has been as follows:

Production of petroleum in Texas, 1889–1902.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1889	48	1897	65,975
1890	54	1898	546,070
1891	54	1899	669,013
1892	45	1900	836,039
1893	50	1901	4,393,658
1894	60	1902	18,083,658
1895	50	Total	24,596,224
1896	1,450		

This table gives the total quantity of crude petroleum produced and sold in 1902 as 18,083,658 barrels. In addition to this quantity 431,359 barrels were held in tanks by the companies which produced it, making the total production for the State 18,515,017 barrels in 1902. It is estimated that at the close of 1902 storage tanks contained about 7,300,000 barrels, leaving 11,215,017 barrels as the quantity which was either used locally or shipped from the State. The total production in 1901, excluding stocks, was 4,393,658 barrels. The gain of 1902 over 1901 amounted to 311.6 per cent. The value received for crude petroleum in 1902 amounted to $3,998,097, or 22.11 cents per barrel. Compared with 1901 the total value shows a gain of 220 per cent.

In the following table is given a statement of the production of crude petroleum in Texas in the year 1902, by districts and months:

Production of crude petroleum in Texas in 1902.

[Barrels of 42 gallons.]

Month.	Beaumont.	Corsicana.	Powell.	Sour Lake, etc.	Total.
January	1,330,498	51,532	2,113		1,384,143
February	1,289,476	48,960	2,548		1,340,984
March	1,212,902	50,486	2,750		1,266,138
April	1,281,652	51,425	3,804		1,366,881
May	1,373,968	51,900	4,855		1,430,723
June	1,361,541	48,833	4,423		1,414,797
July	1,359,126	47,804	3,695		1,410,625
August	1,435,688	45,507	4,383		1,485,578
September	1,523,241	45,397	4,273	6,106	1,579,017
October	1,938,974	44,835	4,586	11,574	1,999,969
November	1,831,135	41,960	4,864	11,374	1,889,333
December	1,482,748	42,420	4,518	15,784	1,545,470
Total	[a]17,420,949	571,059	46,812	44,838	[b]18,083,658

[a] In addition to this quantity 431,359 barrels were produced and were still on hand and unsold by the producing companies in 1902.
[b] Includes a small amount of petroleum produced in Bexar County.

The following table gives a statement of the production and value of crude petroleum at wells in Texas in 1901 and 1902, by fields:

Production and value of petroleum in Texas in 1901 and 1902.

[Barrels of 42 gallons.]

Field.	1901.			1902.		
	Quantity.	Value.	Value per barrel.	Quantity.	Value.	Value per barrel.
Beaumont	3,593,113	$630,752	$0.175	17,420,949	$3,563,285	$0.2045
Corsicana	763,424	604,249	.7915	571,059	410,536	.7189
Powell	37,121	12,148	.3277	46,812	9,863	.2107
Sour Lake, etc				44,838	14,413	.3215
Total	[a] 4,393,658	1,247,150	.284	[a] 18,083,658	3,998,097	.2211

[a] Includes small production of petroleum in Bexar County.

PRODUCTION OF STOCKS IN THE BEAUMONT DISTRICT.

From the foregoing table is derived the following statement of production and stocks in the Beaumont district in 1901 and 1902:

Total production in Beaumont district for 1901 and 1902.

	Barrels.
Production in 1901, including stocks	5,185,883
Production in 1902, including stocks	17,852,308
Total production, including stocks, in 1901 and 1902	23,038,191

The stock in tanks at the close of 1901 and 1902 in the Beaumont field was as follows:

Stock of Beaumont petroleum in tanks at the close of 1901 and 1902.

	Barrels.
Stock in tanks on January 1, 1902	1,592,770
Increase at the close of 1902	5,707,230
Total amount in tanks at the close of 1902	7,300,000
Shipments during 1902	10,552,308
Total production	17,852,308

The value of the stocks held by the producing companies, many of which are also consumers owning their own refineries, is placed at the average of that portion sold, as there are no large companies purchasing the product and storing it, as at Corsicana and in other fields.

NEW MEXICO.

The following summary is from the annual report for 1902 of the governor of New Mexico, which gives an interesting description of recent oil discoveries in the Territory, and the efforts now being made to develop various deposits.

Guadalupe County.—The oil deposits in this county, in the Salado region and near Santa Rosa, are being systematically developed.

Capital has become interested in these oil fields, and drilling for oil, with every indication of success, is in progress.

In the oil fields 4 to 8 miles north of Santa Rosa the rock is asphaltum rock, and the oil oozes to the surface at various places, especially at the so-called springs on the Perea grant.

San Juan County.—This is considered a very good oil-bearing district. A number of companies have been organized for the development of oil, and one company is drilling a well near Farmington, while others are making preparations to do so. The San Juan oil lands comprise, as far as now explored, about 100,000 acres, of which 60,000 have been already filed upon.

Colfax County.—This county is now being exploited through the enterprise of Dr. J. J. Shuler and other citizens of Raton and also of Colorado Springs capitalists, and $15,000 has been raised for driving a well. This work is now in progress some 2 miles from Raton, and the well has reached a depth of 2,300 feet.

Union County.—Indications of oil can be pointed out along many streams in Union County, and often in drilling for water very promising oil indications are struck.

Eddy County.—From the Texas boundary to within a few miles of Carlsbad are fine indications of oil. A number of local companies have been organized to develop these oil indications.

Lincoln County.—There are excellent indications of oil in this county, which is famous for its mining enterprises. A great deal of capital has been brought into the county recently, and all its resources are in a fair way to be largely developed.

Otero County.—Indications of petroleum and gas have lately been struck in one of the canyons a few miles from Alamogordo. Timber and coal are plentiful, which makes the region ideal for the prosecution of mining enterprises of all kinds.

UTAH.

There has been considerable prospecting during 1902 in Utah, in Emery County, on the Green River, where a limited quantity of high-grade lubricating petroleum was developed by the San Rafael Oil Company. There was also some petroleum developed in the Sinbad field, 25 miles southwest from Green River station; and near Bluff, in San Juan County, there were a number of shallow wells drilled, which developed a small quantity of lubricating petroleum.

This State in former years produced a considerable quantity of natural paraffin or black wax from localities in the Sanpete Valley, east of Salt Lake, which were soon exhausted. At the present time several varieties of solid hydrocarbons, somewhat resembling albertite, are mined in these seams.

NEVADA.

The presence of petroleum in paying quantities has not yet been developed in this State. Several wells have been drilled in the vicinity of Elko, and although several sands and shales somewhat similar to those holding petroleum in other sections have been penetrated, they are destitute of oil so far as tested in this locality.

Indications of petroleum are reported in Lincoln County.

MONTANA.

A number of petroleum springs or seeps are known to exist in two localities in Montana. One of these localities is near the Canadian boundary separating Montana from Alberta, east of the Flathead River, in Flathead and Seaton counties. The recent strike reported to the north of this section, in Alberta, on the waters of the Kootenay River, has added additional interest to this section.

The other section of the State in which numerous seeps are known to exist is in southern central Montana, in the counties of Sweetgrass and Carbon. The latter county adjoins Wyoming. Three wells have been recently completed in Carbon County, north of the foothills of Bear Tooth Mountains, where the formations exposed are a series of sandstones and shales. Some of the sandstones carry beds of quartz pebbles that are in some instances 40 feet thick. The deepest of these wells was 1,400 feet; two others, located farther north, were from 300 to 400 feet in depth. All of these wells are reported to have developed a showing of heavy petroleum. Thus far nothing more has been done toward the testing of the many surface indications.

There are also indications of petroleum reported in Beaverhead County, in the extreme southwestern portion of the State.

In connection with the numerous discoveries of oil fields, it is interesting to note the discovery of an extensive field of petroleum shale in Montana similar to the deposits in Utah from which large quantities of the finest oils are distilled.

These fields are located about 60 miles northeast from Helena, and on unsurveyed lands, which fact has largely retarded development. But enough work has been done to prove the existence of a stratum of the shale from 6 to 12 feet thick, covering an area of from 3 to 5 miles in extent.

The shale has been tested by experts of experience in the raw material and in the distilled product, and has been pronounced of as high character as any to be found in the United States, and the deposits are said to be of great commercial value.

WASHINGTON.

During the year 1902 a number of test wells were completed in Chehalis County on the Pacific coast north of Grays Harbor, none of which found petroleum in paying quantities, although there was considerable gas encountered. Some petroleum was reported to have been found at La Push above the Hoh River, in a well completed during 1902. The wells completed north of Spokane were entirely devoid of petroleum or natural gas. So far the prospects in this State are not encouraging, but there is ample room yet for the development of a paying field in Washington.

OREGON.

A number of test wells were drilled in 1902, in Lane, Douglas, Jackson, and Wasco counties, none of which found petroleum in paying quantities. In Josephine County there are several springs in which a film of petroleum is found floating on the top of the water.

CALIFORNIA.

Condition of the industry.—The increase in the production in California during the year 1902 was remarkable, although there were fewer wells drilled than in the preceding year, and during a portion of the time operations were partly suspended for want of the transportation of the production that had accumulated. Even under these conditions the production and sale for the year 1902 were 13,984,268 barrels, the product of nearly 3,000 wells, as compared with 8,786,330 barrels produced and marketed during 1901. The value, however, $4,873,617, was less in 1902 than in 1901 by $100,923. The average price received during 1902 was 34.8 cents, as compared with 56.6 cents in 1901. At the end of 1902 there were stored at the various places of production 3,850,000 barrels of crude petroleum awaiting transportation.

The existence of such quantities of cheap fuel, which by pipe line and ocean freight may be conveniently transported to San Francisco, must add materially to the prosperity of this already prosperous State.

The imports of bituminous coal from foreign countries fell off 400,000 tons during 1902, and the domestic imports were 25 per cent less than in 1901. It has been estimated that, when the railroads of California are fully equipped for the use of liquid fuel, they alone will consume 8,000,000 barrels per year, and that the other industries in the State will use 5,000,000 barrels more when the improved methods of transportation have become fully established.

PRODUCTION OF PETROLEUM IN CALIFORNIA.

In the following tables is shown the production of petroleum in California by years, by counties for 1902, and by counties for various years:

Production of petroleum in California, 1876–1902.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
Previous to 1876	175,000	1890	307,360
1876	12,000	1891	323,600
1877	13,000	1892	385,049
1878	15,227	1893	470,179
1879	19,858	1894	705,969
1880	40,552	1895	1,208,482
1881	99,862	1896	1,252,777
1882	128,636	1897	1,903,411
1883	142,857	1898	2,257,207
1884	262,000	1899	2,642,095
1885	325,000	1900	4,324,484
1886	377,145	1901	8,786,330
1887	678,572	1902	13,984,268
1888	690,333	Total	41,834,473
1889	303,220		

Production of crude petroleum in California in 1902, by counties.

County.	1902. Quantity.	Total value.	Value per barrel.
	Barrels.		
Fresno	572,498	$257,629	$0.45
Kern	9,705,703	2,397,372	.247
Los Angeles	1,938,114	1,119,679	.58
Orange	1,038,549	661,158	.636
Santa Barbara	242,840	167,911	.69
Ventura	484,764	267,168	.55
San Mateo	1,800	2,700	1.50
Total	13,984,268	4,873,617	.348

Production of crude petroleum in California, 1897–1902, by counties.

[Barrels of 42 gallons.]

County.	1897.	1898.	1899.	1900.
Fresno	70,140	154,000	439,372	532,000
Kern	....	10,000	15,000	892,500
Los Angeles	1,327,011	1,462,871	1,409,356	1,730,263
Orange	12,000	60,000	108,077	372,200
Santa Barbara	130,136	132,217	208,370	153,750
Santa Clara	4,000	3,000	1,500	771
Ventura	368,282	427,000	496,200	418,000
Unapportioned	....	....	....	225,000
Total production	1,911,569	2,249,088	2,677,875	4,324,484
Total value	$1,918,569	$2,376,420	$2,660,793	$4,076,975
Average price per barrel	$1.00	$1.05	$0.99	$0.943

Production and value of crude petroleum in California in 1900, 1901, and 1902, by counties.

[Barrels of 42 gallons.]

County.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fresno	532,000	$532,000	780,650	$390,325	572,498	$251,388
Kern	892,500	699,125	4,493,455	1,704,085	9,705,703	2,397,372
Los Angeles	1,730,263	1,730,263	2,188,633	1,584,412	1,938,114	1,119,679
Orange	372,200	377,783	724,565	724,565	1,038,549	661,158
Santa Barbara	153,750	138,375	135,900	116,640	242,840	167,911
Santa Clara	771	1,119	....	....	....	....
Ventura	418,000	384,560	463,127	454,513	484,764	267,168
San Mateo	....	....	....	....	1,800	2,700
Unapportioned	225,000	213,750	....	....	....	....
Total	4,324,484	4,076,975	8,786,330	4,974,540	13,984,268	4,873,617
Value per barrel	....	0.943	....	0.566+	....	0.348

ALASKA.

Alaska contains numerous surface indications of petroleum, beginning at Cape Yaktag, about 400 miles northwest of Sitka, and extending to Cape Martin, about 35 miles east of the mouth of the Copper River, a distance of 80 miles. The prospective territory is on the mainland, and extends from the coast line from half a mile to 4 miles inland, and its promising oil indications have invited many explorers to this wild region. There are found in this section of Alaska remarkable pools of crude petroleum from a foot in diameter up to 10 or 15 feet, and many of the streams emptying into the ocean carry a continuous film of petroleum. Farther back from the coast, in the Kayak region, there is a series of sandstones which carry several veins of bituminous coal from 3 to 8 feet in thickness.

One of the original discoverers of these surface indications was Mr. R. C. Johnson, who ran across them while exploring the numerous small creeks along the ocean for gold. In 1896 he organized the Alaska Development Company, whose stock was largely taken by English capitalists, and which is now known as the Alaska Steam Coal and Petroleum Syndicate. This company, after many unsuccessful attempts to drill a well, succeeded in getting one down late in the summer of 1902, which, at 365 feet, gave very promising results. This well was located on one of the small streams entering Catella Bay from the east on a low divide extending toward Point Hay, where there were abundant surface exposures and small feeders of petroleum constantly coming to the surface.

From Catella Bay to the east there are numerous springs and pools of petroleum, accompanied by natural gas and water, and highly charged with sulphur, extending to the mouth of the Chilkat River and up this stream for several miles. Still farther east, as far as Cape Suckling, but several miles inland, there are other surface indications.

The following is a record of the well completed as reported by the Alaska Steam Coal and Petroleum Syndicate, before referred to:

Log of well east of Catella Bay, Alaska, drilled in 1902.

Formation.	Feet.
6 feet surface drift	6
10 feet decomposed shale	16
140 feet light-colored shale	156
18 feet fine-grained sandstone	174
One-half foot coal contained in the sandstone	174½
190 feet dark shale, very hard	364½
One-half foot quartz containing iron pyrites and contained in the shale	365
1 foot oil sand and flow of oil	1
Total	366
Length of [illegible]-inch casing	[illegible]
Length of [illegible]-inch casing	[illegible]

Numerous small showings of petroleum and natural gas were encountered as the drill proceeded down, and when at 366 feet a large quantity of oil was developed, which flowed some petroleum. The well is said to have continued to flow until it was capped.

An analysis of this petroleum is said to be as follows:

Analysis of Alaska petroleum from Catella Bay well.

Specific gravity at 60° F. 0.7958, equal to 45.9° Baumé.
Cold test did not chill at 3° F. below zero.

	Per cent.
Distillation below 150° C., naphtha	38.5
150° C. to 285°, illuminating petroleum	31
Above 285° C., lubricating petroleum	21.5
Residue, coke and loss	9
Total	100

The petroleum is said to have a paraffin base.

Such a strike has caused the influx of a great number of prospectors and petroleum operators who have located a vast number of mining claims in this region. A second well is drilling not far from the original well owned by the Alaska Steam Coal, and Petroleum Syndicate, which at this writing has not found any petroleum.

There are some indications of petroleum near Innerskin Bay on the northwest shore of Cooks Inlet. This territory has been partially tested by a well recently drilled, but no very promising results have thus far been secured.

Petroleum indications are also reported on the Yukon River near Nulato, also near Cape Sabine on the Arctic Ocean near the sixty-ninth parallel.

The serious difficulty in developing the oil territory of Catella Bay, generally known as the Kayak petroleum field, is the absence of any harbor. Controller Bay is very shallow, and the mouth of Catella Bay is obstructed by a bar. A pipe line could, however, be laid from the present development across Controller Bay, a distance of 18 miles, to Big Kayak Island, where near the northern extremity there is a superior landlocked harbor.

FOREIGN COUNTRIES OF THE WESTERN CONTINENT.

CANADA.

ONTARIO.

For over twenty years there has been a gradual decline in the production of petroleum in Canada. This decline has been heaviest in the Oil Springs pool, while on the other hand the Petrolia district has continued to produce from 70 to 80 per cent of the entire output, with a regularity that is surprising.

The other sections of Canada where petroleum is known to exist have thus far failed to supply any petroleum in commercial quantities. This is true of the provinces of New Brunswick, Quebec, Nova Scotia, Cape Breton, Alberta, and British Columbia. These localities are thousands of miles apart and the western provinces embrace large areas of unexplored territory, which may some day contribute vast quantities of fuel and illuminating petroleum.

The present production of crude petroleum is only sufficient to furnish about 50 per cent of the total amount consumed in Canada, the remainder being imported principally as illuminating petroleum from the United States. There is a government tax of $1.75 per barrel on the refined product, while the tax on the crude article is just one half this amount.

A very large proportion of the crude petroleum produced is converted into merchantable products by the Imperial Oil Company

(Limited), which is located at Sarnia at the mouth of the St. Clair River, and which is connected with Petrolia and Oil Springs by pipe lines. A very complete refinery, though of moderate capacity, which belongs to the Canadian Refining Company (Limited), has also been recently erected at Petrolia.

Toward the close of the year 1902 there was a large well drilled a few miles southeast of Chatham, which caused considerable excitement. Of the numerous wells drilled on the strength of this first producer only a few paid, and the great majority were either dry or were wells of very moderate capacity. The new field is credited with producing only 2,462 barrels in 1902.

Nearly 10,000 wells in Canada produced only 519,845 barrels of petroleum in 1902. Of this number 8,100 were operated at Petrolia and vicinity; about 1,050 at Oil Springs. Euphemia, and Smiths Falls; 95 at Dutton; 210 at Bathwell, and 35 at Northwood and Chatham. The entire field is a few miles east of the St. Clair River in Ontario. The oil is found in a peculiar porous streak in the Corniferous Limestone from 2 to 5 feet in thickness, which invariably has to be shot, that is, torpedoed, before anything like the usual amount of production can be secured.

The depth of the oil-bearing strata is on an average about 465 feet. The wells are very successfully operated in large clusters or groups, and the whole work is carried on in the most economical and business-like way. The character of the petroleum produced at the wells is very similar to that found in the Lima, Ohio, and the Indiana fields. It contains a considerable proportion of sulphureted hydrogen, which makes it difficult to refine, as it is necessary to remove this gas from the merchantable article owing to its offensive odor.

QUEBEC.

Gaspé Bay.—The Canadian Petroleum Company continues to operate in this portion of Canada, and preparations are being made to complete a refinery in this locality. Diligent search, however, has failed to establish the existence of any large amount of petroleum in this district.

NEW BRUNSWICK.

A number of wells have been drilled in the vicinity of Memramcook, south of Moncton, in Westmoreland district. Several of the wells have produced a fair quantity of a superior grade of petroleum. Lately two deeper wells, that found the oil sand at about 1,450 feet, have been drilled. A pumping plant is nearing completion, and a refinery, with a capacity of 400 barrels per day, has been begun, at which benzine, naphtha, and illuminating and lubricating oils will be extracted from the crude petroleum. For the present the more complex residuum will not be further treated, but will be used for fuel. The production comes from the Lower Carboniferous measures.

NOVA SCOTIA.

After several expensive tests by deep wells, the region near Lake Aimslie has been abandoned for the present. The succession of slates and sandstones are very similar to those found in the Pennsylvania and West Virginia oil fields.

CAPE BRETON.

There are some surface indications of oil in the northern portion of Cape Breton, but the territory has not yet been tested.

ALBERTA.

In the southwestern portion of Allerton a well of considerable showing of petroleum was drilled in toward the close of the year on the waters of the Belly River, not far north of the line of the United States. Unfortunately the tools became stuck at a depth of about 1,200 feet, just where the oil-producing formation was tapped. A well was drilled also near Calgary, on the main line of the Canadian Pacific Railroad, which at a depth of 1,020 feet found a considerable quantity of petroleum of a superior quality.

Several years ago a well of some importance was secured near Edmonson. Still farther north, following along the Athabasca River, in the Athabasca district, there are numerous indications of petroleum, reaching to the Pacific Ocean. There are conditions in the central and western portions of British Columbia similar to the regions producing petroleum in California on the south and Alaska on the north, and that will in all probability produce petroleum in quantity in the future when there are sufficient facilities for transportation. At present this region is almost an unexplored wilderness.

NEWFOUNDLAND.

Although there are numerous indications of petroleum along the northwestern margin of Newfoundland, and although a number of wells have produced more or less petroleum, yet so far there seems to have been little progress made in securing a profitable yield. The petroleum of this region is found in the oldest known producing strata correlated with the Quebec group, and underlying the Chazy and the Trenton, and for this reason it is watched with considerable interest, as there are many similar geological conditions on the east flank of the Appalachian Mountains in our Southern States.

PRODUCTION IN CANADA.

The following is a statement of the production of crude petroleum in Canada in the years 1898 to 1902, inclusive, by districts:

Production of crude petroleum in Canada, 1898–1902, by districts.

[Barrels of 35 imperial gallons, or about 42 standard gallons.]

District.	1898.	1899.	1900.	1901.	1902.
Petrolia	513,179	[a] 528,641	541,435	432,906	397,628
Oil Springs	133,366	[b] 107,487	99,019	76,059	60,747
Bothwell	66,404	65,044	47,405	52,873	50,141
Plympton	25,000				
Dawn	5,923				
Euphemia	5,227				
Zone	901				
Dutton		3,622	4,791	10,588	8,867
Raleigh					2,462
Total	750,000	704,794	692,650	572,416	519,845

[a] Includes production from Plympton. [b] Includes the production from Dawn, Euphemia, and Zone.

There has been a considerable decline in production in 1902 as compared with previous years—mainly in the Petrolia district. The new development southeast of Chatham, known as the Raleigh district, opened up toward the close of the year, appears in the table for the first time.

Canadian oils and naphtha inspected and corresponding quantities of crude oil, 1881–1902.

Year.	Refined oils inspected.	Crude equivalent calculated.	Ratio of crude to refined.	Production of crude petroleum.	Average price per barrel of crude.	Value of crude oil.
	Imperial gallons.	*Imperial gallons.*		*Barrels.*		
1881	6,457,270	12,914,540	100 : 50	368,987		
1882	6,135,782	13,635,071	100 : 45	389,573		
1883	7,447,648	16,550,328	100 : 45	472,867		
1884	7,993,995	19,984,987	100 : 40	571,000		
1885	8,225,882	20,564,705	100 : 40	587,563	$0.82¼	$483,271
1886	7,768,006	20,442,121	100 : 38	584,061	.90	525,655
1887	9,492,588	24,980,494	100 : 38	713,728	.78	556,708
1888	9,246,176	24,332,042	100 : 38	695,201	1.02⅔	713,740
1889	9,472,476	24,664,144	100 : 38	704,690	.92¾	653,600
1890	10,174,894	26,776,037	100 : 38	765,030	1.18	902,735
1891	10,065,463	26,435,430	100 : 38	755,298	1.33¾	1,010,211
1892	10,370,707	27,291,334	100 : 38	779,752	1.26¼	984,438
1893	10,618,804	27,944,221	100 : 38	798,406	1.09½	874,255
1894	11,027,082	29,018,637	100 : 38	829,104	1.00¾	835,322
1895	10,674,232	25,414,838	100 : 42	726,138	1.49⅔	1,086,787
1896	10,684,284	25,438,771	100 : 42	726,822	1.59	1,155,647
1897	10,434,878	24,844,995	100 : 42	709,857	1.42½	1,011,546
1898	11,148,348	26,543,685	100 : 42	758,391	1.40	1,061,747
1899	11,927,981	28,399,955	100 : 42	811,427	1.48⅔	1,206,321
1900	13,428,422	24,867,449	100 : 54	913,498	1.62	1,479,867
1901	[a] 11,123,194	26,483,795	100 : 42	756,679	1.62	1,225,820
1902	8,942,361	21,291,336	100 : 42	530,624	1.79¼	951,190

[a] Petroleum and naphtha.

TRINIDAD.

Recent wells completed a little north of the famous Pitch Lake of the island of Trinidad at Guayaguayare in the extreme southeastern portion of the island, have developed one well in this locality which is said to be good for 40 barrels per day and another good for 10 barrels, at a depth of 1,140 feet. The petroleum developed by these wells is said to be quite light in gravity, although very dark in color. Several other well locations have been made, and a thorough test of the possibilities of the island as a producer will be made.

For many years past immense quantities of asphaltum have been taken from Pitch Lake on this island, without any apparent exhaustion of the supply.

ARGENTINA.

Petroleum springs are found on the surface in some places in Argentina, the best known of which are Garrapatal and La Brea, their origin being due to subterranean deposits of unknown depths. The appearance at the surface through narrow crevices in the rocks is easily explained by the fact that gases generating in the interior naturally seek an exit, and force the liquid to the surface. These springs have existed for a long time, and the air has condensed and hardened the oil and converted it into a kind of asphalt. In this manner is formed a mixture resembling tar, out of which the oil oozes at the places mentioned. Near these springs are also found hot springs and sulphur springs. Another proof of subterranean vapors of great expansive force in the provinces of Jujuy and Salta is the frequent occurrence of earthquakes in that vicinity. Petroleum springs are also found in Vachenta, province of Mendoza.

Petroleum is found on the east slope of the Andes Mountains, in southwestern Argentina, not far from the town of Mendoza, and also at other places in the Republic. It is used principally for locomotive fuel.

PERU.

Peru is the only country in South America that produces any refined petroleum.

Production of petroleum in Zorritos oil field of Peru, 1896–1902.

[Gallons.]

Year.	Crude petroleum.	Refined.	Lubricating oil.	Benzine.
1896	1,996,520	608,900	896,450	4,560
1897	2,874,980	959,645	964,680	7,940
1898	2,880,000	600,000	1,250,000	8,350
1899	3,745,000	806,900	2,541,000	11,220
1900	4,325,000	[a] 400,000	....	13,000
1901	3,135,000	[a] 282,430	....	19,060
1902	2,489,500	[a] 373,250	....	25,920

[a] Kerosene.

COUNTRIES OF THE EASTERN CONTINENT.

RUSSIA.

Condition of the industry.—For the first time in eight years the output of crude petroleum in Russia in 1902 has shown a decline. The decline is not very large; it amounts to 4,628,512 barrels, equal to 5 per cent. The production for 1902 was 80,540,044 barrels; that of 1901 was 85,168,556 barrels, the latter being the largest output of crude petroleum in any country in the history of the development up to that date.

This decline in the production in 1902 was due to several known causes, and not to any lack of supply in the original reservoirs. The principal reasons for the decline in the output are the want of organization among the producers as a whole, the inferior means of storage and transportation, and the very heavy tax imposed by the Russian Government upon certain territory that is controlled by it. This tax is based upon a minimum production, and compels the operators on the Government leases to work their wells up to their limit and make forced sales. The quantity thus thrown on the market was so large that at times the price received was less than the tax paid. The average price for crude petroleum was 20 per cent lower than for the year previous.

A new field was developed in December, 1902, by a well drilled by the Nobel Brothers near Berekei Station, on the Vladikavkas Railroad, 170 miles northwest of Baku. The petroleum is said to be of superior quality and entirely disconnected from any other development, and it may become a prominent factor in the future. The present output is only about 1,000 barrels per day. The Bibi-Eibat district produced the largest quantity of petroleum from flowing wells, showing an increase of 40 per cent in 1902 over 1901.

There was a large flowing well or spouter drilled in during the year on the Rothschilds plot, No. 25, at Romany, which yielded about 80,000 barrels per day. Another well on an adjoining property, belonging to Polock & Co., flowed naturally at the rate of 100,000 barrels per day. A large area in the Romany Valley was covered by this great output from the two spouters mentioned. The proportion of crude supplied from the flowing wells amounts to 15 per cent of the production, which is very close to the proportion of last year, although the work in drilling and deepening was much greater in 1901 than it was in 1902.

The Grosni field continued to produce regularly, the output for 1902 being nearly the same as for 1901.

The demand for fuel petroleum continues, although the price declined from an average of 38 cents per barrel in 1901 to 33 cents per barrel in 1902, a loss of 5 cents per barrel.

Close to 50 per cent of the entire output was disposed of as fuel petroleum or residuum. The amount thus consumed reached between 38,000,000 and 40,000,000 barrels in 1902, and would require 13,500,000 tons of Russian coal to replace it.

In the body of this report will be found a detailed statement of the various conditions of the industry in Russia for the year 1902, compiled by Mr. James C. Chambers, United States consul at Batum.

PRODUCTION IN RUSSIA.

Total production of crude petroleum in Russia, 1897–1902.

[Barrels of 42 gallons.]

Year.	Apsheron Peninsula.	Grosni.	Total.
1897	51,645,568	2,754,000	54,399,568
1898	59,409,357	2,200,000	61,609,357
1899	63,048,909	2,906,059	65,954,968
1900	72,120,493	3,658,924	75,779,417
1901	80,977,638	4,190,918	85,168,556
1902	76,414,045	4,125,999	80,540,044

Comparative production of crude petroleum of Russia and the United States, 1894–1902.

[Barrels of 42 gallons.]

Year.	Russia.			United States.			Production of Russia in percentage of production of United States.
	Profitable production.	Gain or loss.	Percentage of gain or loss.	Production.	Gain or loss.	Percentage of gain or loss.	
1894	36,375,428			49,344,516			
1895	46,140,174	9,764,746	+26.8	52,892,276	3,547,760	+ 7.19	87.2
1896	47,220,633	1,080,459	+ 2.3	60,960,361	8,068,085	+15.25	77.4
1897	54,399,568	7,178,935	+15.2	60,475,516	− 484,845	− .80	89.9
1898	61,609,357	7,209,789	+13.3	55,364,233	−5,111,283	− 8.40	111.3
1899	65,954,968	4,345,611	+ 7.05	57,070,850	1,706,617	+ 3.08	115.5
1900	75,779,417	9,824,449	+14.9	63,620,529	6,549,679	+11.50	119.1
1901	85,168,556	9,389,139	+12.4	69,389,194	5,768,665	+ 9.07	122.7
1902	80,540,044	4,628,512	− 5.4	88,766,916	19,377,722	+27.91	90.7

Percentages of world's production of petroleum in 1901 and 1902, by countries.

	1901.	1902.
Percentage of total crude petroleum produced by Russia	51.49	43.50
Percentage of total crude petroleum produced by the United States	41.97	47.94
Percentage of all other countries producing petroleum	6.54	8.56
Total	100.00	100.00

FERGANA, CENTRAL ASIA.

According to London Engineering, the petroleum deposits in Fergana, the most easterly of the Russian provinces in Central Asia, are at present attracting considerable attention. Petroleum seems to exist in almost all parts of the province, and it is in many places found together with a black asphalt-like substance, which is called "kirr," and which is already being somewhat extensively exploited for asphalting purposes. The richest deposits appear to be in the Andishan district, along the borders of the river Malu-Su, and in the Margelan district. The former have recently been examined and a number of borings carried out. The latter, known as the Tschinison deposits, are situated some 16 miles from the town of Margelan and about 12 miles from the railway station of Vannowskoja, on the Central Asian Railway. These deposits have already been worked, in days long gone by, by the Chinese, it is surmised, but when the Russians took possession of the province the petroleum industry was revived in a primitive manner, although the yield was somewhat important. The matter was again dropped, from want of capital and want of transport, but the building of the Samarkand-Andishan Railway gave a fresh impetus to exploitation, and a company has been formed with a capital of 250,000 rubles. The oil-carrying layers are located at a considerable depth, probably about 1,000 feet. Preparatory work for the construction of a pipe to the Vannowskoja Railway has already been commenced, and the building of large tanks is under contemplation. The petroleum is likely to find a ready sale for the Central-Asian and the Orenburg-Taschkent railways.

AUSTRIA-HUNGARY.

GALICIA.

Condition of the industry.—The very remarkable production to the south of the old town of Boryslaw in central Galicia, which for many years has supplied the wonderful mineral wax or ozocerite, has completely demoralized the production in the older fields scattered along the flanks of the Carpathian Mountains for 200 miles. The deep wells in the Boryslaw field began to produce largely at the close of 1901. The year 1902 developed a number of these deep gushers, several of which at a depth of 900 meters, or about 3,000 feet, have flowed as much as 3,500 barrels per day, and even at this depth the oil-bearing strata has not yet been exhausted. The price of crude petroleum was greatly depressed by these large flowing wells, so that very few pumping wells in the other fields could be operated at a profit. The price declined as low as 1 crown, or 50 kreuzers, per 100 kilos, equal to 32 cents per barrel. Many of the wells had to be closed down, as the tankage and railroad facilities were overburdened. This low price must certainly stimulate capitalists to devise some plan by which this article can be marketed in the outside countries. Germany would probably take the crude petroleum in large quantities, but the Austrian refiners want to reap the benefit of refining the crude. It is highly probable, however, that it will finally find a market in Germany either in the refined or in the crude state.

As a fuel oil, it should find a ready market at much better prices than those quoted, as there is a great scarcity of good bituminous coal in this portion of Austria.

There is no doubt that a strong company, having sufficient capital and with the proper franchises, could arrange to market the present production of Galicia at a profit, if it were possible to get the producers to give the necessary united support and thereby reap the benefit due to them. The output of petroleum in Galicia places it second in the list of producing countries in Europe and Asia, the output being about 2 per cent of the entire world's production. The importation of colored distillate, classed as crude, from Russia to Fiume, which amounted in the last sixteen years to 12,729,410 metric centners, or 9,165,000 barrels, ceased in the year 1900, owing to the increased duty imposed by the Austro-Hungarian Government.

The Galician Petroleum Association have just published interesting data relative to the petroleum industry of Galicia in 1902. It is stated that the total quantity of crude oil produced in Galicia last year amounted to 576,000 metric tons, exclusive of the quantity used as fuel at the oil fields. The increase in production, as compared with 1901, amounts to 123,800 metric tons, or 21.35 per cent. From 1896 to 1900, inclusive, the output increased by about 300,000 tons. The increase in the production is almost exclusively due to the prolific wells at Boryslaw, the production in other districts compared with 1901 having changed but little. Boryslaw alone produced last year 261,220 metric tons, or 46 per cent of the total production of Galicia. In eastern Galicia 467,300 tons were produced; in western Galicia there were only 108,760 tons. The greatest proportion of the production (60 per cent) was produced by foreign companies, Galician firms contributing only 40 per cent.

It is specially interesting to note the average productivity of Galician wells. The number of borings at the end of 1902 was 1,824. Thus the average production per well for the year amounted to 316 tons. In western Galicia the average production per well per annum amounts to 120 tons; in eastern Galicia to 600 tons. In Boryslaw, where the oil is produced exclusively by spouters; the average production per well for the year is 3,000 tons.

As the development of the petroleum industry in Galicia at the present moment depends very largely on Boryslaw, where all the boring operations are concentrated, while in other localities the operations are limited to bailing old wells, the local conditions must be taken into account in order to form an idea of what the production in

Galicia may be in the near future. In the opinion of geologists the oil deposits of Boryslaw are not likely to be exhausted for some years.

At the end of 1902 there were at Boryslaw 125 wells in course of boring. Assuming that one-half of these wells are completed in course of 1903 and that one-third are productive during the whole year, and allowing an output of 3,000 tons per well, this would represent an increase in production for the year of 120,000 tons.

During the year the Austro-Hungarian refineries treated 490,230 metric tons of crude oil, and of this, 83,870 tons, or including remainder of stock left over from 1901, about 140,000 tons, could not find a market in Austria-Hungary, which was the cause of the great fall in prices. It may be mentioned that in 1902 the Austrian refineries exported to foreign countries 30,950 tons of burning oil, for the manufacture of which 80,000 tons of crude oil were required, which was sold to the refineries at a specially low price. Thus, as the quantity of crude oil required for kerosene in Austria-Hungary was only from 410,000 to 420,000 tons, the remaining 150,000 tons must be disposed of abroad in the form of kerosene or crude, or be used up in the country for fuel purposes in order to obviate overproduction. In all probability this will be avoided by the export of kerosene abroad, mainly to Germany.

The data given below show the development of the Galician petroleum industry. Up to the year 1894, inclusive, the figures are taken from the statistical reports of the Austrian ministry of agriculture, and those since 1895, inclusive, from the reports of the Galician Petroleum Association:

Production of crude petroleum in Galicia, 1886–1902, by districts.

Year.	Quantity.	District.
	Metric tons.	
1886....	42,540	Gorlice district (Kryg, Lipinki, Libusza, Siary, Sekowa, Kobylanka, Mencina, Wojtowa Harklowa); Bobrka; Lodyna, near Ustrzyki; Ropianka, near Dukla; Sloboda; Rungurska.
1887....	47,817	The above districts and Wietrzno, near Bobrka, Weglowka, near Krosno, Wankowa, and Ropienka, near Olszanica.
1888....	64,882	Same, and Rowne, near Dukla.
1889....	71,659	Same.
1890....	91,650	The above, and Strzelbice and Stary Sambor.
1891....	87,717	The above, and Patok, near Krosno.
1892....	89,871	The above, and Torogzowka, near Krosno; Brelikow, near Olszanica.
1893....	96,331	Districts as in 1886.
1894....	132,000	Districts as in 1886, and Schodnica.
1895....	214,810	Districts as in 1886, chiefly Neu Sandez to Sanok and Lisko to Stryj.
1896....	339,765	Chiefly the second named in above.
1897....	309,626	Chiefly the second and Pasieczna.
1898....	323,142	Do.
1899....	316,384	Do.
1900....	326,334	Chiefly the second and Pasieczna, and Boryslaw, Urycz, Bitkow.
1901....	452,200	Do.
1902....	576,060	Do.

The following table gives a comprehensive idea of the exploitation of the fields in 1901:

Production of crude petroleum in Galicia in 1901, by districts.

District.	Number of bore holes—			Number of—			Quantity.
	With traces of oil.	Productive.	Under boring.	Producing firms.	Producing wells.	Wells in boring.	
							Metric tons.
Neu Sandez, Gorlice	96	12	4	51	400	26	27,000
Jaslo, Krosno, Sanok	170	23	9	39	452	51	81,780
Lisko, Chyrow	130	11	5	12	153	14	22,300
Stryj, Drohobycz	54	10	7	88	607	139	309,700
Stanislaw, Kolomea	51	7	4	34	128	23	11,690

The producing localities and productions are divided into five districts, of which Neu Sandez, Gorlice, and Jaslo, Krosno, Sanok are in the mining district of Jaslo; Lisko, Chyrow in the mining district of Drohobycz; Stanislaw, Madworna, Kolomea in the mining district of Stanislaw.

The total number of petroleum properties in Galicia in 1901 was 240, in 78 localities, of which 166 produced oil, 35 had started boring, and 38 had given up operations.

PRODUCTION IN GALICIA.

In the following table is given a statement of the production of crude petroleum in Galicia from 1886 to 1902, inclusive, as ascertained by the statistical bureau of the Galizischer Landes-Petroleum-Verein, Lemberg:

Production of crude petroleum in Galicia, 1886–1902.

Year.	Quantity.		Year.	Quantity.	
	Metric centners.	*Barrels of 42 gallons.*		*Metric centners.*	*Barrels of 42 gallons.*
1886	425,400	305,884	1895	2,020,720	1,452,999
1887	478,176	343,832	1896	3,397,650	2,443,080
1888	648,824	466,537	1897	3,096,263	2,226,368
1889	716,595	515,268	1898	3,304,510	2,376,108
1890	916,504	659,012	1899	3,216,810	2,313,047
1891	877,174	630,732	1900	3,263,340	2,346,505
1892	898,713	646,220	1901	4,522,000	3,251,544
1893	963,312	692,669	1902	5,760,600	4,142,159
1894	1,320,000	949,146			

The following equivalents of value, weight, and length are given:

1 crown=20.3 cents.
1 florin or gulden=40.2 cents.
1 metric ton=2,204.62 pounds.
1 metric ton=7.1905 barrels of crude petroleum of 42 gallons=2,204.62 pounds.
1 metric centner } =100 kilos (220.462 pounds).
1 quintal }
1 kilo=2.20462 pounds.
1 gallon refined petroleum=6.6 pounds.
1 gallon crude petroleum=7.3 pounds.
1 quintal or 1 metric centner of refined petroleum=0.795317 barrel of 42 gallons.
1 quintal or 1 metric centner of crude petroleum=0.71905 barrel of 42 gallons.
1 kilometer=3,280.89 feet=0.6213 mile.

STATISTICS OF GALICIAN PETROLEUM FIELDS IN 1901 AND 1902.

The following table gives the statistics of the Galician petroleum fields in 1901 and 1902:

Number of properties and of wells, by districts.

District.	Number of properties.		Number of wells.					
			In boring.		In exploitation.		Total.	
	1901.	1902.	1901.	1902.	1901.	1902.	1901.	1902.
							Metric tons.	*Metric tons.*
Jaslo	101	88	77	37	852	916	929	953
Drohobycz[a]	105	131	152	169	760	813	912	982
Stanislaw	34	33	20	1	128	147	148	148
Total	240	252	249	207	1,740	1,876	1,989	2,083

[a] Includes Boryslaw.

Number and capacity of reservoirs.

District.	Number of reservoirs.		Total capacity.	
	1901.	1902.	1901.	1902.
			Metric tons.	*Metric tons.*
Jaslo	698	698	75,600	75,600
Drohobycz[a]	784	813	120,810	174,250
Stanislaw	199	199	4,500	4,500
Total	1,681	1,710	200,910	254,350

[a] Includes Boryslaw.

OZOCERITE.

This solid hydrocarbon is also known as mineral wax, and, under the name of paraffin, is a constituent of the crude petroleum found in the eastern fields of the United States and in many of the European fields, the exceptions being chiefly California and Texas in this country, Peru in South America, and Japan and Borneo in Asia.

Some deposits of a mineral closely related to ozocerite, mined in former years in Utah, were finally exhausted. Immense quantities are extracted from the crude petroleum found in the Pennsylvania and the Lima (Ohio) fields, and also from the crude petroleum produced in Galicia, Roumania, Sumatra, and India.

The principal natural supply comes from Boryslaw, in Galicia, where it has been mined for a number of years by shafts from 30 to 200 meters in depth, from which lateral galleries are driven.

It is necessary to force a large amount of pure air into these workings to carry off the natural gas, which is more or less abundant and which in the past has caused serious explosions, involving the loss of many lives.

As the production does not vary greatly from year to year, the conditions are probably quite similar at this time to those obtaining in 1899, when the condition of the industry was described by the Petroleum and Mining Review. According to that journal ozocerite is found in Austria-Hungary, Roumania, Egypt, Algeria, Canada, and Mexico, generally mingled with rock salt and coal. But so far it has not been discovered anywhere in sufficient quantity to give rise to a lucrative exploitation, except in the district of Boryslaw, in the province of Galicia.

From an official investigation made in 1898, it is stated that during the previous year the Galician mines of ozocerite covered a surface of 956,885 square meters, exploited by 42 firms, and employing 5,413 persons, and the production at that date had amounted to 77,586 quintals, or 8,554 tons.

In 1899 there were exported from Austria 54,413 quintals, or 6,000 tons of ozocerite, valued at 2,149,900 florins, or $864,260, of which 68 per cent, or 37,367 quintals, were for Germany. The rest was shipped to France, Great Britain, and other countries.

In the same year 11,210 quintals, or 1,236 tons, of refined ozocerite, of the value of 588,500 florins, or $236,577, were exported, but for several years past the exportation of the refined product has diminished.

An ozocerite mine is opened by digging a pit, which is put in communication by means of galleries with the deposits of the wax. It sometimes happens when a mine is opened that the enormous pressure of the accumulated gases causes the soft wax to spurt out with violence. Such accidents endanger the lives of the miners, who are obliged to flee to the higher parts of the mine. In certain cases the pressure is so strong that the whole excavation is filled with the wax to the surface. Previous to 1884 the annual average of the deaths caused by such accidents was nine in a thousand. Lately, however, measures have been taken by the Government to protect the lives of the miners. Mineral wax is never found in a pure state, and for exportation must be freed near the mine of the foreign matters contained—earth, small stones, etc. For this purpose it is put into vats heated either by open fire or by steam. In the first case the fire chamber is so arranged as to heat the sides as well as the bottom of the vat, for otherwise the vat would become superheated, which would cause a partial distillation.

The greater part of the ozocerite produced in Austria, says Le Chimique, is converted into ceresin. There are about twenty refineries, and it is doubtful whether two of these refineries employ the same process. In most of the refining factories the wax is mingled with from 6 to 10 per cent of sulphuric acid, heated, and filtered through bone black or charcoal, which imparts a clear yellow color.

It is treated anew with sulphuric acid and finally with caustic soda, until no trace of acid remains. Efforts have been made with some success to replace sulphuric acid with benzol; in this case the solvent must be eliminated by distillation.

ROUMANIA.

Condition of the industry.—The natural resources of petroleum in Roumania are much greater than its production would at the present time indicate. Its geographic position and its undeveloped possibilities will one day place it among the most important producers of superior grades of petroleum and its derivatives. Progress toward the improved methods of developing the known petroleum fields is slow, as a large percentage is produced from hand-dug wells. The facilities for transportation and storing the comparatively small amount of petroleum that is now produced are inadequate. The pipe lines in existence are short, reaching only the nearest railroad station or an inland refinery. The railroads are the principal method of transportation, and their rates are necessarily high on both the crude and the manufactured products, and the facilities are inadequate to the demands of a country that is capable of so large an increase in its production. The crude petroleum should be refined inside of its borders, as thereby numerous incidental industries will be benefited.

Roumania is a large importer of English coal, which costs not less than $9 per ton at many points of consumption. This should in a great measure be replaced by the residuum of the refineries, as is the case now, but to a certain extent only.

A very able report upon this industry in Roumania has been made by Mr. Jacques Kanitz, and although the figures for the production are placed by him at quantities considerably less than were reported from other sources, it is highly probable that the true production lies somewhere between the two statements.

PETROLEUM INDUSTRY IN ROUMANIA IN 1902.

Mr. Kanitz says that Roumania did not escape the great depression which prevailed in the principal centers of the petroleum production in the world in the beginning of 1902. Accordingly a continuous depression in the prices of crude oil is to be noted in the markets of that country during the period covered by the present report, a depression which, unlike that in Russia and America, continued to the end of the year.

The constant increase in the production, without proportional increase in consumption, together with the total lack of organization among the producers, naturally led to a decline in the price of crude oil from 4 kreutzers per kilogram (1 kreutzer equals one-half cent), equal to 58 cents per barrel in October, 1901, to 3½ kreutzers in December, 1901, and to 3 kreutzers per kilogram, equal to 50 cents per barrel, in April, 1902, and toward the end of the year the price reached a minimum of about 1.70 francs per 100 kilograms at the well, equal to 42½ cents per barrel.

Up to the middle of the year the movement toward a combination of the crude-oil producers, supported with the utmost energy by the Roumanian ministry of domains, showed every promise of success. For this reason the price maintained itself above 3 francs up to that period, notwithstanding the fact that in the first half of the year, while the stimulus of the high prices continued, the production had increased considerably. When that combination failed to be realized, and when the consumption of illuminating and heating oil underwent its usual summer decline, without any sale for the crude oil, with which the producers' tanks were soon filled, the prices necessarily dropped, and some producers were even forced to suspend the production of oil or to stop their bore holes before they had reached the oil.

Despite this involuntary limitation of the production in the second half of the year, the total production of 1902 amounted in round numbers to 310,000 metric tons of crude oil, an increase of about 15 per cent over the 270,000 tons of the preceding year, the highest annual production yet attained in Roumania.

The production of the last ten years was as follows:

Production of crude oil in Roumania, 1893–1902.

Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*
1893	56,600	1898	180,000
1894	64,530	1899	250,000
1895	76,000	1900	250,000
1896	80,000	1901	270,000
1897	110,000	1902	310,000

The proportion in which the several districts participated in the total production underwent no material change during the year 1902. Prahova district still produces by far the greatest quantity. The only notable increase was in Dimbovita district, whose quantity was mainly increased by the successful boring operations of the International Roumanian Petroleum Industry Company, in the Gura Ocnita, in 1902. The production of the various districts in 1902 is estimated as follows:

Production of oil in Roumania in 1901 and 1902, by districts.

District.	1902.	1901.
	Metric tons.	*Metric tons.*
Prahova	259,000	233,000
Dimbovita	33,000	17,000
Bacau	13,000	14,000
Buzeu	5,000	6,000
Total	310,000	270,000

The Steaua Romana Company contributes about 45 per cent of the total production of 1902, while only two other companies, the Talega Oil Company and the International, show a production of more than 10 per cent each of the total production.

As regards boring, the first half year of 1902 shows a greater activity than the second half year. The stagnation in the second half year is to be attributed mainly to the causes above set forth, namely, the decline in the price of crude oil, lack of storage room, and lack of sale.

The Steaua Romana, one of the principal refining companies of the country, was placed in a very precarious situation by the failure, in 1900, of its founder, the Ungarische Industrie-Bank in Budapest, and it is only owing to the assistance of the Wiener Bank-Verein in Vienna that the continued existence of the Steaua Romana now seems assured. The good conditions that have prevailed for some time on the world's market, together with the continued good production, render it more than probable that even the current fiscal year of this enterprise—May, 1902–April, 1903—will close with a decided profit.

This probability is further strengthened by the fact that in the spring of 1902 the large refineries of the country succeeded in forming a trust, with the salutary result that the price of refined petroleum, from the low level of 5 francs per 100 kilograms, or \$1 for 220.5 pounds, reached the level of 10 francs per 100 kilograms, or \$2 per 220.5 pounds.

The activity of the refineries during the year 1902 was considerable. At the beginning, under the continued stimulus of the high benzine prices abroad, a forced benzine production ensued, highly remunerative to all the factories, but coming to an abrupt end about the middle of the year through the sudden change in the world's market.

Accordingly the quotation of benzine for export dropped from 15 francs per 100 kilograms to 6 francs at the end of the year.

For this decline the factories were in part compensated, on the one hand, by the above-mentioned rise in the petroleum prices within the country, and, on the other hand, by the considerable increase in the consumption of residuum for heating purposes, and, toward the close of the year, in the great rise in price of refined petroleum on the international markets.

While the petroleum consumption in the country shows no noteworthy upward movement, the use of residuum for heating shows a continuous, strongly progressive rise. Besides private industry, in which the liquid fuel is entirely displacing coal, the principal consumer in the country is the Roumanian State Railway, which is already using petroleum residuum on most of its locomotives. How rapidly this consumption has increased in recent years is seen from the following table of consumption of petroleum residuum by that railway:

Consumption of petroleum residuum on Roumanian State Railway, 1894–1902.

Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*
1894	433	1899	16,178
1895	2,055	1900	20,869
1896	2,233	1901	*a* 30,000
1897	2,087	1902	*a* 40,000
1898	6,510		

a Estimated.

In like manner the tests made by the Roumanian Maritime Service, on the 135 trial trips of the steamer *Regele Carol*, have given such exceedingly favorable results (an effective saving of 40 per cent) that the commission in charge decidedly advocates the definitive introduction of this fuel on ships.

GERMANY.

Condition of the industry.—Although Germany is one of the largest purchasers of petroleum products from the United States, there are in it two producing fields, one of which has maintained a small but steady production for many years in the province of Alsatia, near the town of Haguenau; the other, nearly 300 miles to the northwest, is in the province of Hanover, near the town of Weitze. The latter field, after lying almost dormant for several years, was revived in 1900, and since then has produced more petroleum than the Alsatian province. Of the total production in 1902, the Hanover district produced about 60 per cent and the Alsatian province 40 per cent.

The total production for the year 1902 is placed at 353,674 barrels, of which quantity 209,964 barrels are credited to the Hanover field and 143,710 barrels to the Alsatian field.

Operations near Weitze in the Hanover field have been very active during the last year, a somewhat lighter petroleum having been found in a lower strata. All the crude petroleum produced in Germany is quite heavy, comparatively, and only a small percentage of naphtha and illuminating products are obtained from it in the process of distillation. By careful manipulation in the refinery, however, a superior lubricating product is manufactured from the crude petroleum of both districts.

The principal refineries in the Alsace field are at Pechebroun and Bodromstein, and that near Celle, in the Hanover field, is located at Piene. The petroleum found in Alsace is of a gravity of 28° Baumé, and that in the Hanover field is considerably heavier. Twenty-five per cent of illuminating petroleum is said to be extracted from the petroleum of Alsace as well as over 30 per cent of lubricating oils, and not over 16 per cent of illuminating petroleum is secured from the Hanover field, but the percentage of lubricating petroleum is said to be over 37.

Germany encourages the development of her petroleum fields by imposing on all of the petroleum products brought into the country a heavy import duty amounting to 6 marks per 100 kilos, or $1.80 per barrel, on illuminating petroleum, and to 10 marks per 100 kilos on lubricating petroleum, or $3 per barrel.

PRODUCTION.

The production and value of petroleum in Germany from 1880 to 1902 is shown in the following table:

Production and value of petroleum in Germany, 1880–1902.

[Metric ton = 7.1126 barrels.]

Year.	Quantity.		Value.	
	Metric tons. [a]	Barrels (42 gallons).	Marks. [b]	Dollars.
1880	1,309	9,310	159,000	38,160
1881	4,108	29,219	526,000	126,240
1882	8,158	58,025	751,000	180,240
1883	3,755	26,708	352,000	84,480
1884	6,490	46,161	551,000	132,240
1885	5,815	41,360	471,000	113,040
1886	10,385	73,864	962,000	230,880
1887	10,444	74,284	933,000	223,920
1888	11,920	84,782	1,028,000	246,720
1889	9,591	68,217	881,000	211,440
1890	15,226	108,296	1,242,000	298,080
1891	15,315	108,929	1,195,000	286,800
1892	14,257	101,404	880,000	211,200

Production and value of petroleum in Germany, 1880–1902—Continued.

[Metric ton=7.1126 barrels.]

Year.	Quantity.		Value.	
	Metric tons.[a]	Barrels (42 gallons).	Marks.[b]	Dollars.
1893	13,974	99,391	783,000	187,920
1894	17,232	122,564	972,447	233,387
1895	17,051	121,277	962,455	230,989
1896	20,395	145,061	1,188,511	285,243
1897	23,303	165,745	1,396,444	335,147
1898	25,789	183,427	1,578,208	378,770
1899	27,027	192,232	1,577,456	378,589
1900	50,375	358,297	3,726,086	894,261
1901	44,095	313,630	2,950,478	708,115
1902	49,725	353,674	3,351,000	804,240

[a] One metric ton, crude=7.1126 barrels. [b] One mark taken as=24 cents.

Production of petroleum in Alsace-Lorraine, 1880–1902.

Year.	Quantity.		Year.	Quantity.	
	Metric tons.	Barrels.		Metric tons.	Barrels.
1880	1,053	7,490	1892	12,942	92,051
1881	1,237	8,798	1893	12,609	89,683
1882	2,169	15,427	1894	15,632	111,183
1883	1,198	8,521	1895	15,439	109,812
1884	2,775	19,737	1896	18,883	134,310
1885	3,087	21,956	1897	20,703	147,250
1886	7,696	54,738	1898	23,232	165,237
1887	7,892	56,133	1899	23,554	167,530
1888	9,150	65,080	1900	22,597	160,723
1889	6,532	46,759	1901	19,997	142,230
1890	12,977	92,300	1902	20,205	143,710
1891	12,817	91,162			

ITALY.

Condition of the industry.—The statistics of the production for Italy in 1902 are not yet available. The production for 1901 amounted to nearly 18,000 barrels, as compared with 12,000 barrels in 1900, a large increase.

Some favorable indications of a large deposit have lately been found in the Parma region. The price, as quoted—$8.02 per barrel—ought to stimulate a very careful search. The duty imposed on refined petroleum causes the high price of the native product. There is an import duty of 48 lire per 100 kilos, or $11.50 per barrel, as well as an excise duty of $2.25 per barrel.

Not many miles from Naples petroleum has been found in workable quantities, notably at San Giovanni d'Incarico and at Pico, in the valley of the Liri, both in the province of Caserta. It is a fact that as recently as 1878, 600 tons, or almost all the Italian petroleum, came from Pico alone. In the last twenty years the annual output has seriously decreased. Indeed it has become insignificant as compared with the increased production of the borings in northern Italy. Petroleum has also been stated to occur at Tramutola, on the Gulf of Taranto, and asphalt is recorded on the east side of the Abruzzi, about 20 miles from Pescara. Asphalt has also been found in the province of Salerno.

The depth of the water (80 fathoms) at the spot in the Bay of Naples, where the smell was noticed, is too great for the collection of the oil to be commercially practicable, but the long-continued escape of petroleum in the immediate vicinity of the Apeninne limestones of the Sorrentine peninsula is an indication that deep borings might be successful and might ultimately yield as profitable a supply of petroleum as the borings in northern Italy, near Bologna and Piacenza. These extend along anticlinals of the Tertiary limestone, and therefore are geologically similar in many respects to the country in or near which the newly discovered petroleum spring occurs.

PRODUCTION.

From the volumes of Rivista del Servizio Minerario the following statements are extracted regarding the production of crude and refined petroleum in this country:

Production of crude petroleum in Italy, 1860–1901.

Year.	Number of wells in operation.	Quantity.		Value.				Number of workmen employed.
		Metric tons.	United States barrels.	Unit value.		Total value.		
				Lire.	Dollars.	Lire.	Dollars.	
1860	3	5	36	800.00	21.44	4,400	772	5
1861	3	4	29	800.00	21.31	3,200	618	8
1862	4	4	29	800.00	21.31	3,200	618	9
1863	7	8	58	800.00	21.29	6,400	1,235	18
1864	7	10	72	800.00	21.41	8,000	1,544	32
1865	10	315	2,265	209.52	5.62	66,000	12,738	70
1866	12	138	992	269.86	7.24	37,240	7,187	57
1867	11	110	791	349.10	9.37	38,400	7,411	58
1868	9	51	367	435.29	11.68	22,200	4,285	52
1869	8	20	144	800.00	21.65	16,000	3,118	45
1870	6	12	86	800.00	21.55	9,600	1,853	30
1871	6	38	273	263.16	7.07	10,000	1,930	40
1872	6	46	331	208.69	5.60	9,600	1,853	36
1873	5	65	467	172.31	4.63	11,200	2,162	35
1874	4	84	604	152.38	4.09	12,800	2,470	37
1875	3	113	813	138.05	3.70	15,600	3,011	38
1876	3	402	2,891	123.38	3.31	49,600	9,573	72
1877	2	408	2,934	132.35	3.55	54,000	10,422	45
1878	4	602	4,329	102.99	2.76	62,000	11,966	98
1879	4	402	2,891	124.37	3.34	50,000	9,650	70
1880	2	283	2,035	313.05	8.40	88,595	17,099	24
1881	2	172	1,237	445.00	11.94	76,540	14,772	24
1882	4	183	1,316	474.55	11.98	86,844	15,761	121
1883	5	225	1,618	259.49	6.96	58,387	11,269	92
1884	6	397	2,855	341.18	9.16	135,452	26,142	110
1885	6	270	1,941	407.65	10.94	110,066	21,243	136
1886	7	219	1,575	416.11	11.17	91,130	17,588	145
1887	7	208	1,496	368.84	9.77	76,720	14,614	135
1888	5	174	1,251	319.71	8.58	55,630	10,737	75

Production of crude petroleum in Italy, 1860-1901—Continued.

Year.	Number of wells in operation.	Quantity.		Value.				Number of workmen employed.
		Metric tons.	United States barrels.	Unit value.		Total value.		
				Lire.	Dollars.	Lire.	Dollars.	
1889	7	177	1,273	288.13	7.73	51,000	9,843	70
1890	9	417	2,998	289.21	7.76	120,603	23,276	177
1891	10	1,155	8,305	301.38	8.09	348,100	67,183	251
1892	7	2,548	18,321	296.11	7.95	754,500	145,619	267
1893	8	2,652	19,069	299.80	8.05	795,050	153,445	130
1894	9	2,854	20,522	296.88	7.97	847,260	163,521	194
1895	6	3,594	25,843	358.90	6.95	930,496	179,586	134
1896	9	2,524	18,149	255.34	6.85	644,468	124,383	222
1897	8	1,932	13,892	255.33	6.84	492,288	95,010	231
1898	7	2,015	14,489	292.30	7.85	589,129	113,702	217
1899	6	2,242	16,121	264.97	7.11	594,062	114,654	231
1900	9	1,683	12,102	292.20	7.84	491,769	94,911	226
1901	9	2,246	16,150	298.78	8.02	671,065	129,515	227

7.1905 barrels=1 metric ton of crude 7.955 barrels=1 metric ton of refined. 1 lira=19.3 cents.

Production of crude petroleum in Italy, 1895-1901.

Mining district.	Province.	Number of wells in operation.	Quantity.		Value.			
			Metric tons.	Barrels of 42 gallons.	Per ton.	Per barrel.	Total.	
1895.					*Lire.*		*Lire.*	
Emilia		3	3,532	25,395	260.00	$6.98	918,320	$177,236
Rome		3	62	446	196.71	5.27	12,176	2,350
Total		6	3,594	25,841	258.90	6.95	930,496	179,586
1896.								
Bologna		1	1	7	250.00	7.00	250	48
Milan	Parma	5	61	439	273.00	7.34	16,682	3,220
	Piacenza	2	2,388	17,171	260.00	6.98	620,896	119,833
Rome	Chieti	1	74	532	89.73	2.41	6,640	1,282
Total		9	2,524	18,149	255.34	6.85	644,468	124,383
1897.								
Milan	Parma	5	80	575	260.00	6.98	20,800	4,014
	Piacenza	2	1,791	12,878	260.00	6.98	465,660	89,872
Rome	Chieti	1	61	439	95.44	2.56	5,822	1,124
Total		8	1,932	13,892	255.33	6.84	492,282	95,010
1898.								
Milan	Parma	6	45	324	269.20	7.20	12,089	2,333
	Piacenza		1,910	13,734	300.00	8.05	573,180	110,624
Rome	Chieti	1	60	431	64.33	1.73	3,860	745
Total		7	2,015	14,489	292.30	7.85	589,129	113,702
1899.								
Milan	Parma	7	73	525	270.71	7.26	19,762	3,814
	Piacenza	2	1,806	12,986	300.04	8.05	541,870	104,581
Rome	Chieti	1	363	2,610	89.33	2.39	32,430	6,259
Total		10	2,242	16,121	264.97	7.11	594,062	114,654
1900.								
Milan	Parma	6	62	446	273.43	7.33	16,953	3,272
	Piacenza	2	1,546	11,117	301.35	8.08	465,894	89,917
Rome	Chieti	1	75	539	118.96	3.19	8,922	1,722
Total		9	1,683	12,102	292.20	7.84	491,769	94,911
1901.								
Milan	Parma	6	59	424	251.70	6.76	14,850	2,866
	Piacenza	2	2,147	15,438	303.35	8.14	651,300	125,701
Rome	Chieti	1	40	288	122.87	3.29	4,915	948
Total		9	2,246	16,150	298.78	8.02	671,065	129,515

GREAT BRITAIN.

Condition of the industry.—Petroleum and natural gas are both known to exist in certain localities in England, but thus far no large reservoir has been found. For the last seventeen years or more there has been some production from Longton, North Staffordshire, which is given in the following table. There are a number of localities in which petroleum and natural gas have been found in small quantities, but little has been done in the way of testing by drilling deep wells.

PRODUCTION AND VALUE.

The mineral statistics of the United Kingdom give the production and value of petroleum from 1886 to 1902 as follows:

Production and value of petroleum in Derbyshire, England, 1886–1902.

Year.	Production.		Value.[a]	
	Tons (2,240 pounds).	Barrels (42 gallons).	Pounds sterling.	Dollars.
1886	43	314	129	627
1887	66	482	99	481
1888	35	256	....	....
1889	30	219	45	219
1890	35	256	52	253
1891	100	731	150	729
1892	218	1,594	409	1,988
1893	260	1,900	488	2,372
1894	49	358	92	448
1895	15	110	28	136
1896	12	88	29	141
1897	12	88	29	141
1898	6	44	14	68
1899	5	37	12	58
1900	....	....	....	....
1901	8	59	....	....
1902	25	184	....	....

[a] Value at wells. £1=$4.86.

SCOTCH SHALE-OIL INDUSTRY.

The shale-oil industry of Scotland is of no small importance, and the quantity worked has increased very considerably during the last twenty years. The Scottish oil companies together produce about 500,000 barrels of burning oil per annum, probably 250,000 barrels of lubricating and other oils, approximately 160,000 barrels of naphtha, and 20,000 tons of solid paraffin.

In the following table is given the quantity and value of oil shale produced in Great Britain during the years 1897 to 1902, inclusive:

Quantity and value of oil shale produced in Great Britain, 1897, 1898, 1899, 1900, 1901, and 1902.

Country.	1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*	
England	10,568	£2,642	2,975	£744	200	£50
Scotland	2,211,617	552,904	2,133,409	533,352	2,208,249	552,062
Wales	1,560	390	1,609	402	2,375	891
Total	2,223,745	555,936	2,137,993	534,498	2,210,824	553,003

Country.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*	
England	....	....	....	....	....	....
Scotland	2,279,879	£626,966	....	....	2,105,953	....
Wales	2,342	878	....	....	1,581	....
Total	2,282,221	627,844	2,354,356	....	2,107,534	....

The quantity and value of oil shale produced in Great Britain from 1873 to 1902 are shown in the following table:

Production of oil shale in the United Kingdom, 1873–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Statute tons.			*Statute tons.*	
1873	524,095	£262,047	1888	2,076,469	£519,074
1874	362,747	181,373	1889	2,014,860	503,715
1875	437,774	218,887	1890	2,212,250	608,369
1876	603,538	301,769	1891	2,361,119	707,177
1877	801,701	400,850	1892	2,089,937	522,484
1878	788,704	394,352	1893	1,956,520	489,130
1879	783,748	391,824	1894	1,986,385	496,596
1880	837,805	418,902	1895	2,246,865	561,716
1881	958,255	479,127	1896	2,419,525	604,881
1882	1,030,915	310,685	1897	2,223,745	555,936
1883	1,167,943	299,676	1898	2,137,993	534,498
1884	1,518,871	386,780	1899	2,210,824	553,003
1885	1,770,413	447,302	1900	2,282,221	627,844
1886	1,728,503	435,963	1901	2,354,356	....
1887	1,411,378	355,085	1902	2,107,534	....

NEW SOUTH WALES.

PRODUCTION OF KEROSENE SHALE.

The quality and value of the kerosene shale wrought in the two districts of New South Wales from which it was produced during the years 1899 and 1900 were as follows:

Quantity and value of kerosene shale wrought in New South Wales in 1899 and 1900.

[Annual Report of the Department of Mines, New South Wales.]

Year.	Western division.		Southwestern division.		Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
		£ s. d.		£ s. d.		£ s. d.
1899	29,193	31,415 5 0	7,526	9,408 5 0	36,719	40,823 5 0
1900	21,896	19,444 13 0	966	1,207 0 0	22,862	20,651 13 0

The production of oil shale is gradually decreasing, and there are several reasons for this, among which are—

(1) The area of known first-class shale is becoming rapidly worked out.

(2) The freights for exporting shale have been so high as to limit the quantity exported.

(3) Recently certain oils have been used to increase the illuminating power of gas, which to a large extent is taking the place of oil shale for this purpose.

Mr. F. W. Goding, United States consul at Newcastle, New South Wales, says that it is reported that an oil spring of good quality has been discovered in the southeastern district of South Australia. The spring is near the lakes which exist at the mouth of the Murray River, in the vicinity of the little town of Meningie, on the eastern shore of Lake Albert. The existence of petroleum in this desert region has been known for years. The oil exudes from the banks of Lake Coorong, and also from the more southern coast line. The quantity of the supply and the purity of the oil are questions for future investigation.

At present, large quantities of kerosene are landed at the various ports of the Commonwealth from Asia and America. The oil is stored in immense tanks, from which it is retailed much in the same way as milk. Should the discovery develop into an established industry, it will seriously affect the importation of American kerosene into that Commonwealth.

Imports of kerosene into New South Wales, 1894–1901.

[English gallons and pounds sterling.]

Year.	Quantity.	Value.
	Gallons.	
1894	2,362,415	£64,137
1895	2,569,672	79,225
1896	2,520,044	87,675
1897	2,913,419	98,455
1898	3,625,882	112,738
1899	4,580,201	176,651
1900	4,224,467	181,580
1901	8,148,091	276,766

Exports of shale (kerosene) from New South Wales, 1895–1901.

Year.	Quantity.	Value.
	Long tons.	
1895	34,549	£77,934
1896	14,220	32,846
1897	21,930	44,511
1898	13,845	27,197
1899	9,147	19,355
1900	16,677	36,276
1901	19,385	42,594

NEW ZEALAND.

Petroleum has been known to exist in both the northern and the southern divisions of the island for many years.

In 1874 a shallow well was drilled in the Poverty Bay district, near where there was a natural showing. At a depth of 110 feet the cribbing collapsed and stopped further progress. In a few weeks a large amount of remarkably pure petroleum accumulated in the abandoned hole. Subsequent efforts to find petroleum in paying quantities near this region were failures, although some of the wells reached a depth of 2,000 feet.

Recent explorations have been transferred to the southern division of the island, on the Midland Railway, near Lake Brunner, 21 miles inland from Greymouth, where there are numerous surface indications. Five shallow wells have been completed, all of which gave small showings of petroleum. In one of these wells there is an outburst of natural gas, salt water, and a small showing of petroleum regularly every two hours.

ALGERIA.

THE PETROLEUM INDUSTRY IN ALGERIA IN 1902.[a]

The progress of development work in the petroliferous region, as well as in the refining and marketing of the products in Algeria, was very rapid toward the end of 1902. Algeria is advancing rapidly to the position of a petroleum producing country.

The demonstration of the value of Dahra petroleum as fuel has been made by the syndicate of the same name, which has undertaken active exploitation work.

In view of the favorable results of the use of liquid fuel, both on railways and steamers, obtained in every country in Europe, it may be hoped that Algerians will give every material and moral support, not only to present operations but also to new prospecting work, which is bound to be successful throughout the colony. The searches must be carried out in a rational manner, avoiding all "wild-cat" methods, such as have been used in many countries during the last two or three years.

For lighting purposes Dahra petroleum occupies the first place, both by its illuminating power and flash point, which is above 50° C.

It has been accepted for Government contracts, and wherever it has been tried it has taken preference over other oils.

Dahra oil is thick, but its thickness is due to the presence of solid paraffin and of vaseline to the extent of 10 to 13 per cent in the crude oil. The paraffin scale, filtered by way of an experiment and bleached under the sun, proved to be of first quality. After the separation of burning oil and paraffin scale a lubricating oil is left.

In 1902 a change was introduced into the method of working, and the progress of the development has taken a practical turn. Oil was found at a depth of 400 meters in good quantities, and as much as 32 cubic meters of it was extracted per day from one well. The oil, thickened in its passage upward, oozes out for a distance of 1½ kilometers.

The strata traversed by the well are impregnated with petroleum, and the earth analyzed yielded 20 per cent of oil, the driller striking the petroliferous sand at 400 meters, which is the first oil stratum. The second and third are still awaiting the drill.

Forty-two per cent burning oil, 10 to 12 per cent paraffin scale, and the rest lubricating oil of superior quality, represent the proportions obtained from the oil in 1902. The installation at St. Amie (Oran) consists of a steel tank of 500,000 liters, a new refinery, and works for manufacturing lubricating oils. The governor-general and Government of Algeria are granting every facility, as well as their moral support, toward the development of the oil fields, and it is, thanks to this, that success has been attained in the year 1902.

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[a] Jour. du Pétrole.

PERSIA.

There are rumors of the formation of a Belgian company for petroleum exploitation in Persia.

The Persian petroliferous region extends along a line northeast and southwest, starting at Shahku, on the Turco-Persian frontier, and ending on the eastern side of the Persian Gulf.

The northern part of this basin has its center at Kasharashirin, near Shahku. Around this village are numerous pits of a depth of about 32 feet. This deposit is situated on an eocene axis of sand and marl, and the Kurds exploit it in a most primitive manner, contenting themselves with collecting the oil from the pits every four or five days. An average output of 10 barrels is collected each time. The petroleum is very fluid and of a greenish color and is refined on the spot. In the center of the Persian basin, parallel to the Bakhtiari Mountains, there is the petroliferous district of Lauriston. This district, like that of Kasharashirin, is characterized by the same blue clays which are found in Galicia. The petroleum deposits are in the neighborhood of important salt and sulphur deposits.

The existence of petroleum is also shown in a most conspicuous manner at Chouster, where the inhabitants collect it on the surface. The Chouster oil is of a special quality, being of a yellow color, very clear and almost transparent, and having a specific gravity of 0.773.

South of this station and a few kilometers from Ram-Armuz are the natural springs of Chardin, one of which has a regular output of about 22 gallons per day.

Natural petroleum springs also exist near the Persian convent of Nuamzady at Haf-Cheide. These springs, which have an output of about 1 barrel per day, produce an oil of a greenish color and of a specific gravity of 0.927.

The south of the Persian basin runs along the shore of the Persian Gulf, Dalike being the most important station here. In this district work has been seriously started, which unfortunately could not be brought to a successful finish, owing to the inclemency of the weather in the summer, the bad quality of the water, which corroded the boilers, the high cost of fuel, and especially the pillaging by the neighboring tribes. The Persian Bank Mining Right Corporation, which holds the concession of this property, has placed at its head an experienced man—Engineer Kmentt.

The workmen brought from Galicia were not able to stand the climate, and those from Baku were no better.

The petroleum of Dalike is heavy and bituminous, and, according to Redwood, has a specific gravity of 1.016.

Investigations are to be made shortly on the shores of the Caspian Sea, near the village of Talish, where there are abunaant traces of petroleum. Here drinkable waters and cheap and abundant liquid fuel are obtainable, while the natives are better policed than on the Persian Gulf.

DUTCH EAST INDIES—SUMATRA, JAVA, AND BORNEO.

Condition of the industry.—The year 1902 has been one of activity in all of the three islands, and more petroleum was produced and sold during the year than ever before. The inferior quality found in Java and Borneo was largely marketed as a fuel petroleum, while that produced in Sumatra, being of a superior quality with a paraffin base, was converted into illuminating and lubricating petroleum and paraffin. The refineries of Sumatra produced 264,320,500 liters in 1901, equal to 1,652,000 barrels of refined petroleum, which will probably be increased by at least 30 per cent for the year 1902, when the figures can be secured from these far-off regions. The quality of the illuminating products is generally considered inferior to that of the United States and Russia, and they are sold at a reduced price, reaching a class in the densely populated portions of their own islands, and in China, India, Siam, and Persia that do not appreciate the qualities of a superior illuminating petroleum, being satisfied with an inferior article consumed in a primitive clay lamp.

A very large percentage of the petroleum produced in Java, and nearly all of that produced in, Borneo is marketed as a fuel oil after the more volatile portions have been removed in the refinery. There is also a considerable amount of crude petroleum exported from Sumatra to Java and there refined.

The laws of Japan and India require a flash test of 100° C. for illuminating petroleum, while a number of other countries will accept and store petroleum of a considerably lower flash test.

The Shell Transport Company has devoted a large amount of capital to marketing the fuel petroleum and bulk oils produced in the islands of the Dutch East Indies group and Russia, and has erected storage tanks at the following-named seaports: In Africa at Port Tenenk, on the Suez Canal at Port Said, and at Zanzibar; in British India, at Bombay, Calcutta, Madras, Karachi, Intikorin, Colombo, Penang, and Singapore; in Dutch East India at Soerabaya, Batavia, and Sheribon; in Siam at Bangkok; in China at Hongkong, Shanghai, Amoy, Swatow, and Foochow; in Japan at Kobe, Yokohama, and Nagasaki; and in Australia at Sydney, Greenwig, Williamstown, and Adelaide.

Singapore is a very large and important distributing point, the most important of any in the Far East, for the refined products and the fuel petroleum of the Dutch East Indies. There are ten large storage tanks erected here, and there are ample wharf facilities for the numerous tank steamers which make direct connection with Palembang and Balik-Pappan. There are also extensive canning works located here. Liquid fuel is year by year gaining a more extensive foothold as its merits become more generally known, and because of the increased price of coal, which has to be transported thousands of miles to many of the ports of eastern Europe, southern Asia, and Africa. The yearly increase in the quantity of liquid fuel produced and consumed, together with the new areas that have lately been developed in these islands and elsewhere in the other portions of the globe, show that to a certain extent an increasing amount of coal must be supplanted by liquid petroleum as a fuel.

EXPORTS.

The export of kerosene from Dutch India to various countries between the years 1896 and 1900, as reported by Mr. A. V. Ragosine,[a] was as follows:

Export of kerosene from Dutch India, 1896–1900, by years and countries.

Country.	1896.	1897.	1898.	1899.	1900.
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Holland	8	2	60		
British India	22,860	789,788	631,810	57,110	
Penang	109,860	112,870	112,640	158,520	257,190
Malacca	23,100	72,170	75,440	84,930	358,145
Singapore	340,210	490,860	159,440	300,725	1,415,515
Siam	153,240	141,150	101,120	203,450	169,930
Saigon	76,890	121,310	91,690		56,170
Hongkong	446,560	2,015,080	1,447,080		593,610
Other Chinese ports	92,790	339,450	1,457,950	556,960	89,120
Japan	23,020	243,110	186,030		97,230
Timor	370	380	670	640	600
Australia	50		25	240	
New Guinea (German)	2		50		
Total	1,288,960	4,326,170	4,264,005	1,362,575	3,037,510

Case=10 gallons.

The export was chiefly effected by the Shell Transport and Trading Company, who have exported in their tank steamers kerosene, residuals, and, during the last two years, benzine from Balik-Pappan, Palembang (Moeara Enim Company), and also from Langkat (the Sumatra Company), chiefly in bulk; the Royal Company, who exported in their steamers their own oils and those of the Sumatra Palembang Company, chiefly in cases; and the Mining and Forest Exploitation Company, of Lower Langkat, who export their kerosene of the Dragon brand chiefly to Penang, Singapore, Siam, and China in cases.

[a] Neftiannoie Dielo.

SUMATRA.

There are three large refining companies in the island of Sumatra, namely, the Sumatra Palembang, the Moeara Enim, and the "Koenigliche," as it is improperly called.

The first two companies, the original Holland companies, are located in the southern part of the island; the latter, in the northern part, is a comparatively new organization with rapidly increasing output.

The original Holland companies in their early history, during the years 1897 and 1898, created a flurry in all of the petroleum-producing localities in both the Old and the New Worlds.

The output of the original wells, the comparative ease with which they were drilled, their location so near tide water, and their nearness to the central markets of Asia, as well also as the superior quality of the petroleum, all contributed toward this. Suddenly these wells ceased to flow, and pumping had to be resorted to; this, however, failed to keep up the production. Neither did the drilling of an immense number of wells in the neighborhood of the original gushers supply the deficiency; in consequence, the refineries did not have the necessary quantity of crude petroleum, and their production was greatly decreased. These conditions brought about the necessity of finding new fields, which was finally accomplished; but the locality was from 40 to 120 miles from the refineries, which involved a large amount of expense to connect them by pipe lines. These difficulties for a time curtailed the production of the original plants, which has been more than regained in the last three years.

The production of fuel petroleum on the island of Borneo has been increasing by very large quantities since the year 1900.

The most important company, however, is the "Koninklijke Nederlandsche Maatschappij tot Explotatie van Petroleum-Bronnen," called, in brief, the "Koninklijke"—that is, "Koenigliche." The company was established in the year 1890, with a capital of 5,000,000 gulden preferred stock and 3,000,000 obligations. At first it gained the small territory Lepan near the city Langkat, to which the properties in Besitang, Aroebaai, and Boekit were added, so that in the year 1896 it possessed 170,000 hectares. During the first year little drilling was done, while the wells continuously yielded a quantity of crude oil; and this condition continued until the year 1898, in which the value of the oil fields decreased greatly. Some of the wells ceased to produce oil, others decreased their output, and a third class delivered water instead of oil, so that in the year 1899 they yielded only one-third of what they did at the beginning, despite regular drilling. This induced the company to make very extensive acquisitions and openings in various sections of the country, particularly in the northern part of the island. Previous to the year 1901 these examinations were unsuccessful on the whole. The first success was in Perlak, upon territory acquired from a similar company, which developed very rich wells, whose production reached a total of 1,500,000 metric centners of crude oil in the year 1901, which is an amount equivalent to two-thirds of the complete production of the "Koenigliche." Of the remaining new wells, those in Langsar may be mentioned as profitable, and especially those in Sumatra, Borneo, Koetei, and on the island Pulu Miang. The developments in Perlak have improved the material condition of the "Koenigliche" in an extraordinary manner. The first refinery of the company was erected in the year 1891 in the city of Pankalan-Brandan, and by Americans, for a periodic business. A second refinery was built in the year 1897 in Besitang, not very far distant from the first. The crude oils of the "Koenigliche" are strongly benzine-containing, especially that of Sumatra. They contain on an average:

	Per cent.
Benzine	30 to 40
Petroleum	40 to 50
Residuum	30 to 10

Formerly all the benzine was consumed as fuel, and the production of petroleum was restricted to 35 to 40 per cent. At present the benzine is redistilled, and the heavy portions are added to petroleum, whereby this product has increased to 45 or 50 per cent.

The two refineries of the company possess a manufacturing capacity of over 1,500,000 metric centners of crude oil, but only a part of this amount is refined, on account of the lack of crude oil; so, during the last two years, only half of this quantity was refined, and in the critical years, 1899 and 1900, only a fourth thereof. The greatest production of the company was during the years 1897 and 1898.

During the year 1900, 1,392 metric centners of paraffin were produced, and during 1901, 2,910 metric centners, the quality of which is excellent, for it possesses a melting point of 62° C. and is disposed of in Europe at good prices. On the other hand, the petroleum is of inferior quality, specific gravity 0.837 to 0.869, yellow to dark yellow, and badly refined. These characteristics may be explained by the circumstance that it is destined for consumption by the natives, who are not particular in this respect. The financial statements of the Dordschen Petroleum Company are very good. It gives from 10 to 20 per cent dividends and is considered as an exemplarily conducted undertaking.

In addition, the "Java Maatschappij" and a Chinese firm, Tan-kok-tay, operate in Java. Both are unimportant, but possess their own refineries. Maatschappij Java operates near the city of Samarat, with an annual production of 12,000 metric centners of petroleum. The Chinese company is in operation only periodically.

BORNEO.

The entire production is in the control of S. M. Samue. and the Shell Transport and Trading Company, which undertakings at Borneo bear the names "Niederlandisch-Indische Industrie und Handelsgesellschaft." The earth oil wells of the company are situated in the southeastern part of the island in the basin of the river Koetei, from which the entire strip of land takes its name. The possessions of the company embrace the extensive territory between the city of Samarinda (seat of the Holland assistant minister) and the Balik Papan Bay, and measures 360,000 hexameters, but only a very insignificant part of this territory is developed, and, indeed, in only two places, one lying at the northeastern part of the bay, which likewise bears the name of the bay Balik Papan, and the second, north of this, on the side of the river Koetei, which is named Sanga-Sanga (signifying fever, in the language of the natives). The distance between these two places is about 80 kilometers in an air line, but no land connection exists, and intercourse is effected by means of steamers.

In Balik Papan there are thirty wells, which encountered the first dark crude oil (specific gravity 0.970) at a depth of about 200 meters, and at a depth of from 600 to 620 meters a second, lighter crude oil (specific gravity 0.896). A deeper oil stratum has not yet been found. The entire amount of the crude oil recovered is unimportant. Oil springs do not occur.

JAVA.

The most important company in Java is the Dordsche Petroleum Maatschappij, which was organized in the year 1890 with a capital of 10,000,000 Dutch gulden. In the year 1897 the capital was increased to 20,000,000 gulden. The company disposed of several extensive concessions in Java and Madura, of which the most important are Kedundung, Igareng, Rogozam, and Soerabaya, besides formerly unprofitable concessions in Borneo and Sumatra. The entire area comprises about 600,000 hectares. Mr. Stoop, the general director of the wells, expresses his opinion of the wells as follows: "The common strata which were examined are soft clay and sand, and the harder sandstone and lime appear very seldom. Thanks to this circumstance, a peculiar method of boring, consisting in a revolving pipe with additional steel drill and water spray, is used. Since oil was first discovered in the harder strata the necessity of employing the Canadian system and the Rapid system of drilling was made evident. After experimenting for sixteen years, the flush water has proved very good for the purpose of recovering oil, and the controversy of the Galician technical drillers over this method is inexplicable."

The petroleum is found at a depth of from 150 to 600 meters, and the wells produce from 172 to 1,100 metric centners of petroleum within twenty-four hours. The crude oil is worked up in three refineries in Wonakromo, near the city Soerabaya, in Igareng, in the vicinity of the district of Rembang, and in Semaranga. Semaranga is the youngest refinery and Igareng the greatest refinery in which, besides petroleum, both paraffin and lubricating oils are produced, and recently the refinery was connected with a railway. Formerly the crude oil was conducted through pipe lines which the company possesses for a distance of 200 kilometers; from the Island of Madura the oil is carried to the refineries at Soerabaya by steamers. The refineries work up their petroleum mainly for home consumption and freight it in thin-plated cans with the mark "D. P. M." The interior consumption of petroleum by the very dense population (Java has 27,000,000 inhabitants) amounts to about 4,000,000 cans; therefore the entire production of the company may easily be stated at about 1,500,000 cans.

Since the year 1896 the production of the refined product in cans was as follows:

Production of refined petroleum in Java, 1896–1902.

[Cans.]

Kind of oil.	1896.	1897.	1898.	1899.	1900.	1901.	1902.[a]
Petroleum	1,250,000	1,454,976	1,480,338	1,642,780	1,648,129	1,664,284	800,000
Gasoline	4,499	4,542	6,373	5,745	6,233	....	....
Lubricating oil	6,690	8,866	12,932	12,568	14,572	....	....
Asphalt (metric centners)	1,206	1,505	1,522	1,000	1,598	....	....
Lucigen	1,970	5,000	8,900	8,512	8,541	....	....
Residuum (metric centners)	20,400	21,000	26,700	38,700	44,100	....	....

[a] Six months.

Upon the territory Sanga-Sanga there are over thirty wells, with a top diameter of from 10 to 12 inches and an end diameter of 5 inches. On drilling, four oil zones were encountered at the following depths: Sixty, 100, 180, and 240 meters. There should be a fifth zone at a depth of about 300 meters. The first three zones give a heavy, thick oil, which is lighter than that from the fourth zone and has a specific gravity of 0.860. Likewise, these wells do not yield an especially large production, the best having a daily output of 600 metric centners; on an average, however, they produce scarcely 60 metric centners. There are no springs, though there are a few self-flowing wells, but the majority must be pumped.

The production of this crude oil region chiefly supplies the refinery of the company in Balik Papan, the greatest upon the Sunda Islands.

At present the company is building a sulphuric acid works in the vicinity of the refinery, not only for their own requirements, but also for the entire Indian petroleum industry; as formerly the sulphuric acid was imported from Holland, and recently also from Japan.

The heavy crude oil from Balik-Papan is suitable only for fuel, the lighter with the specific gravity 0.890 yields 44 per cent petroleum distillate, 8.5 per cent solar oil, 46 per cent residuum, and 1.5 per cent loss. The crude oil from Sanga-Sanga, of specific gravity 0.860, yields benzine and loss 18.5 per cent, petroleum distillate 51.9 per cent and residuum 29.6 per cent. Neither the one nor the other contains paraffin. By the working up of equal quantities of both the following result is obtainable:

	Per cent.
Benzine and loss	9
Petroleum	26
Solar oil	7
Residuum	58
Total	100

The benzine obtained is heavy. Light fractions of benzine are not generally obtainable from this crude oil. The final salable products of the Borneo oil may be said to be the following: About 28 per cent petroleum; about 65 per cent residuum.

The petroleum is heavy, from 0.829 to 0.835 specific gravity, and shows, in consequence of the fractional distillation, abnormally high specific gravities to the separate fractions, which are far higher than those of the Russian products. High specific gravity is generally a characteristic mark of the crude oil of Borneo and likewise of that of Java, so that the admission is justified that the same consists of heavy carbureted hydrogen as naphthene. In consequence of this the lighting power of this oil is small. For example, in an experiment with a round burner the petroleum of Borneo gave a light of 4.2 candlepower; on the other hand, in the same lamp, the Russian kerosene gave a light of from 9.5 to 10 candlepower, and when mixed in equal parts a light of 8.6 candlepower. The refinery in Balik-Papan possesses a working capacity of over 2,000,000 metric centners of crude oil, three hundred working days in a year. The effective production in metric centners was:

Year.	Petroleum.	Fuel oil.
1900	43,200	162,000
1901	108,000	300,000

Of fuel oil two kinds were recovered, one having its burning point above 100° C., the other with its burning point below the same. This fuel oil forms the foundation of the entire enterprise, especially of the fleet of the Shell Transport and Trading Company, which supply therewith their 24-tank steamers for the local and more particularly the marine freight connection. Through the possession of such a considerable number of tank steamers this company commands the entire freight intercourse for bulk freight (that is with fluid products), and is of first-class importance to the petroleum business in the Orient. The Shell Company provides for the transportation of oil from Batum and Novorossisk to Egypt and the ports of the Indian Ocean and Far East, freighting the petroleum from the central station in Singapore to the separate harbors of the Dutch and British colonies, China, etc. From Balik-Papan it carries gas oil to England and petroleum and fuel oil to China, Japan, and the central station at Singapore, and benzine from Sumatra to London.

PRODUCTION.

The production of these three islands is estimated as follows for the years 1901 and 1902:

Production of petroleum in Sumatra, Java, and Borneo in 1901 and 1902.

Country.	1901.	1902.
	Barrels.	*Barrels.*
Sumatra	3,100,000	4,200,000
Java	615,000	750,000
Borneo	460,000	910,000
Total	4,175,000	5,860,000

The following statement, furnished by the secretary-general to the department of colonies, Holland, gives the production of petroleum in the Dutch East Indies during the years 1900 and 1901:

Production of petroleum in the Dutch East Indies in 1900 and 1901.

Country.		1900.		1901.	
		Crude.	Refined.	Crude.	Refined.
Borneo	tons[a]	59,352		85,554	24,617
Java	liters[b]	97,308,800		102,797,300	
Sumatra	do		117,109,600		264,320,500

[a] Metric ton = 2,204.6 pounds.
[b] Liter = 61.027 cubic inches = .2642 of a United States gallon. 160 liters = 1 United States barrel (approximately).

PHILIPPINE ISLANDS.

Condition of the industry.—There is considerable petroleum produced on these islands by crude methods. Several unsuccessful attempts to drill by the American methods have been made. One of these tests developed some petroleum, but the soft, caving nature of the ground and the lack of sufficient casing caused the loss of several wells.

There are localities near Cavite where some small amount of crude petroleum has been found bubbling up through the water. This has led to the formation of a company, which will drill a test well in that vicinity.

Explorers are busy examining the conditions of the existence and the quality of the petroleum, and the probabilities are that in a few years petroleum will be one of the articles of export, instead of being, as at present, almost entirely an article of import.

The islands of Panay, Leyte, Guimaras, Negros, Mindanao, and Cebu are known to contain petroleum. The large island of Mindanao produces some petroleum in the vicinity of Chattabatto. The island of Cebu has deposits of petroleum at Toledo, on the west coast, associated with coal and natural gas. On the island of Panay petroleum is reported at Janiway, in the province of Iloilo. The island of Leyte is said to have deposits of petroleum 4 miles from the town of Villaba, on the west coast.

The position of these islands would indicate the probable existence of petroleum, as Borneo, on the southwest, and Formosa and Japan, on the north, contain productive areas that are extensively operated.

JAPAN.

Condition of the industry.—The main supply of petroleum thus far developed in the Empire of Japan is found on the island of Nippon, in the province of Echigo, on the northwestern coast, about 200 miles northwest of the city of Tokyo. There are other localities on this island where some petroleum has been produced, namely, in the province of Ugo, in the extreme northern portion, and in the province of Totomi, about 150 miles southwest of Tokyo.

The island of Hokkaido or Ezo has produced some superior grades of crude petroleum in a limited way, near the western flank of the foothills of the great mountain chain running to the north, in the provinces of Mikawa and Ishikari, but nothing has been so far discovered that is of any commercial value.

The production in Echigo and the indications elsewhere are usually in the middle and newer Tertiary formation. Their individual occurrence is invariably on the flanks or along the crest of well-marked anticlinals. Generally these anticlinals are of comparatively short extent, as they suddenly burst up out of the level newer formations, run their course, with slight undulations, for from half a mile to 2 or 3 miles, and then suddenly plunge under the level surface of the plain. There are other cases where the ridge of an anticlinal can be traced for 10 or 15 miles continuously.

There are usually steep dipping flanks on both sides of the anticlinals which soon carry the oil-bearing strata to depths too great to be reached by the drill, or at which the strata is saturated with water. The depth of the wells is from 750 to 1,250 feet, and probably 80 per cent of the production comes from drilled wells. The remainder is from dug wells or shafts which range in depth from 200 to 500 feet.

The strata holding the crude petroleum is generally a loosely cemented sandstone of a bluish cast, with more or less small crystals of pure silica, and in some cases with pebbles interspersed, the strata being from 5 to 40 feet in thickness. There are usually beds of blue shale or clay capping the sandstone, and in many wells they follow each other in succession. A few of the wells flowed naturally when the field was new. At present nearly all of the wells are pumped. The life of the average well in some of the fields is not long, as a few weeks or months find the output greatly reduced from the original volume; others decrease more slowly. It requires the constant drilling of new wells and the deepening of others where lower productive strata have been developed to keep up the production in most of the fields.

The petroleum produced in the early history of the development generally came from hand-dug wells, which ranged from 100 to 500 feet in depth. These wells were roughly cribbed with timber as they proceeded down. A supply of pure air was furnished the workmen at the bottom by means of a peculiar bellows operated from the top. All of the hoisting was done by a cable made of rice straw.

One of the other methods of drilling is known as the "bamboo rig," in which large bamboo poles are spliced and joined together by iron bands and are coiled upon the outside of a large reel or wheel, on the inside of which one or two workmen raise or lower the tools by treading. The tools are of iron with steel bits and in the operation of drilling are raised by means of a lever in the upper portion of the derrick, or by a walking beam attached to a windlass.

During the last six or eight years the greater portion of the production has been secured by regularly cable-drilled wells, and some wells were drilled by the Canadian rod system. It is rather surprising that the workmen of this country should so soon have acquired the knowledge that enables them to drill wells where there are serious difficulties encountered and a very large amount of skill is required to accomplish the end. In several of the fields the improved method of pumping wells in clusters by wire rope and solid connections is used. There are also a number of pipe lines connecting several of the fields with refineries that have been laid and are operated by Japanese workmen. There is, however, a considerable percentage of crude petroleum transported from the points of production to these native refineries in tin and wooden cases on the backs of coolies. The heavy distillate or residuum is also transported in the same manner from the refineries back to the wells, where it is used as fuel. The locomotives in Echigo use residuals and inferior crude petroleum as a fuel, and its use in the crude and residual condition is almost universal in pumping and drilling wells and under the boilers of the pipe lines.

The refineries are quite numerous in Echigo, about forty now being in operation. Some of them are primitive; others are fairly well equipped. The best refinery is that recently erected by the International Oil Company at Naoyetsu. It was built and is operated by Americans, and a superior quality of illuminating and lubricating petroleum is manufactured.

The other refineries are almost entirely in the hands of two powerful native companies, which also control a very large percentage of the production of the crude petroleum. These are known as the Nippon and the Hoden companies. The refineries operated by these two companies produce inferior manufactured products, which find a ready sale at a reduced price, although the flash test of the illuminating petroleum is generally too low for safety. All of the petroleum produced in Echigo is of an asphalt base; hence there can be no paraffin produced. The quality of the crude varies in the different fields to a marked degree. Some of it will produce as much as 70 per cent of illuminating products, the larger portion will only produce from 35 to 40 per cent, and a still poorer grade from the Nütsu field will only give 20 per cent. This last finds a market as a fuel oil at Nügata and on the railroad between Naoyetsu and Nügata.

The average amount of marketable products secured in Echigo is not far from 40 to 45 per cent. The specific gravity varies from 22° to 45° Baumé; about 75 per cent of the output will average 33° Baumé. The price paid for crude petroleum during 1902 was quite high, owing to there being very little offered for sale, as the production is controlled by the two large Japanese companies and the International Oil Company. Crude petroleum was sold as high as $2\frac{1}{2}$ to 3 yen per koku, or from $1.10 to $1.25 per barrel. The daily production by districts in Echigo in 1902 was as follows:

Daily production in Echigo in 1902, by districts.

District.	Quantity.
	Barrels.
Nagamine, Kamada, and other districts adjacent	1,280
Nagioka	980
Higashi	360
Nütsu	650
Total daily production	3,270

This gives a production of 1,193,550 barrels for the year 1902.

The number of American drilled, native hand-drilled, and hand-dug shafts in operation in the above-named districts in 1902 is estimated to be as follows:

Number of American drilled, native hand-drilled, and hand-dug wells in operation in Echigo in 1902, by districts.

District.	American drilled.	Native hand drilled.	Native hand dug.	Total.
Nagamine, Kamada, and districts adjacent	155			155
Nagioka	183	140	20	343
Higashi	48	8	28	84
Nütsu	65		180	245
Total	451	148	228	827

The following table shows the gradual increase in the production of crude petroleum in Japan from 1875 to 1902. The gain of 1902 over 1901 is very slight, with indications of a smaller production for 1903.

PRODUCTION.

Production of petroleum in Japan, 1875–1902.

Year.	Production.				Value received for crude and refined sold.	
	Crude.		Refined.[a]			
	Koku.[b]	Gallons.	Koku.[b]	Gallons.	Yen.[c]	Dollars.
1875	4,830	191,751	....	....	....	....
1876	8,155	323,753	....	....	....	....
1877	10,114	401,526	....	....	....	....
1878	18,920	751,124	....	....	....	....
1879	24,816	985,195	....	....	....	....
1880	26,974	1,070,868	....	....	....	....
1881	17,721	703,524	....	....	....	....
1882	16,450	653,065	....	....	....	....
1883	21,659	859,862	....	....	....	....
1884	29,541	1,172,778	6,215	246,735	107,964	92,633
1885	30,931	1,227,961	7,326	290,842	98,496	84,510
1886	40,113	1,592,486	13,487	535,434	136,911	110,898
1887	30,304	1,203,069	8,830	350,551	126,298	99,018
1888	39,605	1,572,318	4,511	179,087	138,602	104,367
1889	55,871	2,218,079	7,097	281,751	250,977	184,217
1890	54,399	2,159,640	11,180	443,846	221,478	166,551
1891	55,983	2,222,525	13,012	516,576	207,029	172,041
1892	72,893	2,893,852	13,431	533,211	207,245	154,398
1893	94,145	4,468,122	10,941	434,358	178,290	117,850
1894	151,986	7,213,256	13,980	555,006	245,697	136,608
1895	149,497	5,935,031	17,241	684,468	351,607	172,639
1896	208,500	8,277,450	(d)	(d)	(d)	(d)
1897	231,221	9,179,474	(d)	(d)	468,546	239,427
1898	280,764	11,146,331	(d)	(d)	(d)	(d)
1899	[e]474,406	22,515,309	33,984	1,349,165	1,019,766	507,843
1900	767,092	36,406,186	52,323	2,077,223	1,941,510	970,755
1901	983,000	46,653,180	....	....	....	....
1902	1,060,000	50,307,600	....	....	....	....

[a] This production of refined oil is not the whole amount of refined oil made in Japan, but is only that portion which is refined by those who produce crude oil and refine it themselves. Most of the crude oil goes into the hands of others, by whom it is refined, and as yet there are no means of ascertaining this quantity.

[b] 1 koku = 39.7 English gallons = 47.46 United States gallons = 1.13 United States barrels.

[c] Value of yen on January 1, 1885, in United States money, 85.8 cents; 1886, 81 cents; 1887, 78.4 cents; 1888, 75.3 cents; 1889, 73.4 cents; 1890, 75.2 cents; 1891, 83.1 cents; 1892, 74.5 cents; 1893, 66.1 cents; 1894, 55.6 cents; 1895, 49.1 cents; 1896, 52.9 cents; 1897, 51.1 cents; 1898, 49.8 cents; 1899, 49.8 cents; 1900, 49.8 cents.

[d] Not ascertained.

[e] This represents the quantity of crude sold in 1899.

INDIA.

Condition of the industry.—Nearly the entire production of India is from the two districts in Upper Burma which are known as the Yengenyoung and the Yengenyat districts. The former is 300 miles northwest of Rangoon, and the latter is 50 miles north of the former by direct line, but many miles farther by the river. Both of these districts are very close to the great Irawaddy River. There is at present an insignificant production at Digboi in Upper Assam, 350 miles farther north of the Yengenyat district by direct measurement, and some 60 miles south of the Bramapootra River. Besides the localities named, there are a number of surface indications and shallow wells in which traces of petroleum have been found, extending for 400 or 500 miles in the valley of the Irawaddy River, north of Prome.

Petroleum has been also developed in a small way on the west coast on the islands of Cheduba and Ramree. There was at one time a production in northern Panjab which has been practically abandoned for several years.

The daily production for 1902 is placed as follows:

Daily production of petroleum in India in 1902, by districts.

District.	Quantity.
	Barrels.
Yengenyoung, Upper Burma	2,850
Yengenyat, Upper Burma	1,200
Digboi, Upper Assam	200
Total	4,250

This gives a total of 1,551,250 barrels for the year.

There are 60 producing cable-drilled wells in the Yengenyat district and 110 producing wells in the Yengenyoung district, that range from 700 to 1,350 feet in depth. In the latter district about 700 barrels are produced per day from the old dug wells or pits. This district is about 3½ miles long in a general northwest and southeast direction, and half a mile in width, and is about 3 miles east of the Irawaddy River. The Yengenyat district is 50 miles farther north on the west side of the same river and within one-half to three-fourths of a mile of its bank.

The geological conditions show marked anticlinals with a gentle dip of 15° to 20° to the west and of from 60° to 80° to the east. These can be traced many miles farther to the north of the known producing areas known as the Tangyi hills by following the axis line or by offsetting to other parallel anticlinals. The Irawaddy River breaks through one of these axis lines between these two fields. The parallel ridges to the east of the Yengenyoung production are known as the Pagan and Gwegys hills, and are marked lines of uplift out of a comparatively level plain.

The geological equivalents of this section are the Miocene and Pliocene divisions of the Tertiary group, as determined by Dr. F. Noelling, paleontologist of the geological survey of India.

The wells usually encounter a number of sandstones of a bluish color, that are from 10 to 60 feet in thickness. They contain many quartz grains and are usually capped by a bluish shale. As many as twelve separate sands have been found in a single well, but not more than three have thus far proved to be productive.

Many of these wells flow originally as much as 1,000 to 1,500 barrels per day, but in the course of time they all become pumping wells, continuing to be productive for from eight to ten years, and gradually diminishing until exhausted.

Nearly all the petroleum found in Burma and Assam has a paraffin base. The general average is from 6 to 10 per cent of paraffin. The oil in many cases will chill on the derrick floor at a temperature of 77° F. It is rather remarkable that the crude petroleum as it comes from the well is from 90° to 92° F. in temperature, or 15° F. above the average of the surface. In this particular it is similar to the condition of the petroleum as found in the Beaumont and the Sour Lake districts in Texas. The general specific gravity of the petroleum in Burma and Assam is from 32° to 38° Baumé; probably 36° is the true average. Besides the usual 6 to 10 per cent of paraffin, from 60 to 70 per cent of inferior illuminating product is secured, which has a general average of about 40° Baumé, 3 to 5 per cent of heavy naphtha, 10 to 15 per cent of lubricating petroleum, and 8 to 10 per cent of residuum. A very superior candle is made from the paraffin.

There are extensive refineries at Rangoon to which point all of the crude production in the Yengenyat and the Yengenyoung fields is transported in large iron barges drawing from 3 to 5 feet or more and carrying from 500 to 1,000 long tons each.

The entire business in Burma is in the hands of the Burma Oil Company, which has a monopoly of the industry. The production in the Upper Assam field has only really started since the new refinery has been completed by the Assam Oil Company. This is located at Digboi, some 60 miles inland from Dibrugarh on the Bramapootra River, near the extreme northwestern portion of Upper Assam, where an inferior grade of illuminating petroleum is manufactured, which finds a ready sale and is distributed down the river as far as Gauhati.

There have been 22 wells completed in this field, nearly all of which are producers; but the capacity of the refinery at present is not sufficient to test their output. The oil company here owns 8 square miles of productive territory.

A superior quality of paraffin candle is made at Digboi, which has a much wider range of sale than the other manufactured products.

There are many indications that India will in the future produce a much larger amount of petroleum than it does at present, as the structural conditions are favorable in many localities that have not been sufficiently tested to develop the deposit of crude petroleum that underlies them.

The Yengenyat and Yengenyoung districts are capable of producing much more petroleum than they do at the present time. The extreme drought in this section of India made it impossible for the usual luxuriant jungle growth to exist here. The consequence is that the outcrop of the measures is generally well exposed and the structure easily determined. In the Assam field the jungle growth is very dense; the structure is therefore determined with difficulty in this region.

A pipe line is contemplated connecting the Yengenyoung district with the refinery of the Burma Oil Company at Rangoon. This will greatly facilitate the transportation of the crude petroleum, which is now loaded in bulk barges and towed by steamers to the refinery. The low water of winter and spring greatly interferes with the full loading of these barges, which, when loaded to their capacity, carry from 500 to 1,000 long tons.

PRODUCTION.

The following table gives the production of petroleum in India from 1889 to 1902, in imperial gallons reduced to barrels of 42 gallons and in rupees reduced to dollars:

Production and value of petroleum in India, 1889-1902.

Year.	Quantity.		Value.	
	Imperial gallons.	Barrels (42 United States gallons).	Rupees.	Dollars.
1889	3,298,737	94,250	....	....
1890	4,132,287	118,065	282,173	93,681
1891	6,654,570	190,131	362,792	132,782
1892	8,479,943	242,284	363,631	119,271
1893	10,463,908	298,969	771,112	225,165
1894	11,452,649	327,218	1,126,744	276,052
1895	13,003,748	371,536	1,539,231	332,474
1896	15,049,289	429,979	1,789,167	416,876
1897	19,099,648	545,704	2,257,842	508,014
1898	18,973,878	542,110	1,018,461	204,710
1899	32,934,007	940,971	1,885,259	388,363
1900	37,729,211	1,078,264	2,231,325	722,949
1901	50,075,117	1,430,716	3,065,131	993,102
1902	56,607,688	1,617,363	3,267,245	1,058,587

The value of the rupee on January 1, 1885, in United States money was 37.8 cents; 1886, 35.7 cents; 1887, 34.6 cents; 1888, 32.2 cents; 1889, 32.3 cents; 1890, 33.2 cents; 1891, 36.6 cents; 1892, 32.8 cents; 1893, 29.2 cents; 1894, 24.5 cents; 1895, 21.6 cents; 1896, 23.3 cents; 1897, 22.5 cents; 1898, 20.1 cents; 1899, 20.6 cents; 1900, 32.4 cents; 1901, 32.4 cents; 1902, 32.4 cents.

CHINA.

In a limited way crude petroleum is produced in the Kouang-Li district and in the Tal-li chen district, generally by the crude methods that have been in use for several hundred years. The yield of the wells now operated is small, owing to the methods in use. Petroleum, natural gas, and salt brine deposits are reported by travelers in the vast interior of the Chinese Empire. However, this great Empire will, for many years to come, depend upon the petroleum developed by other countries for its supply.

The petroleum trade of China is one that is constantly on the increase, as is fully shown in the following tables. The gain of 1901 over 1900 is nearly 60 per cent in quantity and 24 per cent in value. A general idea of the intricate nature of the trade with the interior, which is a comparatively small part of the total consumption, may be obtained from a report by Acting Consul-General J. Scott (Canton), who states that kerosene oil has become a daily necessity with the Cantonese, and in Fatshan large establishments are engaged in the manufacture of cheap lamps and chimneys suitable to all classes of Chinese. Hongkong is the great depot for the kerosene trade of the southern ports of China from Foochow to Pakhoi; and at several of the treaty ports large oil-tank installations have been erected by Messrs. Samuel & Co., where the oil is tinned locally and sold at rates which are understood to undersell the American product of the Standard Oil Company. Of recent years kerosene has been discovered in large quantities in Sumatra, and a powerful Dutch company has followed the lead of Messrs. Samuel & Co., and now conducts a large and increasing trade in Dutch oil. The total import of kerosene oil in 1901 amounts to only 340,155 gallons for American oil and 222,210 for the Sumatra product. No Russian oil appears in the maritime customs returns. The explanation is, the native customs in Canton, by charging less duty than would otherwise be payable at the foreign customs department, have secured the whole of this latter import by junk. In 1900 the total import of kerosene was, American, 906,667 gallons; Sumatran, 639,960 gallons; Russian, 291,000 gallons; total, 1,839,633 gallons. This makes nearly six times the quantity imported in 1901. The trade has been subjected to much fluctuation from year to year, due to the vagaries of the officials in taxing or otherwise diverting the import into native hands for the more ready purpose of taxation and even of monopoly. In 1899 the actual import of kerosene amounted to 7,712,220 gallons, which will give a better index of the vast quantity used in the Canton and neighboring provinces, to which large quantities are regularly sent under transit passes.

Kerosene oil in large quantities is sent inland into the three provinces of Canton, Kwangsi, and Kweichow.

HAWAII.

The following table shows the imports of refined oil into Hawaii in the last six months of 1899 and 1902:

Imports of refined mineral oil into Hawaii from the United States in the last six months of 1899 and 1902.

Month.	1899.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*	
July	24,420	$4,811	61,600	$10,137
August	63,712	10,123	214,906	29,887
September	66,034	11,712	38,198	6,243
October	119,400	15,029	76,215	11,386
November	19,500	3,635	142,161	23,398
December	151,000	21,465	145,238	22,203
Total	444,066	66,775	678,318	103,254

KOREA.

The acting British vice-consul at Chemulpo reported in 1902 that the import of kerosene oil continues to increase by leaps and bounds, but it is the American product alone which finds favor in this country, Japanese oil having declined from 222,730 gallons in 1900 to 19,260 gallons during 1901, while Russian and Sumatran oil have long ceased to figure in the returns. American oil, on the other hand, advanced from 1,797,630 gallons in 1900 to 2,463,631 gallons in 1901, an increase of 666,000 gallons. At Fusan, which has hitherto been the center of the Japanese trade, the Standard Oil Company have erected two large godowns, each with a capacity of 50,000 cases, and in December last the sailing ship *Troop* arrived from Philadelphia with 60,000 cases of oil, and she is to be followed by other vessels with further supplies to meet a largely increased demand which is expected to arise with the opening of the Seoul-Fusan Railway to traffic. The commissioner of customs at Fusan, in his annual report on the trade of the year, remarks that one great obstacle in the way of the expansion of this branch of trade is the impossibility of procuring cheap lamps in the interior, owing to the large percentage of breakages, which can not be avoided under the present inconvenient system of transport. This may be true to a certain extent, but, at the same time, it must be remembered that the Koreans have very primitive ideas on the subject of artificial light, and are content to use a tiny lamp made out of old kerosene tins, without any glass at all. The chief factor in preventing the use of kerosene oil becoming general is the prohibitive cost of conveying it into the interior under the present conditions, but the construction of railways will effect a revolution in this industry, as in others.

Exports of petroleum from the United States into Korea in years ending June 30, 1901 and 1902.

Kind of oil.	1901.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*	
Illuminating	....	....	1,361,650	$118,975
Lubricating	1,760	$560	11,517	2,215
Total	1,760	560	1,373,167	121,190

WORLD'S PRODUCTION.

The following table gives the production, approximately, of crude petroleum in all of the known countries of the world, together with the percentages of each for 1901 and 1902, in terms of United States barrels. A small estimated quantity has been placed under the head of "all other countries." This quantity includes a primitive production in several of the South American States, Algeria in Africa, Persia, the Philippines, and China, from which no returns could be secured.

The total increase in 1902 amounted to almost 12 per cent as compared with 1901, and to almost 25 per cent as compared with 1900. The most conspicuous items in the list are the increase in the production of the United States and the decrease in the production of Russia, the United States, for the first time in five years, surpassing Russia in production by 8,226,871 barrels. The United States and Russia produced, in 1902, 91.44 per cent of the total output as compared with 93.22 per cent in 1901, and with 94.11 per cent in 1900. Of the remaining 8.56 per cent Sumatra, Java, Borneo, Galicia, and Roumania, which furnished only 4.65 per cent in 1901, furnished 6.52 per cent in 1902, leaving 2.04 per cent of the total as the output of all the other producing countries.

World's production of crude petroleum in 1901 and 1902.

[Barrels of 42 United States gallons.]

Country.	1901. Quantity.	1901. Percentage of total.	1902. Quantity.	1902. Percentage of total.
United States	69,389,194	41.84	88,766,916	47.94
Canada	572,500	.35	520,000	.28
Peru	72,261	.04	60,000	.03
Russia	85,168,556	51.38	80,540,045	43.50
Galicia	3,251,544	1.96	4,142,160	2.24
Sumatra, Java, and Borneo	3,038,700	1.84	5,860,000	3.17
Roumania	1,406,160	.85	2,059,930	1.11
India	1,430,716	.86	1,617,363	.87
Japan	1,100,000	.67	1,193,000	.64
Germany	313,630	.19	353,675	.20
Italy	10,100	.02	12,000	.02
All other countries	20,000		26,000	
Total	165,773,361	100.00	185,151,089	100.00

The large increase in the production of the United States in 1902, amounting to 19,377,722 barrels, and the decrease in the production of Russia, amounting to 4,628,515 barrels, caused these two countries to change places, the United States now having the largest production.

Although in the production of crude petroleum the United States and Russia so closely divide the 91.44 per cent of the entire production of the world, yet when the quality of the crude petroleum is considered the parallel is by no means so complete, since more than double the quantity of the higher grades of refined products are secured from the average crude petroleum produced in the United States as compared with that produced in Russia.

The following table is compiled upon the assumption that the refined products from the crude petroleum produced in the United States amount to 52 per cent of the gross output, as compared with 20 per cent of the gross output of Russian crude, and with 28 per cent of the average crude produced in all other countries.

Approximate production of refined products from crude petroleum produced in the United States, Russia, and all other countries in 1902.

Country.	Quantity.	Proportion.
	Gallons.	*Per cent.*
United States	1,938,669,445	72.1
Russia	676,536,378	25.2
All other countries	73,018,540	2.7
Total	2,688,224,363	100.0

The United States therefore produced nearly 2.6 barrels of refined products in 1902 for every barrel produced by the rest of the world.

The purest and most valuable grades of crude petroleum in the known world continue to be produced in the northeastern portion of the United States, in the Appalachian and the Lima-Indiana fields.

A very fair grade is also produced in a comparatively small way in Sumatra, Java, Galicia, Roumania, and India.

Of late years there has been a very large production of crude petroleum of inferior quality consumed as fuel oil. Recently in Russia the crude has only been distilled sufficiently to satisfy the requirements of the Government as to the flash test, and the remainder is marketed as fuel petroleum, under the head of residuum. This is also true to a certain extent in our newly-developed fields in Texas, Louisiana, and California, the crude production of which is chiefly marketed in the crude state for fuel petroleum. The exports of this petroleum must of course meet the conditions demanded as to fire and flash test by the country to which it is consigned.

Cheaper transportation by pipe lines and tank ships has made this variety of fuel marketable in distant quarters of the globe that are destitute of coal. Its peculiar adaptability and fitness as a fuel for ocean liners and locomotives, where limited boiler space demands the greatest possible efficiency, are being more generally recognized throughout the world.

NATURAL GAS.

By F. H. Oliphant.

INTRODUCTION.

The early use and development in the United States of this most perfect fuel was chiefly due to its observed presence in natural springs, afterwards to artesian-well drilling in search of salt brine.

In subsequent years the search for petroleum, with which it is usually associated, developed large areas of high pressure reservoirs of this remarkable hydrocarbon, which is to-day, and has been for the last thirty years, a most economical and convenient source of heat, light, and power. Outside of the United States its production is insignificant—not over 1½ per cent of the quantity produced in this country. A large portion of this outside production comes from our neighbor—Canada.

Its introduction into commercial use was slow, and it required several years for its value to begin to be appreciated. After its value was fully demonstrated there was a rush of capital, and a large amount of money was invested in gas territory, gas wells, and pipe lines.

Then followed a period of reckless consumption and appalling waste. These conditions rapidly depleted many of the original fields of their high pressure and brought about the necessity of building larger and in many cases much longer lines to reach more remote districts where the original pressure was known to exist in reservoirs which contained it in commercial quantities, and by their remoteness were not subject to the ruinous competition that helped to exhaust the nearer original fields.

Many of these more recent localities of high-pressure gas were developed in the search for petroleum; others were located by structural conditions of the strata, as natural gas inevitably seeks the higher portions of the rock in which it is sealed.

Not until it was fully realized that a large proportion of our then known natural supply had been consumed and dissipated by the extravagant and wanton methods in use, were improved methods adopted for holding back the gas in the original rock reservoirs.

VALUE OF NATURAL-GAS PRODUCTION.

In the following table is given the approximate value of natural gas produced and sold in the United States from 1889 to 1902, by States:

Approximate value of natural gas produced in the United States, 1889–1902, by States.

State.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
Arkansas	$375	[a]$6,000	$250	$100	$100	$100	$100
California	12,680	33,000	30,000	55,000	62,000	60,350	55,000
Colorado						12,000	7,000
Illinois	10,615	6,000	6,000	12,988	14,000	15,000	7,500
Indiana	2,075,702	2,302,500	3,942,500	4,716,000	5,718,000	5,437,000	5,203,200
Kansas	15,873	12,000	5,500	40,795	50,000	86,600	112,400
Kentucky	2,580	30,000	38,993	43,175	68,500	89,200	98,700
Missouri	35,687	10,500	1,500	3,775	2,100	4,500	3,500
New York	530,026	552,000	280,000	216,000	210,000	249,000	241,530
Ohio	5,215,669	4,684,300	3,076,325	2,136,000	1,510,000	1,276,100	1,255,700
Pennsylvania	11,593,989	9,551,025	7,834,016	7,376,281	6,488,000	6,279,000	5,852,000
South Dakota	25	(a)					
Texas	1,728	(a)		100	50	50	20
Utah	150	(a)			500	500	20,000
West Virginia	12,000	5,400	35,000	500	123,000	395,000	100,000
Other States	1,600,000	1,600,000	250,000	200,000	100,000	50,000	50,000
Total	21,107,099	18,792,725	15,500,084	14,800,714	14,346,250	[b]13,954,400	[b]13,006,650

State.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Arkansas	$60	$40					
California	55,682	50,000	$65,337	$86,891	$79,083	$67,602	$120,648
Colorado	4,500	4,000	3,300	1,480	1,800	1,800	1,900
Illinois	6,375	5,000	2,498	2,067	1,700	1,825	1,844
Indiana	5,043,635	5,009,208	5,060,969	6,680,370	7,254,539	6,954,566	7,081,344
Indian Territory							360
Kansas	124,750	105,700	174,640	332,592	356,900	659,173	824,431
Kentucky	99,000	90,000	103,133	125,745	286,243	270,871	365,611
Missouri	1,500	500	145	290	547	1,328	2,154
New York	256,000	200,076	229,078	294,593	335,367	293,232	346,431
Ohio	1,172,400	1,171,777	1,488,308	1,866,271	2,178,234	2,147,215	2,355,308
Pennsylvania	5,528,610	6,242,543	6,806,742	8,337,210	10,215,412	12,688,161	14,352,223
South Dakota				3,500	9,817	7,255	10,280
Texas			765	8,000	20,000	18,577	14,953
Utah	20,000	15,050	7,875				
West Virginia	640,000	912,528	1,334,023	2,335,864	2,959,032	3,954,472	5,390,181
Other States	50,000	20,000	20,000				
Total	[b]13,002,512	[b]13,826,422	[b]15,296,813	[b]20,074,873	[b]23,698,674	[b]27,066,077	[b]30,867,668

[a] Includes value of gas produced in South Dakota, Texas, and Utah.

[b] Does not include value of gas produced in Canada and consumed in the United States.

This table is conspicuous for the large increase in the value of the natural gas sold in 1902.

A considerable quantity of natural gas is consumed in the manufacture of lampblack. This is the only article manufactured from natural gas.

There was a slight increase in the price of the natural gas marketed in a number of localities. The increase in the quantity marketed came principally from Pennsylvania and West Virginia. Indiana maintained its former production from declining fields by the use of natural-gas compressor plants. In Ohio also the compressor was largely used to keep up the declining output of its fields. The largest gain in 1902 was in West Virginia, which furnished large quantities of natural gas to Pennsylvania and Ohio. Pennsylvania furnished a large amount to New York and Ohio, and a small amount to West Virginia. Indiana furnished gas to Ohio and Illinois, and Kentucky furnished natural gas to Ohio and West Virginia. The quantity and value of the natural gas produced in Kansas has been steadily increasing. The State of California made large gains, although its production is as yet insignificant. Indian Territory appears for the first time in the list of producers, but Utah has for several years past failed to record any production.

The Appalachian and the Lima-Indiana natural-gas production amounted to 97 per cent of the total production of the United States in 1902. The Appalachian proportion of the total value of the production was 69.5 per cent, leaving 27.5 per cent that represented the production of the Lima-Indiana fields. The State of Ohio produced natural gas from both of these fields. Of the total value in 1902, Pennsylvania produced 46.5 per cent, Indiana 22.9 per cent, West Virginia 17.4 per cent, Ohio 7.6 per cent, Kansas 2.67 per cent, New York 1.12 per cent, Kentucky 1.18 per cent, and the remaining States only 0.49 of 1 per cent. Canada's production of natural gas was only 0.63 per cent of the value of that produced in the United States.

QUANTITY AND VALUE OF NATURAL GAS CONSUMED IN 1902.

The value of natural gas produced and sold foı consumption in the United States in the year 1902 was $30,867,668, a value greater than that of any previous year. At an average price of 15 cents per 1,000 cubic feet, this sum represents a production of 205,784,453,333 cubic feet. Were it possible to store this quantity in equal density in a reservoir whose base is 1 square mile the sides of the reservoir would be 1.4 miles high. Assuming that 20,000 cubic feet of natural gas be taken as equal to 1 ton of coal, the quantity of natural gas in 1902 represents, in round numbers, 10,289,000 tons of coal, valued at $3 per ton.

The value of the coal and wood actually displaced is reported as $39,798,833, so that the use of the natural gas resulted in an apparent saving to its consumers in 1902 of $8,931,165.

The value of the natural gas produced and sold in 1902 was $3,801,591 greater than that of 1901, an increase of over 14 per cent. The value of the production in 1901 was 14 per cent more than that of 1900, and that of 1900 was 18 per cent greater than in 1899. It may be interesting to note that the value of natural gas in 1902 was 43.3 per cent of the value of the crude petroleum produced in the same year. When the value of the coal and other fuel displaced by the natural gas is taken into consideration, the value of the natural gas amounts to very nearly 56 per cent of the value of the crude petroleum. Natural gas is a finished product, however, while petroleum is a crude commodity, requiring treatment before it can be marketed.

There were 14,370 wells producing natural gas at the close of 1902, of which number 107 were shut in and not in use, leaving 14,263 wells that were in use. There were 2,749 new productive wells completed during 1902, 594 wells were dry or unproductive, and 1,250 wells were abandoned. At the close of 1901 there were 12,865 producing wells, so that 1902 shows a gain of 1,505 productive wells. In 1902 there were laid 3,125 miles of main line of pipe from 2 inches up to 20 inches in diameter. The total miles of main line in use at the close of 1902 were 24,973, sufficient to girdle the globe.

COMBINED VALUE OF NATURAL GAS AND PETROLEUM, BY STATES, IN 1902.

The following table is made up of the combined value of natural gas and petroleum in 1902. The total value of both was $102,035,924, of which 30.2 per cent was the value of the natural gas and 69.8 per cent that of the petroleum. Of this amount Pennsylvania produced 29 per cent, Ohio 22.7 per cent, West Virginia 22 per cent, Indiana 13.3 per cent, California 4.88 per cent, Texas 3.9 per cent, New York 1.84 per cent, Kansas 1.08 per cent, leaving but 1.3 per cent for the production of the remaining States.

In the States of Indiana, Kansas, and Kentucky the value of the natural gas produced exceeded the value of the petroleum. The value of natural gas in Pennsylvania in 1902 was only $913,870 less than that of the petroleum. This State produces the largest part of the combined value of natural gas and petroleum.

The combined value of natural gas and petroleum ranks next to pig iron and coal in the list of the values of the crude mineral products of the United States in 1902.

Value of the natural gas and petroleum produced in 1902 and their combined value, by States.

State.	Value of natural gas.	Value of petroleum.	Value of natural gas and petroleum.
Pennsylvania	$14,352,223	$15,266,093	$29,618,316
Ohio	2,355,308	20,757,359	23,112,667
West Virginia	5,390,181	17,040,317	22,430,498
Indiana	7,081,344	6,526,622	13,607,966
California	120,648	4,862,963	4,983,611
Texas	14,953	3,998,097	4,013,050
New York	346,431	1,530,852	1,877,283
Kansas	824,431	292,464	1,116,895
Colorado	1,900	484,683	486,583
Kentucky and Tennessee	365,611	141,044	506,655
Louisiana		188,985	188,985
Wyoming		43,771	43,771
Indian Territory	360	32,190	32,550
South Dakota	10,280		10,280
Michigan, Missouri, and Oklahoma	2,154	1,816	3,970
Illinois	1,844	1,000	2,844
Total	30,867,668	71,168,256	102,035,924

VALUE OF NATURAL GAS CONSUMED, BY STATES.

The following table is interesting as revealing three important facts. The first column shows that there was a large increase—2,116, as compared with 1,545 in 1901—in the number of companies and individuals reporting on the consumption of natural gas during 1902. This increase is largely made up from small producers in Pennsylvania, New York, Indiana, Illinois, and California. Many of the large natural-gas companies have consolidated in Pennsylvania, Ohio, and West Virginia.

The second column of this table indicates the value of the natural gas consumed in the State which produced it. Pennsylvania, Indiana, and West Virginia sold a considerable portion of their production outside of their borders. Ohio purchased very nearly double the amount that was produced inside of the State. West Virginia sold 54 per cent of her production to the States of Pennsylvania and Ohio. New York produced only 20 per cent of the quantity consumed; the other 80 per cent came from Pennsylvania chiefly. Gas produced in Canada and consumed in New York is not included in this table.

A considerable portion of the natural gas produced in Kentucky was consumed in West Virginia and Ohio. The remaining States consumed inside of their own borders all of the natural gas they produced.

In the third column is given the value of the wood and coal displaced by natural gas in 1902. The increase in value was $8,931,165, an increase of 29 per cent, as compared with an increase of 20 per cent in 1901. This seems to indicate a considerable increase in the price both of the anthracite coal displaced by natural gas in the lake cities, in which anthracite was formerly used, and of the bituminous coal formerly used as a household fuel, a much greater increase in proportion than in the price of natural gas. In Indiana and Kansas natural gas is sold at very low prices, comparatively, and the fuel displaced would have cost nearly 50 per cent more than the price obtained for the natural gas.

Value of natural gas consumed in the United States in 1902, by States, and the value of coal or wood displaced by same, as reported by 2,147 persons, firms, and corporations.

State.	Companies or individuals reporting.	Amount received for sale of gas or value of gas consumed.	Estimated value of coal, wood, or other fuel displaced by gas.
Pennsylvania	[a] 379	$13,942,823	$17,912,669
Indiana	929	6,710,080	10,066,248
Ohio	[b] 451	4,785,616	5,351,778
West Virginia	79	2,473,174	2,994,777
New York	[c] 116	1,723,669	1,771,037
Kansas	80	824,431	1,175,349
Kentucky and Tennessee	21	255,736	282,445
California	38	120,648	204,784
Texas	9	14,953	14,953
South Dakota	3	10,280	117,080
Missouri	11	2,154	2,394
Colorado	3	1,900	2,850
Illinois	23	1,844	1,969
Indian Territory	4	360	500
Arkansas	1	....	....
Total	2,147	30,867,668	39,798,833

[a] Includes 94 individual producers in Erie County, the product of whose wells is principally for their own domestic consumption.

[b] Includes 333 individual producers in Ashtabula, Cuyahoga, Lake, and Lorain counties, the product of whose wells is principally for their own domestic consumption.

[c] Includes 63 individual producers in Chautauqua County, the product of whose wells is principally for their own consumption.

In the following table is given the value of natural gas consumed in the United States in 1899, 1900, 1901, and 1902, by States. The first-named five States, which produce and consume more than nine-tenths of the natural gas, show a regularly increased production during the last four years, and have maintained their respective places for that period.

Value of natural gas consumed in the United States, 1899–1902, by States.

State.	1899.	1900.	1901.	1902.
Pennsylvania	$7,926,970	$9,812,615	$11,785,996	$13,942,823
Indiana	[a]5,833,370	[a]6,412,307	[a]6,276,119	[a]6,710,080
Ohio	3,207,286	3,823,209	4,119,059	4,785,616
West Virginia	1,310,675	1,530,378	2,244,758	2,473,174
New York	1,236,007	1,456,286	1,694,925	1,723,669
Kansas	332,592	356,900	659,173	824,431
Kentucky	125,745	194,032	187,660	255,736
California	86,891	79,083	67,602	120,648
Texas	8,000	20,000	18,577	14,953
South Dakota	3,500	9,817	7,255	10,280
Missouri	290	547	1,328	2,154
Colorado	1,480	1,800	1,800	1,900
Illinois	2,067	1,700	1,825	1,844
Indian Territory	....	....	....	360
Total	20,074,873	23,698,674	27,066,077	30,867,668

[a] A portion of this was consumed in Chicago, Ill.

By comparing the value of the natural gas consumed as recorded in the above table with that produced as recorded in a previous table, it will be found that West Virginia produced $2,917,007 worth of gas in excess of the value of that consumed in the State in 1902. Indiana produced $371,264 worth of gas more than was consumed in the State. In Pennsylvania $409,400 represents the amount sold out of the State over that produced and purchased within the State. On the other hand, Ohio purchased $2,430,308 worth from other States, and New York purchased $1,377,238 worth of natural gas in excess of its production in 1902.

USES OF NATURAL GAS.

In the following table are specified the uses to which the natural gas produced in the United States in 1902 was put:

Uses to which natural gas produced in the United States in 1902 was put, as reported by 2,147 persons, firms, and corporations.

State.	Companies or individuals reporting.	Domestic consumers supplied.	Establishments supplied.				
			Iron mills.	Steel works.	Glass works.	Other establishments.	Total.
Pennsylvania	379	185,678	30	69	124	2,225	2,448
Indiana	929	101,481	13	7	141	3,121	3,282
Ohio	451	120,127	8	9	56	713	786
West Virginia	79	29,357	3	8	31	835	877
New York	116	50,536		1	8	206	215
Kansas	80	13,488	1		3	87	91
Kentucky	21	7,149	1	2		372	375
California	38	1,434			1	7	8
Texas	9	103				13	13
South Dakota	3	251				2	2
Missouri	11	38					
Colorado	3	6				4	4
Illinois	23	32					
Indian Territory	4	15				2	2
Arkansas	1						
Total	2,147	509,695	56	96	364	7,587	8,103

There was an increase of 602 companies and individuals reporting in 1902 as compared with 1901. Many of these, however, were individuals owning a single well, which accounts in part for the large increase. A number of iron, steel, and glass works in Pennsylvania and a number of glass works in Indiana have their own natural-gas plants. The natural-gas companies have found more profitable customers in supplying the domestic trade, for which the natural gas is so eminently fitted and from which nearly all of their revenue is derived. There were 509,695 domestic consumers supplied in 1902. It is estimated that not less than 3,850,000 individuals are supplied with light and fuel by natural gas, and that not less than 4,500,000 people received the benefit of its use as an illuminant.

RECORD OF WELLS AND PIPE LINES, BY STATES.

In the following table will be found the number of companies and individuals reporting, the producing wells at the close of 1901 and 1902, the producing wells drilled, and the nonproducing or dry holes drilled in 1902, together with the total length of pipe in use at the close of 1902, by States.

Record of wells and amount of pipe line, as reported by 2,147 persons, firms, and corporations in 1902, by States.

State.	Companies or individuals reporting.	Wells.					Total pipe laid to Dec. 31, 1902.	
		Producing, Dec. 31, 1901.	Producing, drilled in 1902.	Abandoned in 1902.	Producing, Dec. 31, 1902.	Nonproducing holes drilled in 1902.	Feet.	Miles.
Pennsylvania	379	4,529	775	203	5,101	232	48,863,621	9,254.48
Indiana	929	5,371	1,331	882	5,820	205	36,121,980	6,841.28
Ohio	451	1,099	266	75	1,290	40	20,093,670	3,805.62
West Virginia	79	794	142	51	885	37	14,548,395	2,755.38
New York	116	583	69	14	638	8	5,894,517	1,116.38
Kansas	80	299	144	24	419	63	5,034,791	953.56
Kentucky	21	116	8	....	124	2	749,875	142.02
California	38	27	2	....	29	....	365,925	69.30
Texas	9	11	2	....	113	....	96,196	18.22
South Dakota	3	4	1	1	4	1	26,900	5.09
Missouri	11	10	4	0	14	2	14,672	2.78
Colorado[a]	3	....	....	....	....	....	12,500	2.36
Illinois	23	23	2	....	25	2	31,894	6.04
Indian Territory	4	3	1	....	4	....	4,700	.90
Arkansas	1	2	2	....	4	2	....	....
Total	2,147	12,871	2,749	1,250	[b]14,370	594	131,859,636	24,973.41

[a] Gas is produced from oil wells. [b] Includes 107 wells not utilized in 1902.

RECORD BY STATES.

PENNSYLVANIA.

This State has the largest area of natural gas. Its pools are thickly scattered to the west of an imaginary line drawn from the southeast corner of Greene County to the northeast corner of Potter County, embracing an area of about one-third of the entire State. All the counties to the west of and including those cut by this imaginary line in this portion of Pennsylvania produce more or less natural gas.

The pools in which the natural gas is found are generally extended in a northeast and southwest direction of greater or less extent. There are instances where cross lines of elevation have interrupted the general trend of the pools.

Three requisites are necessary for the accumulation and storage of natural gas: First, there must be an open, porous, or cellular structure in which the gas can accumulate; second, this open structure must be capped by a clay or shale that will close up the reservoir and adjust itself to the vents caused by flexures so as to seal them up; third, there must be sufficient pitch or relief in the gas-holding strata, so that the natural gas can accumulate in the domes of the arches and the flanks of the elevations, and thus be separated from the petroleum and salt water with which it is usually associated.

These conditions have been particularly fulfilled in the structure of the western portion of the State of Pennsylvania. This State produced nearly 47 per cent of the entire output of the United States in 1902, nearly as much as the combined production of Indiana, Ohio, and West Virginia. The value of the production in 1902 was $14,352,223, an increase of $1,664,062 over the value of the production in 1901.

When the combined values of natural gas and petroleum are considered, Pennsylvania heads the list with a production of $29,618,316, amounting to nearly 30 per cent of the combined value of natural gas and petroleum produced in 1902.

Although many of the older natural-gas pools, which in former years were large producers, have at this date ceased to produce any considerable amount, there are other fields in which by means of the suction lines leading to the gas-compressor plants large areas of low-pressure gas are made available and have for many years been producing large amounts in the aggregate.

The deep Bayard and other sands in Greene County, the Gordon, the Big Injun, the Fourth and the Fifth sands of Washington and Fayette counties, the Speechley in Butler, Armstrong, and Venango counties, and the deeper underlying sands of Elk, McKean, and Potter counties have all contributed largely to maintain and even to increase materially the output of Pennsylvania.

Value of natural gas produced in Pennsylvania, 1885–1902.

Year.	Value.	Year.	Value.
1885	$4,500,000	1894	$6,279,000
1886	9,000,000	1895	5,852,000
1887	13,749,500	1896	5,528,610
1888	19,282,375	1897	6,242,543
1889	11,593,989	1898	6,806,742
1890	9,551,025	1899	8,337,210
1891	7,834,016	1900	10,215,412
1892	7,376,281	1901	12,688,161
1893	6,488,000	1902	14,352,223

RECORD OF NATURAL-GAS INDUSTRY IN PENNSYLVANIA.

In the following table there is exhibited a very complete record of the several uses to which natural gas is applied, including its value, the value of other fuel displaced, the number of domestic consumers supplied, the number of iron, steel, glass, and other establishments supplied, the operation of wells, and the feet of pipe line completed at the close of 1900, 1901, and 1902.

Record of natural-gas industry in Pennsylvania, 1900–1902.

	1900.	1901.	1902.
Amount received for sale of gas or value of gas consumed	$9,812,615	$11,785,996	$13,942,823
Value of natural gas produced	$10,215,412	$12,688,161	$14,352,223
Value of coal and wood displaced	$9,789,065	$11,892,070	$17,912,669
Domestic consumers supplied	[a] 229,730	[a] 326,912	185,678
Iron and steel works supplied	55	82	99
Glass works supplied	80	80	124
Other establishments supplied	1,161	1,581	2,225
Total establishments supplied	1,296	1,743	2,448
Total wells producing Jan. 1	3,407	3,776	4,529
Total productive wells drilled	513	660	775
Total wells abandoned	210	239	203
Total wells producing Dec. 31	3,710	4,197	5,101
Total dry holes drilled	142	143	232
Total feet of pipe laid to Dec. 31	43,865,000	47,913,618	48,863,621
Number establishments reporting	266	296	379

[a] Number domestic fires supplied.

INDIANA.

The production of natural gas in this State in 1902 is valued at $7,081,344, a gain of $126,778 over 1901. It is remarkable with what regularity the production in this State has been maintained for the last ten years in the face of a declining pressure. Indiana probably produced as much natural gas in 1902 as did Pennsylvania, although the price received in the latter State was double that received for the sale of natural gas in Indiana. A very large proportion of the natural gas is marketed in this State at a low figure, based upon the amount that passes through a certain sized orifice. Whether a greater or less amount is consumed by the individual, the price remains the same, and there is no effort on the part of the consumer to use the gas in an economical manner. When the gas is sold by the meter, the indifference of the consumer ends, and the gas is consumed in such a manner that usually one-half the amount formerly used will accomplish the same results. There has been a disposition of late years to consume an extra amount of the gaseous fuel that is developed in drilling prospective oil wells, and is sold to manufacturers at a low rate. The petroleum found in the Trenton rock on the northern flank of the great natural-gas field has caused the waste of many millions of cubic feet of gas that has escaped into the air in the process of completing oil wells. To guard against this waste, a special law was enacted requiring the shutting in of wells that produced large quantities of natural gas accompanied usually by a small quantity of petroleum. This law had some good effect, but in many cases it was evaded.

The original natural-gas field in Indiana occupied an area of 2,850 square miles of almost continuous territory over the flat dome of the

Trenton rock. This field was unsuspected for many years until the Ohio field was developed. The original pressure in 1886 was 325 pounds to the square inch. At the end of 1902 this pressure had declined to an average of about 50 pounds, which represents only 15½ per cent of the original volume. This may be increased to 20 per cent, owing to tardy manner in which the pressure adjusts itself in the rock as the gas approaches exhaustion.

By means of natural-gas compressors and fan blowers the remaining portion in the once great reservoir is being fast depleted. Salt water becomes more of an enemy to the life of a gas well as the pressure decreases.

The production of petroleum in Indiana in 1902 was valued at $6,526,622; the value of the natural gas was $7,081,344, a total of $13,607,966, which is 13.3 per cent of the combined value of petroleum and natural gas produced in the United States during 1902.

For a number of years gas mains leading from Indiana to Chicago, Ill., have furnished that city with from 18,000,000 to 20,000,000 cubic feet per day. Several large towns on the western border of Ohio have also been supplied with natural gas produced in Indiana.

In the following table will be found a statement of the value of the natural gas produced in Indiana from 1886 to 1902:

Value of natural gas produced in Indiana, 1886–1902.

Year.	Value.	Year.	Value.
1886	$300,000	1895	$5,203,200
1887	600,000	1896	5,043,635
1888	1,320,000	1897	5,009,208
1889	2,075,702	1898	5,060,969
1890	2,302,500	1899	6,680,370
1891	3,942,500	1900	7,254,539
1892	4,716,000	1901	6,954,566
1893	5,718,000	1902	7,081,344
1894	5,437,000		

RECORD OF THE NATURAL-GAS INDUSTRY IN INDIANA.

The following table is a complete record of the operations in the Indiana natural-gas field in the years 1900, 1901, and 1902, and it indicates a considerable increase in nearly all of the items. Many of the gas wells were drilled in search of petroleum, and when they developed into gas wells they were piped to the nearest manufacturer and their product disposed of at remarkably low rates. There is a decided increase in the price of the production in the face of the declining pressure and of the many abandoned gas wells.

Record of natural-gas industry in Indiana, 1900–1902.

	1900.	1901.	1902.
Amount received for sale of gas or value of gas consumed..	$6,412,307	$6,276,119	$6,710,080
Value of natural gas produced	$7,254,539	$6,954,566	$7,081,344
Value of coal and wood displaced	$11,862,768	$10,669,402	$10,066,248
Domestic consumers supplied	a 181,751	a 153,869	101,481
Iron and steel works supplied	15	11	20
Glass works supplied	101	111	141
Other establishments supplied	2,635	2,448	3,121
Total establishments supplied	2,751	2,570	3,282
Total wells producing Jan. 1	4,333	4,287	5,371
Total productive wells drilled	861	985	1,331
Total wells abandoned	648	700	882
Total wells producing Dec. 31	4,546	4,572	5,820
Total dry holes drilled	156	208	205
Total feet of pipe laid to Dec. 31	33,958,001	31,241,320	36,121,980
Number of establishments reporting	670	656	929

a Number domestic fires supplied.

WEST VIRGINIA.

This State is yearly becoming more prominent as a natural-gas producer, and is the hope of the future for a continued supply to western Pennsylvania and eastern Ohio. Its field operations have within the last two years proven the existence of deeply-buried strata containing high-pressure gas over many large areas in Lewis, Harrison, Marion, Monongalia, and Wetzel counties, developed in the Big Injun, the Gordon sand, the Gordon Stray, the Fourth, the Fifth, and the Bayard or Sixth sands. Many of the wells in this section of the State are among the largest in volume; as much as 26,000,000 cubic feet are recorded as the output of a single well. The rock pressure is from 1,000 to 1,250 pounds to the square inch, and the depth of the wells is from 2,700 to 3,200 feet. The other counties in which more or less natural gas has been developed are Tyler, Ritchie, Doddridge, Marshall, Wood, Wirt, Roane, Calhoun, Boone, Mingo, Kanawha, Logan, and Gilmer. Several of the largest natural-gas companies in western Pennsylvania supply Pittsburg with natural gas produced in West Virginia. During the last year several large lines have been completed across the Ohio River into eastern and southern Ohio.

The value of the production of natural gas in 1902 was $5,390,181, an increase of $1,435,709, or 36 per cent, as compared with 1901, this State showing the largest percentage of increase in 1902. Of the total product only about 46 per cent was consumed within the State, 54 per cent going to Pennsylvania and Ohio. West Virginia also received some natural gas from Kentucky and Pennsylvania which was consumed inside of its borders. The combined production of natural gas and petroleum in this State in 1902 was valued at $22,430,498, or 21.98

per cent of the combined value of petroleum and natural gas produced in the United States in 1902. The increase in production of natural gas in this State has been quite regular since 1895. There are sufficient reservoirs now developed to add largely to the State's wealth in the future, as the petroleum and bituminous coal deposits recently developed have done.

The value of the natural-gas produced in West Virginia from 1889 to 1902 is shown in the following table:

Value of natural gas produced in West Virginia, 1889–1902.

Year.	Value.	Year.	Value.
1889	$12,000	1896	$640,000
1890	5,400	1897	912,528
1891	35,000	1898	1,334,023
1892	500	1899	2,335,864
1893	123,000	1900	2,959,032
1894	395,000	1901	3,954,472
1895	100,000	1902	5,390,181

RECORD OF NATURAL-GAS INDUSTRY IN WEST VIRGINIA.

The following table gives a detailed statement of the operations in this State in developing and marketing natural gas in 1900, 1901, and 1902. All of the individual items show an increase in 1902 over 1901, as does also 1901 over 1900.

Record of natural-gas industry in West Virginia, 1900–1902.

	1900.	1901.	1902.
Amount received for sale of gas, or value of gas consumed	$1,530,378	$2,244,758	$2,473,174
Value of natural gas produced	$2,959,032	$3,954,472	$5,390,181
Value of other fuel displaced	$1,712,462	$2,415,360	$2,994,777
Domestic consumers supplied	a 45,943	a 55,808	29,357
Iron and steel works supplied	2	2	11
Glass works supplied	14	13	31
Other establishments supplied	168	251	835
Total establishments supplied	184	266	877
Total wells producing Jan. 1	328	418	794
Total productive wells drilled	129	177	142
Total wells abandoned	37	51	51
Total wells producing Dec. 31	420	544	885
Total dry holes drilled	6	8	37
Total feet of pipe laid to Dec. 31	10,185,093	11,852,303	14,548,395
Number establishments reporting	34	44	79

a Number of domestic fires supplied.

OHIO.

This State contains three natural-gas fields. The first known field was along the eastern margin of the State, where are the sands of the Lower Coal Measures, the Waverly Series, and the Ohio shales. The second field in the central portion of the State receives its natural gas from the Clinton Limestone of the Upper Silurian series. This field was the last developed. The third field is that found in the northwestern portion of the State, and obtains its natural gas exclusively from the upper portion of the Trenton limestone of Lower Silurian series. The early use of natural gas dates back to 1866, when it was used at Gambier, in Coshocton County, in the manufacture of lampblack. In 1874 it was used at East Liverpool, in the household, for heat and light. The great Trenton rock gas field was first opened at Findlay in November, 1884. The Lancaster gas field was developed by a well drilled near that city in 1887. The gas produced from the eastern portion of the State, which was secured from the Berea, the Cow Run, and the Big Injun sands, was not developed in sufficient quantity to warrant the piping of it to far distant localities, but it has been an important factor in supplying many near-by towns and industries.

The Trenton rock gas field was rapidly developed until it covered about 500 square miles. The original rock pressure was 425 pounds to the square inch. A wanton waste of this fuel was caused by wild speculation and inflated values, and the end of this pool was in sight before the gas was thoroughly introduced into the near-by cities. For the last four years the pool has been practically exhausted.

The Lancaster field in central Ohio long lay undeveloped to any large extent until in 1899, when there was a rapid development of what is known as the Sugar Grove field. The original pressure of 750 pounds was, by 1900, reduced to 400 pounds, and in 1902 it was still further reduced to less than 100 pounds to the square inch.

During 1901 and 1902 a very large field was opened north of the original Lancaster field in Knox and Licking counties, which receives its production from the geological horizon of the Clinton limestone. The area of this field, so far as developed, is now about 20 miles long and from 4 to 6 miles in width. Of a total of 72 wells drilled inside of the area named, only 4 were dry holes. The rock pressure is 800 pounds to the square inch. The average flow is about 4,000,000 cubic feet per 24 hours. One well started at the rate of 14,000,000 cubic feet, but fell off to about 9,000,000 cubic feet. The area of this field, so far as developed, is much larger than the original Lancaster or Sugar Grove field, and promises to produce large quantities of high-pressure natural gas.

Ohio has felt the loss of the natural gas in the original area near

Findlay, which was squandered in the most reckless manner before it was possible to impress upon many individuals directly interested in the natural-gas business that the supply of natural gas is limited, that every cubic foot taken out leaves that much less to follow. The new fields are being operated with more care, owing to the severe lessons taught in the early stage of the development. In Ashtabula County a number of small gas wells have been secured from the Corniferous limestone, which have lately been piped to Ashtabula and Jefferson. West Virginia, however, continued to furnish a large quantity of natural gas to Ohio, supplying Marietta, Belpre, Newport, New Matamoras, Sardis, Powhatan, Dennison, Urichville, Canal Dover, Canton, Massillon, Akron, Cleveland, and in part Steubenville, East Liverpool, Toronto, Bridgeport, Mingo, and Wellsville. The indications are that a much larger quantity will be delivered to Ohio from West Virginia in the future. Pennsylvania supplies Youngstown and several villages in eastern Ohio. Kentucky furnishes gas to Ironton, and Indiana furnishes natural gas to several towns near the western border of the State.

The value of the natural gas produced in Ohio in 1902 was $2,355,308, which is a gain of $208,093 as compared with 1901. The greatest production in this State was in 1889, after the great Findlay gas field had been first opened; the least production was in 1897, just before the Lancaster and Sugar Grove pools were developed. Of the $4,785,616 in value of natural gas consumed in Ohio in 1902, $2,355,308 in value, or 49.3 per cent, was produced by the State; the remainder was furnished by West Virginia, Indiana, Pennsylvania, and Kentucky. Of the total State production $2,005,351 worth was from wells located in the counties of Fairfield, Hocking, Licking, Knox, Belmont, Guernsey, Noble, and Perry. The other counties in Ohio which produced commercial gas in 1902 were as follows: Allen, Auglaize, Columbiana, Darke, Hancock, Hardin, Harrison, Holmes, Logan, Lucas, Mercer, Morgan, Monroe, Ottawa, Sandusky, Stark, Van Wert, Washington, and Wood. In the total production for the State is included $20,719 worth of gas produced from oil wells, about one-fourth of which was consumed for domestic purposes. During the year 1902 the city of Cleveland was for the first time supplied by natural gas from West Virginia.

The combined value of the natural gas and petroleum produced in Ohio in 1902 was $23,112,667, equal to 22.7 per cent of the entire production of natural gas and petroleum in the United States. Ohio occupies the second place in the combined value of natural gas and petroleum, Pennsylvania being first with a credit of over 29 per cent. The value of the petroleum produced in Ohio during 1902 was $20,757,359.

The value of the natural gas produced in Ohio from 1885 to 1902 is shown in the following table:

Value of natural gas produced in Ohio, 1885–1902.

Year.	Value.	Year.	Value.
1885	$100,000	1894	$1,276,100
1886	400,000	1895	1,255,700
1887	1,000,000	1896	1,172,400
1888	1,500,000	1897	1,171,777
1889	5,215,669	1898	1,488,308
1890	4,681,300	1899	1,866,271
1891	3,076,325	1900	2,178,234
1892	2,136,000	1901	2,147,215
1893	1,510,000	1902	2,355,308

RECORD OF THE NATURAL-GAS INDUSTRY IN OHIO.

The following table gives the details in the operation of the natural-gas industry in Ohio for three years, 1900, 1901, and 1902, in a complete manner. There are included in the following statement of wells 333 small wells or individual producers in the counties of Ashtabula, Cuyahoga, Lake, and Lorain, which supply one or two families.

Record of natural-gas industry in Ohio, 1900, 1901, and 1902.

	1900.	1901.	1902.
Amount received for sale of gas or value of gas consumed	$3,823,209	$4,119,059	$4,785,616
Value of natural gas produced	$2,178,234	$2,147,215	$2,355,308
Value of coal and wood displaced	$3,565,142	$4,448,584	$5,351,778
Domestic consumers supplied	[a]135,743	[a]149,709	120,127
Iron and steel works supplied	10	6	17
Glass works supplied	10	13	56
Other establishments supplied	1,072	930	713
Total establishments supplied	1,092	949	786
Total wells producing Jan. 1	853	885	1,099
Total productive wells drilled	97	113	266
Total wells abandoned	60	48	75
Total wells producing Dec. 31	890	950	1,290
Total dry holes drilled	19	35	40
Total feet of pipe laid to Dec. 31	15,030,304	15,199,295	20,093,670
Number establishments reporting	281	305	451

[a] Number domestic fires supplied.

NEW YORK.

Natural gas is found over a very large area in the western portion of New York in a number of different sands and limestones, including the Devonian black slate, the Bradford sand, and the underlying Kane and Elk sands, the Corniferous limestone, the Medina sandstone, the Trenton limestone, and the Upper Calciferous. The greater portion of the gas comes from the neighborhood of Wellsville and Ricebrook, in Allegany County, from the sands found in the Upper Devonian. There are a vast number of wells scattered along the south shore of Lake Ontario and many wells along the south shore of Lake Erie that furnish from one to four families with gas. The greater portion of the natural gas consumed in the State comes from Pennsylvania, the largest consumption being in the city of Buffalo. The town of Fredonia used natural gas as far back as 1821 from natural flows and shallow wells, and has the honor of first making use of it as a source of light and heat. The counties producing natural gas are Allegany, Cattaraugus, Erie, Livingston, Niagara, Onondaga, Ontario, Oswego, Seneca, and Steuben. The value of the natural gas produced in New York in 1902 was $346,431, an increase of $53,199 as compared with 1901. The value of the natural gas consumed in the State in 1902 was $1,723,669, which was largely supplied by Pennsylvania. There were some new developments in southeastern Allegany County during 1902.

The value of natural gas produced in New York from 1885 to 1902 is given in the following table:

Value of natural gas produced in New York, 1885–1902.

Year.	Value.	Year.	Value.
1885	$196,000	1894	$249,000
1886	210,000	1895	241,530
1887	333,000	1896	[a]256,000
1888	332,500	1897	200,076
1889	530,026	1898	229,078
1890	552,000	1899	294,593
1891	280,000	1900	335,367
1892	216,000	1901	293,232
1893	210,000	1902	346,431

[a] A portion of this amount should be credited to Pennsylvania, but it was impossible to make the separation.

RECORD OF NATURAL-GAS INDUSTRY IN NEW YORK.

The following table gives a complete statement of the business operations in natural gas in the State of New York for the years 1900, 1901, and 1902, from which the conditions of this industry can readily be compared.

Record of natural-gas industry in New York, 1900, 1901, and 1902.

	1900.	1901.	1902.
Amount received for sale of gas or value of gas consumed..	$1,456,286	$1,694,925	$1,723,669
Value of natural gas produced	$335,367	$293,232	$346,431
Value of coal and wood displaced	$1,387,258	$1,655,942	$1,771,037
Domestic consumers supplied	a 89,837	a 95,161	50,536
Iron and steel works supplied	0	0	1
Glass works supplied	4	2	8
Other establishments supplied	134	96	206
Total establishments supplied	138	98	215
Total wells producing Jan. 1	487	535	583
Total productive wells drilled	57	53	69
Total wells abandoned	11	8	14
Total wells producing Dec. 31	533	580	638
Total dry holes drilled	11	14	8
Total feet of pipe laid to Dec. 31	5,772,796	5,785,038	5,894,517
Number of establishments reporting	89	114	116

a Number of domestic fires supplied.

KANSAS.

This State is making remarkable progress in the development of its natural-gas fields. The present development begins at Paola and extends in a series of pools southwest across the southeast portion of the State to Indian Territory, embracing the counties of Miami, Allen, Neosho, Crawford, Wilson, Montgomery, and Labette. The principal pools of high-pressure gas with large volume have been developed at Iola, Gas City, and La Harpe, in Allen County; at Chanute, in Neosho County; and near Cherryvale, Independence, and Coffeyville, in Montgomery County.

The gas is found in the sandstones and the more porous beds of the Cherokee shales, which are at the base of the Coal Measures in the Kansas field. There is not a uniform gas-producing formation, but rather local "sands" at varying horizons in the 450 feet of Cherokee shales. The depth at which gas is encountered increases to the westward as a result of the dip, and in the more productive belt varies from 700 to 1,150 feet. The volume of many of these wells is as high as 5,000,000 cubic feet in twenty-four hours, and a few have gone as high as 10,000,000 cubic feet. The original rock pressure, which was 325 pounds to the square inch in a number of the pools, has decreased somewhat. In some of the pools the pressure was originally only 150 pounds.

The early history of this district dates back thirty years, when the Acres Mineral well was completed at Iola, which gave a small flow of natural gas. After several wells had been drilled near this location a vigorous well was found in 1893, which flowed about 3,000,000 cubic feet in twenty-four hours. In 1892 the gas began to be introduced successfully in a small way. In the year 1899 it was successfully applied to the reduction of zinc ore, and began to be used by many of the large towns in southeastern Kansas, and it began to be used also in the manufacture of brick and hydraulic cement and in numerous other manufactories. Development in the last year has been active, and numerous natural-gas wells have been found.

The production of natural gas in Kansas in 1902 is valued at $824,431, an increase of $165,258, or almost 20 per cent. The value of the fuel displaced was $1,175,349, a saving of $350,918 to the consumers. The value of the petroleum produced in Kansas in 1902 was $292,464, a total of $1,116,895 for the combined value of natural gas and petroleum, or over 1 per cent of the total value of both.

The value of the natural gas produced in Kansas from 1889 to 1902 has been as follows:

Value of natural gas produced in Kansas, 1889–1902.

Year.	Value.	Year.	Value.
1889	$15,873	1896	$124,750
1890	12,000	1897	105,700
1891	5,500	1898	174,640
1892	40,795	1899	332,592
1893	50,000	1900	356,900
1894	86,600	1901	659,173
1895	112,400	1902	824,431

RECORD OF NATURAL-GAS INDUSTRY IN KANSAS.

The following table gives in detail the record for natural gas in Kansas during 1901 and 1902:

Record of natural-gas industry in Kansas, 1901 and 1902.

	1901.	1902.
Amount received for sale of gas or value of gas consumed	$659,173	$824,431
Value of natural gas produced	$659,173	$824,431
Value of coal and wood displaced	$995,350	$1,175,349
Domestic consumers supplied	10,227	13,488
Iron and steel works supplied	0	1
Zinc smelters supplied	8	9
Glass works supplied	0	3
Brick works supplied	12	14
Other establishments supplied	52	64
Total establishments supplied	72	91
Total wells producing Jan. 1	213	299
Total productive wells drilled	71	144
Total wells abandoned	28	24
Total wells producing Dec. 31	256	419
Total dry holes drilled	35	63
Total feet pipe laid to Dec. 31	2,425,410	5,034,791
Number of establishments reporting	48	80

KENTUCKY.

The principal gas area thus far developed is in eastern Kentucky, in Martin County. There are some fair gas wells in western Floyd County. Ashland, Catlettsburg, and Louisa are supplied from this region. In Meade County there is still found some shale gas, which is conveyed to Louisville. During the fall of 1901 a large gas well was developed near the Beaver oil pool in Wayne County. There is also a fair gas well just over the State line in Fentress County, Tenn. There is a small supply of gas obtained for domestic use in Breckinridge County, in the vicinity of Cloverport, also in Hardin and Jefferson counties.

Numerous gas wells of moderate output were found in the search for petroleum, few of which have been utilized. A considerable portion of the natural gas produced in eastern Kentucky was sold at Huntington and other towns in West Virginia, and at Ironton, Ohio.

The production in 1902 was valued at $365,611, which is a large increase over former years.

The value of the natural gas produced in Kentucky from 1889 to 1902 is shown in the following table:

Value of natural gas produced in Kentucky, 1889–1902.

Year.	Value.	Year.	Value.
1889	$2,580	1896	$99,000
1890	30,000	1897	90,000
1891	38,993	1898	103,133
1892	43,175	1899	125,745
1893	68,500	1900	286,243
1894	89,200	1901	270,871
1895	98,700	1902	[a] 365,611

[a] Includes some gas produced in West Virginia but consumed in Kentucky.

CALIFORNIA.

Although there are numerous small gas wells in this State, by far the greatest production comes from wells at the city of Stockton, in the great San Joaquin Valley. It is also found near the city of Sacramento, in the Sacramento Valley, in Tulare County, near Tulare Lake, and in Tehama County. To a small extent it is produced by a few wells at the city of Los Angeles. In the two former instances it is associated with artesian-water flows. At Stockton the wells are 2,000 feet deep, yet none of them has passed through the alluvial deposit into the solid stratified measures. Under the pressure of 2,000 feet, water will absorb a large amount of gas, which is gradually liberated as it ascends in the well and the pressure diminishes. Ten of these wells at Stockton yield about 30,000 cubic feet of natural gas a day.

The total value of natural gas produced in California in 1902 was $120,648, of which a quantity valued at $88,510 was used principally for domestic purposes. Nearly all of this gas was produced from wells in San Joaquin and Sacarmento counties, the product being consumed in Sacramento and Stockton, where there were some 1,400 consumers. A few wells located in Los Angeles and Santa Barbara counties produced a small amount of gas, which was utilized for domestic purposes by the owners of the wells.

In the total value of gas for the State of California we have included $32,138 worth of gas produced from oil wells, the product being used in the operation of oil plants and none being sold for domestic purposes.

The value of the natural gas produced in California from 1889 to 1902 is shown in the following table:

Value of natural gas produced in California, 1889–1902.

Year.	Value.	Year.	Value.
1889	$12,680	1896	$55,682
1890	33,000	1897	50,000
1891	30,000	1898	65,337
1892	55,000	1899	86,891
1893	62,000	1900	79,083
1894	60,350	1901	67,602
1895	55,000	1902	a 120,648

a Includes $32,138 worth of gas produced from oil wells and consumed in oil operations.

TEXAS.

The total value of the natural gas produced in the State of Texas in 1902 amounted to $14,953, of which $11,575 worth was from gas wells, the remainder being from oil wells. The gas used in the State for domestic purposes is produced from gas and oil wells in Navarro County and is consumed in the city of Corsicana. Gas from wells in Jefferson County was consumed by establishments in Gladys City.

Some wonderful pockets of high-pressure gas have been developed in the Beaumont field, which blew up bowlders and sand mixed with water and traces of petroleum. When the pressure was confined it developed 250. or more pounds to the square inch, and, after the gas originally in the rock had been exhausted, the gas under pressure was used to assist the petroleum wells to flow by having the gas turned into the petroleum wells.

Several large natural gas wells were developed on Bryans Mound, near the shore of the Gulf in Brazoria County, and at Big Hill in Jefferson County, none of which have as yet been utilized.

Numerous artesian wells along the Gulf coast give off considerable natural gas with the artesian water.

SOUTH DAKOTA.

The gas found in this State is associated with flows of water at a number of localities, but only recently has its value been appreciated.

At Pierre there are three wells which have furnished sufficient natural gas to be used extensively for domestic purposes in the town and to furnish fuel for a 60-horsepower boiler. These wells also supply sufficient water for the use of the inhabitants of the town.

The locations and conditions of the occurrence of natural gas in this State, so far as developed, were discussed at some length in an article written by Prof. J. E. Todd, State geologist, and quoted in this report for 1901.

The value of the natural gas produced in South Dakota from 1899 to 1902 has been as follows:

Value of natural gas produced in South Dakota, 1899–1902.

Year.	Value.	Year.	Value.
1899	$5,500	1901	$7,255
1900	9,817	1902	10,280

ILLINOIS.

The production of natural gas in this State comes from shallow but persistent wells in Randolph and Bureau counties, which supply single families.

The production of natural gas in Illinois from 1889 to 1902 was valued as follows:

Value of natural gas produced in Illinois, 1889–1902.

Year.	Value.	Year.	Value.
1889	$10,615	1896	$6,375
1890	6,000	1897	5,000
1891	6,000	1898	2,498
1892	12,988	1899	2,067
1893	14,000	1900	1,700
1894	15,000	1901	1,825
1895	7,500	1902	1,844

UTAH.

No natural gas has been produced in this State for four years. The wells, 12 miles north of Salt Lake City, have become choked up by the decomposition of the slate forming the walls of the gas wells.

The value of natural gas produced in Utah from 1893 to 1902 has been as follows:

Value of natural gas produced in Utah, 1893–1902.

Year.	Value.	Year.	Value.
1893	$500	1898	$7,875
1894	500	1899	0
1895	20,000	1900	0
1896	20,000	1901	0
1897	15,050	1902	0

MISSOURI.

During the year 1902 a gas well was drilled in Cass County, Mo., the product of which has been supplied to consumers in the town of Belton since September of that year. The gas is found at a depth of 366 feet.

Several gas wells in Bates County are producing small quantities of gas, which is utilized for domestic purposes by the owners of the wells.

A small quantity of gas is also produced and used for heating and illuminating purposes in Kansas City.

ARKANSAS.

During the year 1902 some development work was done in Sebastian County, Ark., two productive gas wells having been drilled. There are at present four productive gas wells, and preparations are being made to utilize the gas in the town of Mansfield, where pipes are now being laid for its distribution. The wells are 2,380, 1,125, 970, and 1,040 feet deep, the pressure being from 160 to 225 pounds.

INDIAN TERRITORY

A small amount of gas was produced from a few wells at Red Fork, in Creek Nation, during the year 1902, the product being used chiefly for domestic purposes.

CANADA.

There was a large decline in the amount and value of the natural gas produced in the Essex County field, the supply being discontinued to the city of Detroit in the fall of 1901. The Welland County field continues to furnish the city of Buffalo a decreasing supply. The drain on both these fields has reduced the original rock pressure materially. There is some natural gas found among the small petroleum wells between Petrolia and Sarnia, which is consumed in operating gas engines.

Statistics of natural-gas production in the Province of Ontario, Canada.

Year.	Producing wells.	Miles of gas pipe.	Workmen employed.	Value of gas product.	Wages for labor.
1893	107	117	59	$238,200	$24,592
1894	110	183½	99	204,179	53,130
1895	123	248	92	282,986	73,328
1896	141	287¼	87	276,710	47,527
1897	140	297	84	308,448	42,338
1898	142	315¼	85	301,599	31,457
1899	150	341½	95	440,904	40,149
1900	175	306	161	392,823	43,636
1901	158	368	129	342,183	59,140
1902	169	369	107	195,992	55,618

NATURAL GAS IN ENGLAND.

Recently several gas wells have been drilled in the eastern portion of Sussex County, 50 miles southeast of London. A well drilled at Netherfield in 1875 developed several violent flows or pockets of natural gas which, after a time, ceased.

The railroad company in drilling for water at Hearthfield station, in August, 1896, developed a flow of natural gas, but no water, at a depth of 300 feet. They therefore pulled out all of the casing except the first few feet that had been inserted.

The persistent escape of natural gas from this well continued. In 1899 the railway company, owing to the continued flow, capped the casing and piped the gas into the station house near by, and from this date they have lighted the railway station with it, a portion of it being also used to operate a small gas engine for pumping water.

Recently a number of shallow wells have developed sufficient natural gas to supply from 70 to 80 houses for lighting, cooking, and heating, also for street lighting, incandescent mantles being used.

Recently Mr. R. Pearson has associated with himself a number of American gentlemen and has located and drilled six test wells in the Hearthfield district, which range from 300 to 400 feet in depth, all of which found more or less natural gas. This locality is on a well-marked uplift known as the Mid-Sussex Anticlinal.

The geological formation producing the gas is the Hastings Sands at the bottom of the Cretaceous, which overlie the Purbeck Beds and which in other localities have produced pockets of natural gas.

The pressure so far developed ranges from 135 to 200 pounds to the square inch. The composition of this gas taken from a number of bore holes does not vary to any extent. The presence of a large percentage of ethane gives it a higher illuminating power than the average natural gas. The proportion methane or marsh gas is also large; otherwise it is quite similar to a large proportion the natural gas used in America.

There is no free hydrogen or sulphuretted hydrogen reported as present. The following is given as its composition: Methane 93.4 per cent, ethane 3 per cent, nitrogen 2.7 per cent, carbonic oxide 0.9 per cent.

ASPHALTUM AND BITUMINOUS ROCK.

By Joseph Struthers.

INTRODUCTION.

The general term "asphaltum" may be applied to the numerous varieties of hydrocarbons of an asphaltic base which exist in all conditions from the liquid to the solid state. In this report, however, it is specifically used to include all the purer forms of hard and soft bitumen, i. e., elaterate, gilsonite, albertite, wurtzilite, uintaite, nigrite, brea, etc. The statistics of crude petroleum, which may also be included in the general term "asphaltum," are given in the chapter devoted to petroleum. A large quantity of asphaltic oil is produced in California, which is refined for illuminating and lubricating oils, and as there is no strict line of demarcation between oils which should be considered as petroleum and those which should be considered as asphaltum, the general rule has been observed to include under asphaltum only material used as such, for instance, the residuum from petroleum-refining processes which is sold and used as asphalt. For the year 1902 asphalt of this character is reported separately under the heading "By-product asphalt." A slight duplication may arise in a few instances from this arbitrary classification, but it is impracticable to separate the two products absolutely. The term "bituminous rock" includes sandstones and limestones impregnated with asphaltum or bitumen which are sold and shipped without previous refining. The rock is used principally for street pavement and is mixed with other ingredients at the place of use. An inconsiderable portion of bituminous rock is treated to obtain asphaltum or bitumen, the product being sold as refined or gum asphalt. The asphalt and bituminous rock deposits of the United States have been described in great detail by Mr. George H. Eldridge in the Twenty-second Annual Report of the United States Geological Survey (for 1900–1901), Part I, pages 219–252.

PRODUCTION.

The following table shows the annual production of asphaltum and bituminous rock in the United States from 1882 to 1902, inclusive:

Production of asphaltum and bituminous rock, 1882–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	3,000	$10,500	1893	47,779	$372,232
1883	3,000	10,500	1894	60,570	353,400
1884	3,000	10,500	1895	68,163	348,281
1885	3,000	10,500	1896	80,503	577,563
1886	3,500	14,000	1897	75,945	664,632
1887	4,000	16,000	1898	76,337	675,649
1888	50,450	187,500	1899	75,085	553,904
1889	51,735	171,537	1900	54,389	415,958
1890	40,841	190,416	1901	63,134	555,335
1891	45,054	242,264	1902	[a] 105,458	[a] 765,048
1892	87,680	445,375			

[a] The production of the crude material in 1902 was reported as 66,238 short tons valued at $236,728.

As will be seen from the preceding table, the production of asphaltum and bituminous rock in 1902 showed a large increase over that of 1901, amounting in quantity to 42,324 short tons, and in value to $209,713. The relatively smaller increase in value as compared to quantity was due to the very large proportion of bituminous sandstone, which is of less value per ton. The production in 1900, both in quantity and in value, and the production in 1901 in quantity, have been the smallest reported during the last seven years.

The table on the following page classifies the production of asphaltum during the last six years. Summarizing the varieties, it is seen that the production of bituminous sandstone increased from 34,248 short tons ($138,601) in 1901 to 57,837 short tons ($157,093) in 1902. The production of bituminous limestone decreased from 6,970 short tons ($33,375) in 1901 to 2,869 short tons ($19,817) in 1902.

The production of hard and refined asphaltum, which includes gilsonite and similar pure varieties, increased from 19,316 short tons ($333,509) in 1901 to 22,321 short tons ($264,817) in 1902.

The production of liquid asphaltum, or maltha, all of which was derived from California, decreased from 2,600 short tons ($49,850) in 1901 to 1,605 short tons ($20,172) in 1902. No sales of mastic were reported during 1899, 1900, 1901, and 1902, the crude-material from which it was previously made being now included in the output of bituminous sandstone and bituminous limestone. The quantity of asphaltum produced in the refining of crude oil during 1902 amounted to 20,826 short tons ($303,249). In former years the quantity of asphaltum so produced has been included under the class "hard and refined asphaltum."

The following table shows the production and value of the several kinds of asphaltum and asphaltum products in 1897, 1898, 1899, 1900, 1901, and 1902. Both quantity and value are for the product in the condition in which it was first sold.

Varieties of asphaltum, etc., produced annually, 1897-1902.

Variety.	1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Bituminous sandstone	48,801	$158,914	43,624	$126,831	43,041	$121,023
Bituminous limestone [a]	2,100	10,600	5,502	26,412	15,650	79,500
Mastic	483	9,864	1,158	17,840	....	....
Hard and refined, or gum [b]	9,911	173,904	13,178	233,566	15,694	343,730
Liquid, or maltha	14,650	311,350	12,875	271,000	700	9,651
Total	75,945	664,632	76,337	675,649	75,085	553,904

Variety.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Bituminous sandstone	38,334	$119,779	34,248	$138,601	57,837	$156,993
Bituminous limestone [a]	2,434	11,322	6,970	33,375	2,869	19,817
Hard and refined, or gum [b]	12,367	256,793	19,316	333,509	22,321	264,817
Liquid, or maltha [c]	1,254	28,064	2,600	49,850	1,605	20,172
By-product from oil	....	....	....	....	20,826	303,249
Total	54,389	415,958	63,134	555,335	105,458	765,048

[a] Not including mastic or refined asphaltum made from bituminous limestone.
[b] Including gilsonite from Colorado and Utah, gum asphaltum from Texas, and "Ventura" hard asphaltum, from California.
[c] Not including 100 barrels of asphaltum ($450) from Texas.

IMPORTS AND EXPORTS.

The importation of asphaltum into the United States is chiefly from the island of Trinidad, off the coast of Venezuela. In addition, imports of asphalt are made from Bermudez, Venezuela; bituminous limestones are imported from Neuchatel and Val de Travers, in Switzerland; from Seyssel, in France; and, in small quantities, from Germany, Cuba, Mexico, and other countries. Comparing the table of imports with the table of domestic production, it is seen that the value of the domestic product in 1902 was about $123,000 greater than that of the imported asphalt. In this connection, however, it should be stated that the value of the imported asphaltum is at the point of shipment, and does not include freight charges or import duties.

The following table shows the imports of crude asphaltum since 1867:

Crude asphaltum imported for immediate consumption into the United States, 1867–1902.

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—	*Long tons.*		Dec. 31—	*Long tons.*	
1867		$6,268	1886	32,565	$108,528
1868	185	5,632	1887	30,808	95,735
1869	203	10,559	1888	36,494	84,045
1870	488	13,072	1889	61,952	138,163
1871	1,301	14,760	1890	73,861	223,368
1872	1,474	35,533	1891	102,433	299,350
1873	2,314	38,298	1892	120,255	336,868
1874	1,183	17,710	1893	74,774	196,314
1875	1,171	26,006	1894	102,505	313,680
1876	807	23,818	1895 [a]	79,557	210,556
1877	4,532	36,550	1896 [a]	96,192	304,596
1878	5,476	35,932	1897 [a]	115,528	392,770
1879	8,084	39,635	1898 [b]	69,857	203,385
1880	11,830	87,889	1899 [c]	106,474	425,263
1881	12,883	95,410	1900 [d]	118,771	454,732
1882	15,015	102,698	1901 [e]	138,833	553,473
1883	33,116	149,999	1902 [f]	146,883	492,658
1884	36,078	145,571			
1885	18,407	88,087			

[a] In addition to the crude asphaltum imported in 1895 there was some manufactured or refined gum asphaltum, valued at $36,664. In 1896 the value of the manufactured asphaltum imported was $77,449, and in 1897, $25,095. The quantity was not reported.

[b] Includes 3,069 long tons, "dried or advanced," valued at $17,005.

[c] Includes 4,264 long tons, "dried or advanced," valued at $35,395.

[d] Includes 5,141 long tons, "dried or advanced," valued at $49,242.

[e] Includes 6,754 long tons, "dried or advanced," valued at $36,958.

[f] Includes 7,239 long tons, "dried or advanced," valued at $62,561.

During 1902 there were exported 2,930 long tons of crude asphaltum, valued at $23,564.

The following statement shows the quantity and value of the asphaltum imported during the fiscal years ending June 30, 1898, 1899, 1900, 1901, and 1902, with the countries from which it was exported.

The imports from Trinidad decreased from 112,834 long tons in 1901 to 99,592 long tons in 1902, and the imports from Venezuela decreased from 18,605 long tons in 1901 to 12,406 tons in 1902. The total imports from Trinidad and Venezuela in 1901 amounted to 131,439 long tons, as against 111,998 long tons in 1902. The imports from Cuba increased from 4,888 long tons in 1901 to 7,252 tons in 1902.

Imports of asphaltum during the fiscal years ending June 30, 1900, 1901, and 1902, with the countries from which exported.

Country.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
West Indies:	*Long tons.*		*Long tons.*		*Long tons.*	
British (Trinidad)	93,687	$277,378	112,834	$382,754	99,592	$329,819
Dutch	25	263				
Cuba	553	14,009	4,888	19,162	7,252	28,497
Italy					20	757
Venezuela (Bermudez)	11,579	58,298	18,605	93,025	12,406	62,028
Germany	50	185		9	50	362
France	105	2,202				
Mexico	40	642	95	1,648	41	629
Turkey in Asia	108	9,548			38	3,679
Great Britain					92	1,135
United States of Colombia	5	48			1	15
Canada			5	99		4
Netherlands	10	718	13	497	35	1,122
Belgium					98	830
Total	106,162	363,291	136,440	497,194	119,625	428,877

PRODUCTION IN OTHER COUNTRIES.

BARBADOS AND TRINIDAD.

BARBADOS.

At the island of Barbados, nine manjak mines were operated during 1902, three of which were controlled by the Barbados Manjak Mines, Limited, employing from 70 to 100 laborers. No statistics of production are made to the Government, but the custom returns showed that during 1901 1,043 tons of manjak, valued at £9,394, were exported from Barbados. The chief uses for manjak ore, or glance pitch, as it is sometimes called, is to make Brunswick varnish, used to insulate electric cables, etc. The exports from Barbados in long tons during recent years are reported as follows: 1897, 1,880; 1898, 1,160; 1899, 1,026; 1900, 1,120; 1901, 1,043.

TRINIDAD.

The exports of asphalt from the island of Trinidad are given in the following table, which has been furnished through the courtesy of the New Trinidad Lake Asphalt Company, Limited. Seven-eighths of the asphalt exported is dug from Pitch Lake, which is leased to the company till 1930. The removal of 1,885,000 long tons of asphalt during the last thirty-five years has apparently made but little impression on the deposit. The New Trinidad Lake Asphalt Company contributes the greater bulk of the exports, although about 30,000 tons are handled annually by smaller shippers from other properties. The lake contains no liquid asphalt, but in other parts of the island this variety, from which illuminating and lubricating oils can be distilled, is found widely distributed.[a] Glance pitch also is found in the island, and is used for electric insulations and for black varnishes. Manjak, another variety, has recently been discovered in quantity about 10 miles north of the Pitch Lake.

Exports of Pitch Lake asphaltum from Trinidad, 1881–1902.

[In tons of 2,240 pounds.]

Year.	To United States.			To Europe.			To other countries.			Grand total of exports in crude equivalent.
	Crude.	Dried.	Total equivalent in crude.	Crude.	Épuré and dried.	Total equivalent in crude.	Crude.	Épuré and dried.	Total equivalent in crude.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1881	5,600	....	5,600	10,656	6,174	19,917	....	....	....	25,517
1882	12,710	....	12,710	24,712	12,007	42,722	....	....	....	55,432
1883	22,885	....	22,885	11,744	4,668	18,746	....	....	....	41,631
1884	17,885	....	17,885	15,910	6,561	25,751	....	....	....	43,636
1885	15,505	....	15,505	12,135	7,636	23,589	....	....	....	39,094
1886	22,225	....	22,225	5,130	5,394	13,221	....	....	....	35,446
1887	21,915	....	21,915	10,205	5,771	18,861	....	....	....	40,776
1888	24,321	....	24,321	8,445	8,248	20,817	....	....	....	45,138
1889	45,410	....	45,410	9,378	9,581	23,750	....	....	....	69,160
1890	39,907	....	39,907	11,755	9,951	26,681	668	....	[b] 668	67,256
1891	52,510	....	52,510	9,984	9,969	24,937	901	....	[b] 901	78,348
1892	70,806	....	70,806	11,596	9,458	25,783	1,076	....	[b] 1,076	97,665
1893	65,436	....	65,436	10,640	6,650	20,615	....	....	....	86,051
1894	71,860	....	71,860	8,967	9,413	23,086	....	....	....	94,946
1895	61,702	2,256	64,976	5,058	7,365	16,104	....	....	....	81,080
1896	60,637	....	60,637	8,320	8,052	20,391	....	1,300	[c] 1,918	82,946
1897	71,969	1,769	74,407	14,629	13,510	34,856	....	500	680	109,243
1898	46,089	1,692	48,423	15,703	13,228	35,537	[b] 693	[c] 1,646	2,999	86,959
1899 [d]	70,111	666	70,777	21,337	20,618	41,955	....	2,359	2,359	115,091
1900 [d]	67,758	3,180	70,938	23,386	23,966	47,352	1,422	3,031	4,453	122,743
1901	80,449	....	80,449	31,213	15,815	54,761	....	586	844	136,054
1902	101,876	2,211	104,956	17,711	10,509	33,474	....	536	746	139,176

[a] A description of the pitch lake deposits is given in Mineral Resources U. S. for 1901, pp. 637–638.

[b] Australia.

[c] Argentina and Mexico.

[d] The dried and "épuré" in 1899 and 1900 are not reduced to crude equivalents

Exports of land asphaltum from Trinidad, 1886–1902.

[In tons of 2,240 pounds.]

Year.	To United States. Crude.	To United States. Épuré.	To United States. Total equivalent in crude.	To Europe. Crude.	To Europe. Épuré.	To Europe. Total equivalent in crude.	To other countries. Crude.	To other countries. Épuré.	To other countries. Total equivalent in crude.	Grand total of exports in crude equivalent.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1886	2,297	....	2,297	....	....	....	....	....	....	2,297
1887	1,195	2,100	4,345	220	....	220	....	....	....	4,565
1888	5,316	1,536	7,620	619	....	619	....	....	....	8,239
1889	10,490	2,052	13,568	....	....	....	833	....	[a] 833	14,401
1890	15,406	1,341	17,417	....	....	....	....	....	....	17,417
1891	20,507	7	20,517	139	....	139	40	....	[b] 40	20,696
1892	17,406	....	17,406	699	....	699	....	....	....	18,105
1893	3,450	....	3,450	2,432	1,862	5,225	110	178	[b] 377	9,052
1894	3,365	325	3,853	2,200	4,699	9,249	13	94	[b] 154	13,256
1895	4,445	199	4,744	1,770	2,368	5,322	....	169	[b] 254	10,320
1896	11,943	71	12,049	842	1,988	3,824	....	....	....	15,873
1897	19,243	....	19,243	293	700	1,343	415	178	682	21,268
1898	15,160	....	18,160	700	258	1,087	404	312	872	20,119
1899 [c]	24,622	542	25,164	275	250	525	80	298	378	26,067
1900 [c]	33,936	860	34,796	251	....	251	127	70	197	35,244
1901	31,767	([d])	31,767	1,704	([d])	1,704	1,446	....	1,446	34,917
1902	25,003	100	25,153	200	....	200	15	50	90	25,443

[a] Australia.
[b] Canada, Venezuela, and West Indies.
[c] The dried and "épuré" in 1899 and 1900 are not reduced to crude equivalents.
[d] Included in shipments of crude.

Total exports of all asphaltum from Trinidad, 1886–1902.

[In tons of 2,240 pounds.]

Year.	To United States. Lake.	To United States. Land.	To United States. Total.	To Europe. Lake.	To Europe. Land.	To Europe. Total.	To other countries. Lake.	To other countries. Land.	To other countries. Total.	Grand total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1886	22,225	2,297	24,522	13,221	....	13,221	....	....	....	37,743
1887	21,915	4,345	26,260	18,861	220	19,081	....	....	....	45,341
1888	24,321	7,620	31,941	20,817	619	21,436	....	....	....	53,377
1889	45,410	13,568	58,978	23,750	....	23,750	....	833	833	83,561
1890	39,907	17,417	57,324	26,681	....	26,681	668	....	668	84,673
1891	52,510	20,517	73,027	24,937	139	25,076	901	40	941	99,044
1892	70,806	17,406	88,212	25,783	699	26,482	1,076	....	1,076	115,770
1893	65,436	3,450	68,886	20,615	5,225	25,840	....	377	377	95,103
1894	71,860	3,853	75,713	23,086	9,249	32,335	....	154	154	108,202
1895	64,976	4,744	69,720	16,104	5,322	21,426	....	254	254	91,400
1896	60,637	12,049	72,686	20,391	3,824	24,215	1,918	....	1,918	98,819
1897	74,407	19,243	93,650	34,856	1,343	36,199	680	682	1,362	130,511
1898	48,423	18,160	66,583	35,537	1,087	36,624	2,999	872	3,871	107,078
1899 [a]	70,777	25,164	95,941	41,955	525	42,480	2,359	378	2,737	141,158
1900 [a]	70,938	34,796	105,734	47,352	251	47,603	4,453	197	4,650	157,987
1901	80,449	31,767	112,216	54,761	1,704	56,465	844	1,446	2,290	170,971
1902	104,956	25,153	130,109	33,474	200	33,674	746	90	836	164,619

[a] The dried and "épuré" in 1899 and 1900 are not reduced to crude equivalents.

PRODUCTION IN PRINCIPAL PRODUCING COUNTRIES.

In the table below is given a statement of the production of asphaltum in the principal producing countries from 1890 to 1901, inclusive:

Production of asphaltum in principal producing countries, 1890–1901.

Year.	United States.		Trinidad.		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	40,841	$190,416	94,834	$254,019	59,361	$89,961
1891	45,054	242,264	110,929	297,132	54,163	89,419
1892	87,680	445,375	129,438	347,310	58,713	99,686
1893	47,779	372,232	106,515	285,309	52,056	84,962
1894	60,570	353,400	121,186	324,606	61,691	107,350
1895	68,163	348,281	102,368	274,200	65,638	108,153
1896	80,503	577,563	110,667	296,457	67,830	107,908
1897	75,945	664,632	146,172	292,344	67,933	91,984
1898	76,337	675,649	112,220	553,890	75,550	99,088
1899	75,085	553,904	153,870	745,242	82,397	123,984
1900	54,389	415,958	177,751	855,744	98,833	160,000
1901	63,134	555,335	191,488	799,010	99,420	168,750

Year.	France.		Italy.		Spain.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	198,934	$335,092	49,728	$232,351	47	$94
1891	278,316	402,631	31,054	131,028	274	505
1892	246,848	323,854	38,107	162,308	554	1,014
1893	244,644	311,116	28,630	109,200	904	1,235
1894	254,562	339,294	66,663	270,854	1,085	1,939
1895	294,234	355,700	51,478	197,584	870	1,525
1896	249,052	336,013	50,092	171,507	1,231	2,156
1897	257,127	328,002	60,984	183,017	1,825	3,196
1898	252,358	322,117	103,312	256,347	2,604	4,605
1899	285,208	356,719	90,350	222,519	2,801	4,964
1900	293,651	383,429	112,115	292,287	4,621	8,632
1901	275,216	372,989	114,761	261,761	4,361	8,137

Year.	Austria-Hungary.		Russia.		Venezuela.
	Quantity.	Value.	Quantity.	Value.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1890	....	....	....	....	....
1891	43	$258	15,471	$108,000	....
1892	48	288	20,838	118,760	....
1893	97	624	18,337	120,000	1,771
1894	2,740	75,696	17,706	176,400	7,751
1895	2,963	59,001	20,699	144,893	3,073
1896	3,449	72,429	20,043	133,141	6,197
1897	3,699	81,104	24,488	171,416	11,528
1898	4,152	86,018	13,244	128,176	Nil.
1899	6,276	79,634	25,435	170,300	12,014
1900	3,787	70,603	(*a*)	....	17,981
1901	3,770	68,150	(*a*)	....	24,378

[a] Statistics not yet available.

STONE.

INTRODUCTION.

The statistics presented in the following report are of especial value on account of the completeness of the canvass in collecting them. A large part of them were obtained by direct visits to the quarrymen, made necessary by the fact that statistics of labor, wages, and expenses required by the Census Office for the mining census, were collected at the same time. This extra work has delayed the publication of the report, but this office wishes to thank the various quarrymen for their cooperation and for the information given to the various agents of this office and of the Census Office.

In 1889–90, at the time of the last mining census, the value of the stone produced in the United States was $53,035,620. In the census of 1902 the value of the stone produced was $64,559,099, an increase of $11,523,479. In the interval the yearly value of the output fluctuated, until in 1896 it decreased to $31,346,171. Since then the output has steadily increased to its present status.

The stone industry for 1902, though showing a large increase in value of production, has not exhibited an unusual state of activity, not nearly so much so as in the year 1901. This is shown by the fact that though there was a large increase in value of the production for 1902, this increase was not so large as the increase of 1901 over 1900, or of 1900 over 1899.

The check given to the building trade by various builders' strikes all over the country is in part accountable for this, the contractors being unable to use the material contracted for, which material was therefore not taken out. In some places, also, there were strikes among the quarrymen, although this was not general, as the quarrymen themselves are not as a rule union men. The cutters, polishers, and skilled laborers, however, employed to work the stone after it leaves the quarry are usually union men.

The coal strike during 1902 influenced the stone production to some extent, in that some of the large producers were unable to get coal for their engines, and especially were the lime burners affected who depended upon coal as a fuel for their kilns.

The crushed-stone industry, influenced by the demand for good roads and by the use of crushed stone for concrete in masonry, has in the last six or seven years given a strong impetus to the stone industry as a whole.

In the last year the export trade in stone has been more active than before.

A tendency toward combination has also been more or less felt during the last two or three years, and in several States large interests have combined to control the output of various quarries. This is the case in New York, Pennsylvania, Massachusetts, Minnesota, Wisconsin, Ohio, Indiana, Connecticut, Vermont, and other States.

CLASSIFICATION.

In this report stone is classified, as usual in the trade, under the general headings of granite, sandstone, limestone, slate, and marble.

Under the head of granite are included granite, gneiss, mica-schist, andesite, syenite, and quartz-porphyry, which are used for all purposes for which granite is used, such as building stone, foundation work, monumental stone, paving blocks, curbstone and flagstone, rubble, and crushed stone for riprap, macadam roads, concrete, and railroad ballast. Besides these the following are also included: The diabase, trap rocks, basalts, diorites, and gabbros, quarried extensively in the New England and the Eastern States and in the far West, and used almost entirely for paving or as crushed stone for road metal.

Under sandstone are included all consolidated sands. The value of the stone depends upon the cementing material, quartz grains cemented by silica forming the hardest and most durable stone. The varieties of sandstone are often called by the quarrymen bluestone, freestone, and (when the grains composing the stone are of considerable size) conglomerates. As such they are classed as sandstone in this report. Some bituminous sandstone, quartzites used as refractory material in furnaces, the jasper stone of Minnesota and South Dakota, and the lava stone of Colorado are also included.

Limestone, when in its pure state, consists essentially of amorphous calcium carbonate, often cemented together by crystalline material and containing many impurities. In this report there is included with true limestone not only the calcium carbonate with the usual small amounts of impurities, such as the oxides of iron, aluminum, silica, etc., but stone containing calcium carbonate and magnesium carbonate in varying proportions. When the stone contains a considerable amount of magnesium carbonate it is called magnesium limestone, and when the stone is about equally composed of the carbonate of lime and of magnesia it is called dolomite. The limestones also include travertine, or the limestone deposited by running streams and springs in large compact masses, and fossiliferous, shell, and coral limestones. In composition there is no essential difference between limestone and what is generally known as marble. Marble is, however, limestone that by action of heat has been transformed into a crystalline form. There is also included with the marble some onyx marble, which in composition is the same as marble, but which is deposited from solution in crystalline form at different intervals, thus giving it a banded appearance and variegated colors. There is also included a small amount of serpentine.

PRODUCTION.

The figures as given in the table which follows do not include values of stone quarried for the following purposes: Sandstone converted into grindstones, whetstones, and other abrasive materials; sandstone quarried and crushed into sand for the manufacture of glass; bituminous limestone and sandstone used in making asphalt pavements and asphalt blocks; limestone used in blast furnaces, although the statistics of the furnace flux are shown under the part of the report treating of limestone; and limestone used in the manufacture of Portland cement.

The statistics of stone used for abrasives is shown in the report on abrasives as published by this office.

In making the statements as to the value of the stone the values given represent as nearly as it was possible to obtain them the value of the stone as it left the hands of the producer exclusive of any shipment values. When the stone was sold by the producer to the manufacturers in the rough state, the value is so given; and when the producer dressed his own stone, the value given is the dressed value. This applies particularly to the rough and the dressed granite, sandstone, and marble used for building and for monumental work.

The total value of the stone reported to this office in 1902, exclusive of the products mentioned above, was $64,559,099. The value in 1901 was $55,615,926. This shows a gain in 1902 of $8,943,173. The corresponding gain in 1901 over 1900, when the figures were $44,321,345, was $11,294,581, a larger increase in 1901 than in 1902.

Limestone, not including furnace flux, increased more in value of production than any other kind of stone, the figures for 1902 being $24,959,751 and for 1901 $21,747,061, a gain of $3,212,690 for 1902. The value of limestone used for blast-furnace flux, and not included in the above, increased from $4,659,836 in 1901 to $5,271,252 in 1902, a gain of $611,416.

Granite, including trap rock, increased from $15,976,961 in 1901 to $18,257,944 in 1902, or $2,280,983. The trap-rock production increased from $1,710,857 in 1901 to $2,181,157 in 1902, a gain of $470,300.

Sandstone, including bluestone, but not including grindstones and whetstones, increased from $8,138,680 in 1901 to $10,601,171 in 1902, a gain of $2,462,491. The value of bluestone, included in the above figures, was practically the same for 1901 and 1902, being $1,164,481 in 1901 and $1,163,525 in 1902.

The value of marble production increased slightly in 1902, the figures, however, being practically the same for both years—$4,965,699 in 1901 and $5,044,182 in 1902, an increase of $78,483.

The slate production in 1902 increased in value from $4,787,525 in 1901 to $5,696,051 in 1902, a gain of $908,526.

Value of the different kinds of stone produced in the United States, 1890–1902.

Year.	Granite.	Trap rock.	Marble.	Slate.	Sandstone.	Bluestone.	Limestone.	Total.
1890	$14,464,095	....	$3,488,170	$3,482,513	$10,816,057	$1,689,606	$19,095,179	$53,035,620
1891	13,867,000	....	3,610,000	3,825,746	8,700,000	*a* 1,500,000	15,792,000	47,294,746
1892	12,642,000	....	3,705,000	4,117,125	8,315,500	*a* 1,600,000	18,342,000	48,721,625
1893	8,808,934	....	2,411,092	2,523,173	5,295,151	*a* 1,000,000	13,947,223	33,985,573
1894	10,029,156	....	3,199,585	2,790,324	3,955,847	*a* 900,000	16,190,118	37,065,030
1895	8,894,328	....	2,825,719	2,698,700	4,211,314	*a* 750,000	15,308,755	34,688,816
1896	7,944,994	....	2,859,136	2,746,205	4,023,199	*a* 750,000	13,022,637	31,346,171
1897	8,905,075	....	3,870,584	3,524,614	4,065,445	*a* 900,000	14,804,933	36,070,651
1898	9,324,406	....	3,629,940	3,723,540	4,724,412	*a* 1,000,000	16,039,056	38,441,354
1899	10,343,298	$1,275,041	4,011,681	3,962,733	*b* 4,924,670	815,284	18,757,963	44,090,670
1900	10,969,417	1,706,200	4,267,253	4,240,466	*b* 5,272,865	1,198,519	*c* 16,666,625	44,321,345
1901	14,266,104	1,710,857	4,965,699	4,787,525	*b* 6,974,199	1,164,481	*c* 21,747,061	55,615,926
1902	16,076,787	2,181,157	5,044,182	5,696,051	*b* 9,407,646	1,163,525	*c* 24,959,751	64,559,099

a Estimated.
b Does not include value of grindstones and whetstones.
c Does not include value of limestone for flux.

The following tables show the value of stone produced in 1901 and 1902, by States:

Value of various kinds of stone produced in 1901 and 1902, by States.

1901.

State.	Granite.	Sandstone.	Slate.	Marble.	Limestone.	Total value.
Alabama	....	$8,680	....	....	$619,423	$628,103
Alaska	....	....	....	$4,500	....	4,500
Arizona	....	202,500	....	300	300	203,100
Arkansas	$23,554	62,825	....	300	68,319	154,998
California	*a* 1,134,675	301,028	$18,608	6,642	645,455	2,106,408
Colorado	138,996	237,331	....	....	245,799	622,126
Connecticut	*a* 616,654	146,814	....	....	140,424	903,892
Delaware	671,204	....	....	....	....	671,204
Florida	....	....	....	....	51,870	51,870
Georgia	761,646	....	3,000	936,549	85,629	1,786,824
Idaho	5,100	20,843	....	....	21,251	47,194
Illinois	....	12,884	....	....	2,793,837	2,806,721
Indiana	....	28,334	....	....	2,993,186	3,028,145
Indian Territory	(*b*)	....	....	....	....	(*b*)
Iowa	....	14,341	....	....	777,484	791,825
Kansas	*c* 48,530	49,901	....	....	478,986	577,417

a Includes trap rock. *b* Included with Kansas. *c* Includes Indian Territory.

Value of various kinds of stone produced in 1901 and 1902, by States—Continued.

1901—Continued.

State.	Granite.	Sandstone.	Slate.	Marble.	Limestone.	Total value.
Kentucky		$108,259			$199,567	$307,826
Maine	$2,703,116		$202,325		715,272	3,620,713
Maryland	613,356	4,546	105,798	$68,100	382,381	1,174,181
Massachusetts	[a] 2,216,258	147,428		126,546	244,039	2,834,153
Michigan	2,706	290,578			565,931	859,215
Minnesota	260,105	246,685	1,400		522,778	1,030,968
Missouri	95,806	42,170		2,100	1,362,272	1,502,348
Montana	15,200	58,439		1,500	143,866	221,285
Nebraska		515			154,717	155,232
Nevada	4,100					4,100
New Hampshire	935,494					935,494
New Jersey	[a] 894,167	244,512	30,000		309,738	1,478,417
New Mexico				10,600		10,600
New York	[a] 489,828	[b] 1,331,327	100,960	379,159	1,738,716	4,039,990
North Carolina	261,288	11,682			8,266	281,236
Ohio		1,999,180			2,606,502	5,183,225
Oklahoma Territory					32,497	32,497
Oregon	10,754	531		500	24,520	36,305
Pennsylvania	[a] 486,008	[b] 2,063,082	2,984,264	157,547	5,081,387	10,772,288
Rhode Island	501,698				38,030	539,728
South Carolina	996,084				28,500	1,024,584
South Dakota	99,941	17,647			53,780	171,368
Tennessee		10,342		494,637	330,927	835,906
Texas	27,005	111,568			209,658	348,231
Utah	5,588	38,919		320	78,900	123,727
Vermont	1,245,828		1,162,191	2,753,583	205,138	5,366,740
Virginia	275,701	5,303	178,979		539,128	1,446,160
Washington	43,808	89,174		22,816	234,587	390,385
West Virginia		103,010			447,049	106,710
Wisconsin	389,953	90,425			1,225,448	1,705,826
Wyoming	2,810	54,145			1,340	58,295
Total	[a] 15,976,961	[b] 8,138,680	4,787,525	4,965,699	[c] 26,406,897	60,982,060

1902.

State.	Granite.	Sandstone.	Slate.	Marble.	Limestone.	Total value.
Alabama		$42,706		([d])	$759,617	$802,323
Arizona	$3,000	107,910				110,910
Arkansas	12,115	85,917	([e])	([d])	113,163	211,195
California	[a] 1,137,679	462,328	([e])	$92,298	496,843	2,189,148
Colorado	66,023	366,161			203,700	635,884
Connecticut	[a] 812,141	128,579		([d])	205,371	1,146,091
Delaware	276,753					276,753
Florida					63,571	63,571
Georgia	803,778	1,250	([e])	660,517	111,589	1,577,134
Hawaii		6,688				6,688
Idaho	940	13,777			15,074	29,791
Illinois		32,200			3,222,608	3,254,808
Indiana		37,593			2,865,691	2,903,284
Indian Territory	11,970					11,970

[a] Includes trap rock.
[b] Includes bluestone.
[c] Includes blast-furnace flux
[d] Includes Alabama, Arkansas, Connecticut, Iowa, Maryland, Montana, New Mexico, and Utah.
[e] Included in other States.

Value of various kinds of stone produced in 1901 and 1902, by States—Continued.

1902—Continued.

State.	Granite.	Sandstone.	Slate.	Marble.	Limestone.	Total value.
Iowa		$15,061		(b)	$649,984	$665,045
Kansas		105,509			670,536	776,045
Kentucky		128,470			593,747	722,217
Maine	$2,659,450		$206,558		745,132	3,611,140
Maryland	758,203	15,405	118,084	(b)	453,030	1,344,722
Massachusetts	a 3,451,397	487,366		$165,489	339,349	4,443,601
Michigan		188,073			621,380	809,453
Minnesota	478,989	347,472			830,857	1,657,318
Missouri	157,708	56,990			1,697,139	1,911,837
Montana	77,050	85,152		(b)	104,725	266,927
Nebraska		168			145,473	145,641
Nevada	2,090	6,115			2,800	11,005
New Hampshire	1,147,097					1,147,097
New Jersey	a 948,474	406,726	(c)		181,650	1,536,850
New Mexico		12,291		(b)		12,291
New York	a 651,014	d 1,408,699	126,718	577,298	2,419,121	5,182,850
North Carolina	338,750	4,825			23,153	366,728
Ohio		2,078,754			3,201,718	5,280,472
Oklahoma		24,200			50,541	74,741
Oregon	38,429	1,109			20,133	59,671
Pennsylvania	a 661,062	d 2,800,108	3,547,322	160,423	5,420,287	12,589,202
Rhode Island	734,623				33,814	768,437
South Carolina	598,848				37,850	636,698
South Dakota		110,789			86,605	197,394
Tennessee		7,670		518,256	482,033	1,007,959
Texas	60,003	165,565			228,662	454,230
Utah	1,479	105,011		(b)	186,663	293,153
Vermont	1,570,423		1,464,918	2,628,164	225,703	5,889,208
Virginia	282,046	2,500	160,951		534,113	979,610
Washington	147,273	30,725		61,176	213,814	452,988
West Virginia		423,532			616,366	1,039,898
Wisconsin	369,137	207,086			1,351,058	1,927,281
Wyoming		90,691			6,340	97,031
Other States			e 71,500	e 180,561		252,061
Total	a 18,257,944	d 10,601,171	5,696,051	b 5,044,182	f 30,231,003	f 69,830,351

a Includes trap rock.
b Includes Alabama, Arkansas, Connecticut, Iowa, Maryland, Montana, New Mexico, and Utah.
c Included in other States.
d Includes bluestone.
e Includes Arkansas, California, Georgia, and New Jersey.
f Includes blast-furnace flux.

From the table for 1902 it will be seen that Pennsylvania, producing every kind of stone, ranks first in the total valuation of the stone produced. Vermont is second in rank; and Ohio, producing, however, only limestone and sandstone, is third. New York is fourth, followed by Massachusetts, Maine, Illinois, Indiana, and California, in the order named. Each of these States has a product of over $2,000,000. The drop from the value of the Pennsylvania product to the value of the Vermont product, the second State, is noticeable. Pennsylvania's entire stone product is valued at $12,589,202, and Vermont's product at $5,889,208.

In 1901 the rank of the States was Pennsylvania, Vermont, Ohio, New York, Maine, Indiana, Massachusetts, Illinois, and California.

The following table is given to show the total values of the stone used for various purposes in 1901 and 1902. Only those values are given which are for uses common to two or more varieties of stone.

Value of granite, sandstone, limestone, and marble used for various purposes in 1901 and 1902.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone and curbstone.	Paving.	Crushed stone.
1901.					
Granite	$5,660,129	$2,715,225	$670,703	$1,821,431	$3,003,443
Sandstone	4,875,973	....	1,663,221	358,910	285,347
Limestone	5,219,310	....	463,925	....	5,271,642
Marble	1,080,969	2,019,474	....	....	....
Total	16,836,381	4,734,699	2,797,849	2,180,341	8,560,432
1902.					
Granite	$7,034,832	$3,998,911	$876,726	1,523,776	$3,211,780
Sandstone	6,007,484	....	1,815,353	527,617	1,116,449
Limestone	5,563,084	....	573,656	....	7,152,730
Marble	2,184,941	1,942,674	....	....	....
Total	20,790,341	5,941,585	3,265,735	2,051,393	11,480,959

This table is of interest as showing the total value of stone that went for different purposes. The stone used for building showed an increase of $3,953,960 in 1902, the figures for 1901 being $16,836,381, and for 1902, $20,790,341. In 1901 the increase in value was from $10,672,598 in 1900 to $15,112,600 in 1901, or $4,440,002, a larger increase for 1901 than for 1902.

The stone for monumental use was valued at $5,941,585 in 1902, and at $4,734,699 in 1901, an increase of $1,206,886. In 1901 this value decreased slightly as compared with 1900. This does not include any limestone or sandstone, a small amount of which was used for this purpose.

Flagstone and curbstone increased from $2,797,849 in 1901 to $3,265,735 in 1902, or $467,886, and the value of paving stone decreased from $2,180,341 in 1901 to $2,051,393 in 1902, or $128,948.

Crushed stone increased in value from $8,560,432 in 1901 to $11,480,959 in 1902, a gain of $2,920,527.

As the crushed-stone industry has become such a decided factor in the quarry trade, the following table is given, showing the production of crushed stone in 1901 and 1902 according to the variety of stone, and showing also the purpose for which this stone was used:

Value of crushed stone in the United States in 1901 and 1902.

1901.

Kind.	Railroad ballast.	Road making.	Concrete.	Total value.
Limestone	$1,758,541	$2,298,286	$1,214,815	$5,271,642
Sandstone	30,887	130,503	123,957	285,347
Granite	516,768	2,008,966	477,709	3,003,443
Total	2,306,196	4,437,755	1,816,481	8,560,432

1902.

Kind.	Railroad ballast.	Road making.	Concrete.	Total value.
Limestone	$2,661,081	$2,890,985	$1,600,664	$7,152,730
Sandstone	347,869	442,113	326,467	1,116,449
Granite	574,780	1,902,439	734,561	3,211,780
Total	3,583,730	5,235,537	2,661,692	11,480,959

In the following tables is shown the total value of the crushed stone produced in the United States in 1901 and 1902, by States.

Value of crushed stone produced in the United States in 1901 and 1902, by States.

1901.

State.	Granite.	Limestone.	Sandstone.	Total value.
Alabama		$2,500		$2,500
Arkansas	$5,877	1,000	$36,204	43,081
California	375,941	211,148	24,000	611,089
Colorado	2,190	100	15,500	17,790
Connecticut	216,306			216,306
Delaware	87,263			87,263
Florida		6,420		6,420
Georgia	98,170	13,581		111,751
Idaho		25		25
Illinois		1,155,746	20	1,155,766
Indiana		225,740		225,740
Indian Territory	450			450
Iowa		183,902	275	184,177
Kansas	37,333	137,283	450	175,066
Kentucky		99,415		99,415
Maine	90,499			90,499
Maryland	101,458	53,663		155,121
Massachusetts	191,823	150	65,400	257,373
Michigan	2,706	125,448		128,154
Minnesota	2,085	20,268	9,515	31,868
Missouri	27,862	295,470	2,896	326,228
Montana			2,300	2,300
Nebraska		67,309		67,309
New Hampshire	25,223			25,223
New Jersey	721,126	1,925	831	723,882
New York	320,610	627,884	18,715	967,209
North Carolina	85,083	4,668		89,751
Ohio		853,886	15,005	868,891
Oklahoma		24,534		24,534

Value of crushed stone produced in the United States in 1901 and 1902, by States—Cont'd.

1901—Continued.

State.	Granite.	Limestone.	Sandstone.	Total value.
Oregon	....	$12,100	$49	$12,149
Pennsylvania	$369,078	746,895	56,942	1,172,915
Rhode Island	6,676	....	....	6,676
South Carolina	79,091	1,000	....	80,091
South Dakota	3,000	....	....	3,000
Tennessee	....	42,120	50	42,170
Texas	....	9,250	10,000	19,250
Utah	....	23	....	23
Vermont	2,107	610	....	2,717
Virginia	60,008	77,985	....	137,993
Washington	9,868	840	240	10,948
West Virginia	....	....	1,730	1,730
Wisconsin	81,610	268,729	1,519	351,858
Wyoming	....	25	23,706	23,731
Total	3,003,443	5,271,642	285,347	8,560,432

1902.

State.	Granite.	Limestone.	Sandstone.	Total value.
Alabama	....	$12,890	$200	$13,090
Arkansas	$11,000	22,510	44,746	78,256
California	266,103	26,900	187,750	480,753
Colorado	3,750	....	71,008	74,758
Connecticut	295,063	....	....	295,063
Delaware	109,462	....	....	109,462
Florida	....	11,008	....	11,008
Georgia	43,910	12,310	....	56,220
Hawaii	....	....	6,688	6,688
Illinois	....	1,220,772	25	1,220,797
Indiana	....	274,491	1,000	275,491
Indian Territory	320	....	....	320
Iowa	....	153,372	785	154,157
Kansas	....	383,904	42,050	425,954
Kentucky	....	327,217	55,000	382,217
Maine	9,944	....	....	9,944
Maryland	155,761	95,966	5,965	257,692
Massachusetts	427,035	1,093	296,529	724,657
Michigan	....	146,501	....	146,501
Minnesota	15,660	128,244	21,099	165,003
Missouri	38,044	502,741	1,350	542,135
Montana	....	....	750	750
Nebraska	....	52,742	43	52,785
New Hampshire	26,550	....	....	26,550
New Jersey	753,005	580	30,930	784,515
New York	318,003	1,084,594	59,552	1,462,149
North Carolina	67,196	21,063	....	88,259
Ohio	....	951,751	8,304	960,055
Oklahoma	....	9,000	800	9,800
Oregon	14,150	....	228	14,378
Pennsylvania	386,774	1,149,355	179,305	1,715,434
Rhode Island	15,410	....	....	15,410
South Carolina	60,233	350	....	60,583
South Dakota	....	9,600	168	9,768
Tennessee	....	70,713	....	70,713
Texas	....	18,993	42,207	61,200

Value of crushed stone produced in the United States in 1901 and 1902, by States—Cont'd.

1902—Continued.

State.	Granite.	Limestone.	Sandstone.	Total value.
Utah	....	$400	....	$400
Vermont	$6,373	1,387	....	7,760
Virginia	78,275	19,455	....	97,730
Washington	22,974	....	....	22,974
West Virginia	....	157,351	$25,041	182,392
Wisconsin	86,785	285,477	764	373,026
Wyoming	....	....	34,162	34,162
Total	3,211,780	7,152,730	1,116,449	11,480,959

The division of this product, according to the uses to which the stone was put, is shown in the table giving the values of the different varieties of stone by States and uses.

IMPORTS AND EXPORTS.

The figures following, giving statistics of the imports and exports of stone for the United States, are taken from data collected by the Bureau of Statistics of the Department of Commerce and Labor. These statistics are collected by fiscal years, and when the figures for a special year are given in this report, the year ending June 30 of the year mentioned is meant.

The value of the stone imported into this country for the fiscal year ending June 30, 1902, was $1,641,388. The corresponding figures for previous years were $1,276,602 for 1901, $1,028,550 for 1900, $883,852 for 1899. This shows an increase of $144,698 in 1900; $248,052 in 1901, and $364,786 in 1902.

These values include rough and manufactured marble to the amount of $680,533 in 1899, $812,606 in 1900, $1,024,687 in 1901, and in 1902 $1,408,885. This shows an increase of $132,073 in 1900, $212,081 in 1901, and $384,168 in 1902. The largest feature of the marble importation was rough and manufactured marble from Italy, which was valued at $573,871 in 1899, $665,221 in 1900, $823,488 in 1901, and $1,127,688 in 1902. This shows an increase of $91,350 in 1900, $158,267 in 1901, and $304,200 in 1902, a notable increase in the last year. The other countries exporting to this country any considerable amount of marble are in order of importance, France, Mexico, Greece, United Kingdom, Belgium, Germany, and Denmark.

The rest of the stone, rough and manufactured, including slate imported to this country was valued at $203,319 in 1899, $215,944 in 1900, $251,915 in 1901, and $232,533 in 1902.

Besides the above, there was imported, chiefly from the Dominion of Canada, lime valued at $58,066 in 1899, $63,900 in 1900, $65,399 in 1901, and $91,785 in 1902.

The total value of the stone exported from the United States in 1902 was $1,716,696. In comparison with exports in previous years, valued at $1,886,756 in 1899, $1,677,169 in 1900, and $1,638,314 in 1901, there was a decrease of $209,587 in 1900, a decrease of $38,855 in 1901, and an increase of $78,382 in 1902, as compared with the previous years.

Roofing slate is the largest factor of the exported stone, and amounted in value to $1,363,617 in 1899, $950,543 in 1900, $898,262 in 1901, and $945,352 in 1902. This shows a decrease of $413,074 in 1902, a decrease of $52,281 in 1901, and an increase of $47,090 in 1900. The value of other manufactured stone exported in 1902 was $644,071. In comparison with exports, valued at $454,236 in 1899, $606,229 in 1900, and $646,332 in 1901, there was an increase of $151,993 in 1900, an increase of $40,103 in 1901, and a decrease of $2,261 in 1902.

The unmanufactured stone exported was valued at $172,273 in 1902, as compared with $68,903 in 1899, $120,397 in 1900, and $93,720 in 1901. Most of the unmanufactured product is sent to the Dominion of Canada and the United Kingdom, the same being true of the manufactured product; but considerable quantities of unmanufactured were also shipped to Germany, Cuba, British Australasia, France, Mexico, Belgium, and the British West Indies, named in order of importance.

In addition to the stone, lime valued at $39,447 was exported in 1902 chiefly to the Dominion of Canada. The value of the lime exported in previous years is given as $73,385 in 1899, $81,647 in 1900, and $30,216 in 1901.

GRANITE.

The value of granite, including gneiss, mica-schist, lava, andesite, syenite, quartz-porphyry, trap rock, basalt, and allied igneous rocks, quarried in the United States in 1902 was $18,257,944. This, in comparison with the value of this stone produced in 1901, $15,976,961, shows an increase of $2,280,983. The increase in value of the stone quarried in1901, $15,976,961, over that quarried in 1900, $12,675,617, was $3,301,344, which shows that the increase for the year 1902, although considerable, did not equal the increase for 1901; and the increase in the value for 1900 as compared with 1899 was $1,057,278.

In 1902 Massachusetts still held first place in the production of granite in the United States. Maine, Vermont, New Hampshire, and California followed in the order named.

In 1902 Maine showed the largest value for building stone, with Massachusetts second and New Hampshire third. Vermont showed the largest value for monumental stone, with Massachusetts second and Rhode Island third. The largest value for paving blocks was from Massachusetts followed closely by Maine, and third, by Georgia. The value of crushed stone was largest in New Jersey, Massachusetts, and California following.

The greatest increase was in the value of stone used for building purposes. In 1901 the value of this product, including dressed and rough stone sold by the quarrymen was $5,660,129. In 1902 the value of this product was $7,034,832, a gain of $1,374,703. The rough building stone increased from a value of $1,878,835 in 1901, to $2,175,082 in 1902, a gain of $296,247. The stone quarried and dressed by the producer for building purposes increased from $3,781,294 in 1901 to $4,859,750 in 1902, a gain of $1,078,456.

The stone sold for monumental work in 1902, including the rough stock sold by the quarrymen for this purpose and the stone quarried and dressed for this purpose by the quarrymen was $3,998,911. In 1901 this value was $2,715,225, a gain of $1,283,686. The rough monumental stock was valued at $1,714,156 in 1902, and $1,257,668 in 1901, an increase for 1902 of $456,488. The dressed stone was valued at $2,284,755 in 1902 and $1,457,557 in 1901, an increase for 1902 of $827,198.

The value of the paving blocks decreased from a value of $1,821,431 in 1901, to a value of $1,523,776 in 1902, a decrease of $297,655.

The crushed stone increased from a value of $3,003,443 in 1901 to a value of $3,211,780 in 1902, an increase of $208,337.

The following tables give the value of the granite produced in the United States in 1901 and 1902, by States and uses:

Value of granite produced in the United States in 1901 and 1902, by States and uses.

1901.

State.	Sold in the rough.			Dressed for building.	Dressed for monumental work.	Made into paving blocks.
	Building.	Monumental.	Other.			
Arkansas						$2,627
California	$24,057	$38,755	$6,815	$358,832	$72,257	46,300
Colorado	45,650	7,562		60,835	1,787	5,750
Connecticut	108,959	26,267	24,384	94,611	70,894	29,533
Delaware	9,069		2,678	1,750	400	32,191
Georgia	54,321	22,315	2,725	57,207	14,526	328,087
Idaho	100	5,000				
Indian Territory, Kansas	2,340			7,800		
Maine	407,418	24,475	27,447	1,501,797	76,276	401,189
Maryland	181,608	20,180	1,500	188,568	7,800	51,637
Massachusetts	333,047	236,327	118,567	455,535	236,273	364,721
Michigan						
Minnesota	13,215	42,197	1,550	55,017	96,902	20,002
Missouri	550	17,406	2,095			40,651
Montana, Nevada				15,600	3,500	
New Hampshire	156,832	52,231	9,797	363,957	171,239	112,581
New Jersey	60,905	2,515		19,888		87,933
New York	24,312	1,325	6,150	97,350	6,283	33,025
North Carolina	27,464	4,105	2,212	68,975	6,813	10,862
Oregon	3,748	250	1,590	3,900	1,116	
Pennsylvania	63,568	1,050	4,538	18,916	227	15,712

Value of granite produced in the United States in 1901 and 1902, by States and uses—Continued.

1901—Continued.

State.	Sold in the rough.			Dressed for building.	Dressed for monumental work.	Made into paving blocks.
	Building.	Monumental.	Other.			
Rhode Island	$9,722	$92,974	$110	$160,190	$198,831	$27,666
South Carolina	56,831	23,433	5,730	165,594	12,789	8,276
South Dakota	25,106		2,159	1,650		52,089
Texas	2,652	11,521		243	10,400	
Utah	2,288	3,300				
Vermont	208,825	534,755	101,779	16,343	354,563	16,304
Virginia	40,763	8,300	230	45,737	52,404	17,253
Washington	9,100	2,250		3,000		3,360
Wisconsin	3,575	79,175	28,015	17,999	62,277	113,682
Wyoming	2,810					
Total	1,878,835	1,257,668	350,071	3,781,294	1,457,557	1,821,431

State.	Curbing and flagging.	Crushed stone.			Riprap, rubble, etc.	Total.
		Railroad ballast.	Road making.	Concrete.		
Arkansas	$12,496		$3,500	$2,377	$2,554	$23,554
California	22,200	$62,103	110,871	202,967	189,518	1,134,675
Colorado	397		750	1,440	14,825	138,996
Connecticut	14,358		213,672	2,634	31,342	616,654
Delaware	2,853	a 87,263			535,000	671,204
Georgia	155,920	25,700	35,545	36,925	28,375	761,646
Idaho						5,100
Indian Territory / Kansas	62	37,333		450	545	48,530
Maine	124,535	25,325	59,714	5,460	49,480	2,703,116
Maryland	42,045	13,092	37,962	50,404	18,560	613,356
Massachusetts	146,325	5,455	135,775	50,593	133,640	2,216,258
Michigan			2,706			2,706
Minnesota	18,155	40	1,025	1,020	10,982	260,105
Missouri	3,142		27,862		4,100	95,806
Montana / Nevada	200					19,300
New Hampshire	28,708	3,615	7,140	14,468	14,926	935,494
New Jersey		43,500	677,176	450	1,800	894,167
New York	773	40,000	262,410	18,200		489,828
North Carolina	51,733	64,660	17,223	3,200	4,041	261,288
Oregon	150					10,754
Pennsylvania	7,611	48,686	294,986	25,406	5,308	486,008
Rhode Island	2,456		5,676	1,000	3,073	501,698
South Carolina	2,723	46,835	21,806	10,450	641,617	996,084
South Dakota	795			3,000	15,142	99,941
Texas	2,189					27,005
Utah						5,588
Vermont	10,400	400	1,707		752	1,245,828
Virginia	7,977	7,841	9,850	42,317	43,029	275,701
Washington	9,000	4,920		4,948	7,230	43,808
Wisconsin	3,500		81,610		120	389,953
Wyoming						2,810
Total	670,703	516,768	2,008,966	477,709	1,755,959	15,976,961

a Includes roadmaking.

Value of granite produced in the United States in 1901 and 1902, by States and uses—Continued.

1902.

State.	Sold in the rough.			Dressed for building.	Dressed for monumental work.	Made into paving blocks.	Curbing.	Flagging.
	Building.	Monumental.	Other.					
Arkansas	$50	$215	....	$600	....	....	$75	....
Arizona	....	....	....	....	$3,000	....	....	....
California	230,988	34,992	$8,455	133,574	43,855	$144,160	28,205	$495
Colorado	47,752	8,770	....	1,800	1,513	....	....	....
Connecticut	117,802	28,862	3,929	200,262	66,899	34,579	23,080	371
Delaware	20,640	....	4,593	2,407	....	9,675	4,701	....
Georgia	30,159	45,814	12,330	99,213	18,565	151,779	317,164	12,533
Idaho Indian Territory	840	....		7,700	1,800	....	850	....
Maine	485,217	52,836	12,720	1,435,803	155,305	354,530	112,290	10,238
Maryland	139,856	15,825	4,150	323,239	17,500	30,521	35,955	7,301
Massachusetts	400,842	412,172	123,399	965,342	381,872	358,398	111,184	15,614
Minnesota	17,154	80,656	2,700	181,089	154,825	3,280	15,340	480
Missouri	3,000	27,051	....	29,283	2,185	42,359	6,900	....
Montana	16,600	100	....	16,000	250	....	300	....
Nevada	....	....	....	150	1,800	....	140	....
New Hampshire	148,579	57,335	8,564	471,337	289,400	101,548	22,328	340
New Jersey	70,884	2,940	450	43,761	....	72,404	....	....
New York	131,549	1,500	975	175,904	7,180	6,562	827	640
North Carolina	26,490	820	1,250	131,525	8,804	6,986	79,332	3,283
Oregon	3,931	2,750	1,000	5,460	2,000	6,400	....	375
Pennsylvania	121,198	1,650	525	78,678	450	44,411	6,799	....
Rhode Island	18,798	111,752	750	120,767	438,967	14,657	5,478	160
South Carolina	70,580	20,986	333,728	71,000	24,290	4,547	7,059	500
Texas	10,345	17,135	....	3,439	29,084	....	....	....
Utah	495	534	....	....	450	....	....	....
Vermont	28,845	756,007	23,896	289,567	453,187	2,855	5,770	....
Virginia	21,158	12,500	....	28,840	51,612	14,845	29,796	550
Washington	9,870	4,304	....	12,057	11,953	5,000	10,273	....
Wisconsin	1,460	16,650	500	30,953	118,009	114,280	....	....
Other States	....	....	....	....	....	....	....	....
Total	2,175,082	1,714,156	543,914	4,859,750	2,284,755	1,523,776	823,846	52,880

State.	Crushed stone.			Rubble.	Riprap.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Arkansas	$9,000	$2,000	....	$175	....	....	$12,115
Arizona	....	....	....	....	....	....	3,000
California	135,842	13,861	$116,400	24,635	$48,099	$174,118	1,137,679
Colorado	3,750	....	....	2,438	....	....	66,023
Connecticut	238,261	2,250	54,552	8,468	32,426	400	812,141
Delaware	41,237	57,291	10,934	61,066	63,300	909	276,753
Georgia	26,741	10,122	7,047	50,870	....	21,441	803,778
Idaho Indian Territory	....	....	320	1,400	....	....	12,910
Maine	8,070	90	1,784	6,318	13,077	11,172	2,659,450
Maryland	74,522	26,535	54,704	9,055	2,250	16,790	758,203
Massachusetts	278,656	50,795	97,584	224,187	26,460	4,892	3,451,397
Minnesota	12,635	1,525	1,500	6,605	1,200	....	478,989
Missouri	18,803	....	19,241	....	3,451	5,435	157,708

Value of granite produced in the United States in 1901 and 1902, by States and uses—Continued.

1902—Continued.

State.	Crushed stone.			Rubble.	Riprap.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Montana					$43,800		$77,050
Nevada							2,090
New Hampshire	$16,788	$1,750	$8,012	$810	17,056	$3,250	1,147,097
New Jersey	578,424	59,546	115,035	700	4,330		948,474
New York	193,435	30,126	94,442	6,874	1,000		651,014
North Carolina	4,910	54,080	8,206	6,888	3,676	2,500	338,750
Oregon	11,500	1,550	1,100	1,550	813		38,429
Pennsylvania	140,166	188,129	58,479	16,769	3,488	320	661,062
Rhode Island	12,808	42	2,560	2,974	621	4,289	734,623
South Carolina	650	23,510	36,073	5,585		340	598,848
Texas							60,003
Utah							1,479
Vermont	3,348	3,025		2,000	108	1,815	1,570,423
Virginia	6,133	25,554	46,588	26,255	17,215	1,000	282,046
Washington		22,974		34,054	36,788		147,273
Wisconsin	86,760	25		500			369,137
Other States							
Total	1,902,439	574,780	734,561	500,176	319,158	248,671	18,257,944

The following table shows the value of the production of granite in the United States from 1898 to 1902, inclusive:

Value of granite produced in the United States, 1898–1902.

State.	1898.	1899.	1900.	1901.	1902.
Arkansas		$39,470	$62,500	$23,554	$12,115
Arizona					3,000
California	$247,429	471,665	738,993	1,134,675	1,137,679
Colorado	25,923	78,261	143,054	138,996	66,023
Connecticut	682,768	516,886	507,754	616,654	812,141
Delaware	677,754	1,039,349	608,028	671,204	276,753
Georgia	339,311	411,344	380,434	761,646	803,778
Idaho			2,450	5,100	12,910
Indian Territory				48,530	
Kansas			30,000		
Maine	1,032,621	1,321,082	1,568,573	2,703,116	2,659,450
Maryland	317,258	423,823	486,822	613,356	758,203
Massachusetts	1,650,508	1,798,294	1,698,605	2,216,258	3,451,397
Michigan			3,957	2,706	
Minnesota	79,309	159,459	221,684	260,105	478,989
Missouri	78,423	151,688	139,103	95,806	157,708
Montana		9,950	9,091	19,300	77,050
Nevada					2,090
New Hampshire	683,595	802,636	870,646	935,494	1,147,097
New Jersey	753,513	779,822	1,170,555	894,167	948,474
New York	516,847	306,711	446,171	489,828	651,014
North Carolina	79,969	225,544	257,962	261,288	338,750
Oregon		3,012	5,313	10,754	38,429

Value of granite produced in the United States, 1898–1902—Continued.

State.	1898.	1899.	1900.	1901.	1902.
Pennsylvania	$237,780	$385,101	$396,271	$486,008	$661,062
Rhode Island	320,242	400,128	444,316	501,698	734,623
South Carolina	169,518	361,034	500,802	996,084	598,848
South Dakota	17,443	91,049	114,115	99,941	(a)
Texas	4,685	84,945	76,069	27,005	60,003
Utah	3,545	4,735	2,170	5,588	1,479
Vermont	1,084,218	1,212,967	1,113,788	1,245,828	1,570,423
Virginia	136,180	223,380	211,080	275,701	282,046
Washington	9,700	42,766	48,900	43,808	147,273
Wisconsin	175,867	270,538	407,711	389,953	369,137
Wyoming	....	2,700	8,700	2,810	....
Total	9,324,406	11,618,339	12,675,617	15,976,961	18,257,944

[a] Value of quartzite included in sandstone for 1902.

The following tables show the value of the trap rock produced in the United States in 1901 and 1902, by States and uses:

Value of trap rock produced in the United States in 1901 and 1902, by States and uses.

1901.

State.	Sold in rough.	Made into paving blocks.	Crushed for roads or ballast.	Other purposes.	Total.
California	....	$1,250	$121,120	$4,627	$126,997
Connecticut	....	193	202,006	11,784	213,983
Massachusetts	....	....	128,079	2,469	130,548
New Jersey	....	83,922	633,129	44,286	761,337
New York	....	22,750	161,248	5,985	189,983
Pennsylvania	....	1,890	281,706	4,413	288,009
Total	....	110,005	1,527,288	73,564	1,710,857

1902.

State.	Building.	Paving.	Crushed stone.			Other.	Total.
			Road making.	R. R. ballast.	Concrete.		
California	....	....	$95,409	$1,065	$115,000	$316	$211,790
Connecticut	$1,057	$274	235,743	2,250	48,188	....	287,512
Massachusetts	13,675	....	239,552	47,131	70,182	....	370,540
New Jersey	34,640	66,727	532,128	59,546	80,835	3,496	777,372
New York	....	....	164,723	26,126	19,151	....	210,000
Pennsylvania	4,080	13,244	121,194	152,649	32,456	320	323,943
Total	53,452	80,245	1,388,749	288,767	365,812	4,132	2,181,157

SANDSTONE.

The value of the sandstone quarried in 1902 in the United States was $10,601,171. This shows an increase of $2,462,491 over the value for 1901, which was $8,138,680.

The bluestone production of New York and Pennsylvania, although practically it forms an industry by itself, is included in the above sandstone total.

The entire value of the bluestone produced in these two States was valued at $1,163,525 in 1902, as compared with $1,164,481 in 1901, the values for the two years being almost identical. Deducting the value of the bluestone, we have the sandstone production for 1902 valued at $9,437,646, as compared with $6,974,199 in 1901; an increase of $2,463,447. In the figures for 1901 and 1902 no attempt is made to show the value of stone used for abrasives, such as grindstones, whetstones, buhrstones, etc., as these are included in the report on abrasive materials published by this office.

The States showing an increased production were Alabama, Arkansas, California, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, New Jersey, New Mexico, New York, Ohio, Oregon, Pennsylvania, Texas, Utah, West Virginia, Wisconsin, and Wyoming. Arizona, Connecticut, Idaho, Nebraska, North Carolina, South Dakota, Tennessee, Virginia, and Washington showed a decrease in value of production. Georgia, Hawaii, Nevada, and Oklahoma, were added to the list of States producing, and made the States and Territories producing sandstone in the United States number forty-one.

Pennsylvania, Ohio, and New York are the largest producers and show values of production of $2,800,108, $2,078,754, and $1,408,699, respectively. The next State approaching these States in production is Massachusetts, with a value of $487,366. The production of the three principal States in 1901 was: Pennsylvania, $2,063,082; Ohio, $1,999,180; and New York, $1,331,327.

Pennsylvania, Ohio, and New York, in the order named, produced the largest quantities of building sandstone in 1902, the values for these States being $1,916,959 for Pennsylvania, $1,279,910 for Ohio, and $550,439 for New York. In Ohio most of the stone is sold by the quarrymen as rough stone, in Pennsylvania as dressed stone, while in New York it is about evenly divided between the two. New York gives the greatest value for stone for curbing and also for paving, and Ohio for flagstones.

In 1901 the total value of the sandstone sold by the quarrymen for building purposes was $4,875,973; in 1902 the dressed and rough building stone sold by the quarrymen amounted to $6,007,484, an increase of $1,131,511, which accounted for $1,000,000 of the entire increase in the value of the sandstone production. The value of the crushed-stone product increased from $285,347 in 1901 to $1,116,449 in 1902, an increase of $831,102.

The value of stone used for paving increased from $358,910 in 1901 to $527,617 in 1902, or $167,707; flagstones increased in value from $1,026,499 in 1901 to $1,142,699 in 1902, or $116,200; curbing increased from $636,722 to $672,654, or $35,932.

The following tables show the values of the sandstone production of the United States in 1901 and 1902, by States and uses:

Value of sandstone produced in the United States in 1901 and 1902, by States and uses.

1901.

State.	Building purposes.	Crushed stone.			Paving.
		Railroad ballast.	Road making.	Concrete.	
Alabama	$1,880				
Arizona	202,500				
Arkansas	10,805	$700	$15,136	$20,368	$2,000
California	230,521		23,000	1,000	29,594
Colorado	93,534		15,500		
Connecticut	114,795				
Idaho	20,843				
Illinois	8,720	20			523
Indiana	23,475				650
Iowa	13,491		275		251
Kansas	15,981	450			1,775
Kentucky	100,569				6,000
Maryland	4,546				
Massachusetts	176,850		14,600	50,800	
Michigan	128,909				
Minnesota	85,800		3,015	6,500	82,500
Missouri	32,899		2,884	12	1,890
Montana	39,135			2,300	
Nebraska	515				
New Jersey	211,318		756	75	64
New York	512,352	6,125	9,560	3,030	168,596
North Carolina	11,100				
Ohio	936,650	2,000	5,230	7,775	
Oregon	482		49		
Pennsylvania	1,544,621	20,157	28,919	7,866	65,067
South Dakota	13,325				
Tennessee	10,180			50	
Texas	39,605		10,000		
Utah	32,636				
Virginia	4,703				
Washington	67,480			240	
West Virginia	95,406	1,435	60	235	
Wisconsin	72,229		1,519		
Wyoming	18,118			23,706	
Total	4,875,973	30,887	130,503	123,957	358,910

Value of sandstone produced in the United States in 1901 and 1902, by States and uses—Continued.

1901—Continued.

State.	Riprap, rubble, etc.	Curbing.	Flagstones.	Other purposes.	Total value.
Alabama	$2,000			$4,800	$8,680
Arizona					202,500
Arkansas	3,278	$10,256	$232	50	62,825
California	16,633		280		301,028
Colorado	24,406		85,491	18,400	237,331
Connecticut	1,470			30,549	146,814
Idaho					20,843
Illinois	355		2,042	1,224	12,884
Indiana	4,098		111		28,334
Iowa	178		71	75	14,341
Kansas	125		31,370	200	49,901
Kentucky			830	860	108,259
Maryland					4,546
Massachusetts	400			4,660	247,310
Michigan	26,519			19,000	174,428
Minnesota	52,870			16,000	246,685
Missouri	3,278	146	464	597	42,170
Montana	15,684		200	1,120	58,439
Nebraska					515
New Jersey	18,705			13,594	244,512
New York	12,579	281,679	269,790	67,616	1,331,327
North Carolina	582				11,682
Ohio	95,563	233,965	510,568	207,429	1,999,180
Oregon					531
Pennsylvania	78,243	85,676	113,508	119,025	2,063,082
South Dakota	4,272			50	17,647
Tennessee				112	10,342
Texas	28,918	25,000	8,000	45	111,568
Utah	3,224		3,000	59	38,919
Virginia	600				5,303
Washington	20,050			1,404	89,174
West Virginia	5,660		214		103,010
Wisconsin	15,509		328	840	90,425
Wyoming	12,321				54,145
Total	447,520	636,722	1,026,499	507,709	8,138,680

Value of sandstone produced in the United States in 1901 and 1902, by States and uses—Continued.

1902.

State.	Rough building.	Dressed building.	Crushed stone.			Ganister.	Riprap.
			Road-making.	Railroad ballast.	Concrete.		
Alabama		$14,252			$200		$8,727
Arizona	$9,570	75,000					4,800
Arkansas	8,374	1,420		$38,475	6,271		415
California	80,038	123,240	$37,750	4,000	146,000		71,090
Colorado	93,116	15,267		65,000	6,008		2,347
Connecticut	123,634	4,945					
Georgia	1,250						
Hawaii			6,688				
Idaho	7,823	434					
Illinois	21,185	4,100	25				1,000
Indiana	24,565	5,564	1,000				450
Iowa	9,044	775	750		35		
Kansas	10,157	2,080		42,050			
Kentucky	47,775	5,600	5,000	50,000			
Maryland	7,210		10	4,500	1,455		545
Massachusetts	93,197	96,595	256,273		40,256		
Michigan	136,280	23,600					800
Minnesota	30,796	70,935	5,400		15,699		4,061
Missouri	32,880	15,323		900	450		345
Montana	4,822	61,158			750		3,795
Nebraska	96	24	18		25		
Nevada	2,383						
New Jersey	232,051	81,145	50		30,880		
New Mexico	6,800	2,125					
New York	279,009	271,430	50,447	3,795	5,310		5,452
North Carolina	750	4,000					
Ohio	1,067,938	211,972	1,554	75	6,675	$1,595	21,853
Oklahoma Oregon	24,281		1,028				
Pennsylvania	491,235	1,425,724	30,742	129,591	18,972	92,471	62,927
South Dakota	19,970	22,192		168			3,652
Tennessee	6,950	600					
Texas	4,832	28,000	16,300		25,907		59,919
Utah	63,529	265					
Virginia	2,200	300					
Washington	2,500	15,225					8,000
West Virginia	104,601	193,157	3,995	8,685	12,361		3,323
Wisconsin	54,392	85,353	83	630	51	18,534	5,436
Wyoming	14,003	26,448	25,000		9,162		332
Total	3,119,236	2,888,248	442,113	347,869	326,467	112,600	269,269

State.	Rubble.	Paving.	Flagstone.	Curbing.	Other.	Total value.
Alabama	$16,675				$2,852	$42,706
Arizona	18,300				240	107,910
Arkansas	3,115	$9,810	$2,979	$14,878	180	85,917
California	210					462,328
Colorado	37,998	718	101,486	42,607	1,614	366,161
Connecticut						128,579
Georgia						1,250
Hawaii						6,688

Value of sandstone produced in the United States in 1901 and 1902, by States and uses—Continued.

1902—Continued.

State.	Rubble.	Paving.	Flagstone.	Curbing.	Other.	Total value.
Idaho	$5,520					$13,777
Illinois	2,925	$2,400	$160		$105	32,200
Indiana	1,069	240	120	$4,585		37,593
Iowa	3,157		75		1,225	15,061
Kansas	6,162	275	21,124	23,561	100	105,509
Kentucky		1,075	7,420	4,900	6,700	128,470
Maryland	1,035				650	15,405
Massachusetts	1,000			45		487,366
Michigan	27,393					188,073
Minnesota	29,351	140,726	225	43,659	6,620	347,472
Missouri	3,001		881	1,710	1,500	56,990
Montana	4,462		390	2,435	7,340	85,152
Nebraska	5					168
Nevada	3,657			75		6,115
New Jersey	59,777		2,200		623	406,726
New Mexico	50	360	756	950	1,250	12,291
New York	18,583	264,858	230,158	272,831	6,826	1,408,699
North Carolina	75					4,825
Ohio	44,471	750	664,659	43,077	14,135	2,078,751
Oklahoma Oregon						25,309
Pennsylvania	202,295	26,985	104,521	174,184	40,461	2,800,108
South Dakota	24,447	39,260		500	600	110,789
Tennessee					120	7,670
Texas	7,000			22,850	757	165,565
Utah		35,000	2,200	4,010	7	105,011
Virginia						2,500
Washington	5,000					30,725
West Virginia	79,030		2,745	15,635		423,532
Wisconsin	29,760	160		112	12,575	207,086
Wyoming	10,096	5,000	600	50		90,691
Total	645,619	527,617	1,142,699	672,654	106,780	10,601,171

The following table shows the value of the sandstone production in the United States from 1898 to 1902, inclusive, by States:

Value of sandstone production in the United States, 1898–1902, by States.

State.	1898.	1899.	1900.	1901.	1902.
Alabama	$27,882	$71,675	$7,132	$8,680	$42,706
Arizona	57,444	4,168	64,000	202,500	107,910
Arkansas	24,825	73,616	104,923	62,825	85,917
California	358,908	261,193	200,090	301,028	462,328
Colorado	89,637	129,815	119,658	237,331	366,161
Connecticut	215,733	271,623	192,593	146,814	128,579
Georgia			600		1,250
Hawaii					6,688
Idaho			438	20,843	13,777
Illinois	13,758	16,133	19,141	12,884	32,200
Indiana	45,342	35,636	45,063	28,334	37,593

Value of sandstone production in the United States, 1898–1902, by States—Continued.

State.	1898.	1899.	1900.	1901.	1902.
Iowa	$7,102	$24,348	$19,063	$14,341	$15,061
Kansas	19,528	49,629	55,173	49,901	105,509
Kentucky	72,525	119,982	56,178	108,259	128,470
Louisiana	200,500	[a]226,503	[b]118,192	....	....
Maryland	13,646	24,426	6,655	4,546	15,405
Massachusetts	91,287	131,877	153,427	247,310	487,366
Michigan	222,376	320,192	238,650	174,428	188,073
Minnesota	175,810	294,615	267,000	246,685	347,472
Missouri	48,795	57,662	53,401	42,170	56,990
Montana	3,682	26,160	59,630	58,439	85,152
Nebraska	....	....	....	515	168
Nevada	....	....	....	....	6,115
New Jersey	257,217	147,768	198,234	244,512	406,726
New Mexico	3,500	1,829	2,500	....	12,291
New York	566,133	[c]1,218,053	[c]1,467,496	[c]1,331,327	[c]1,408,699
North Carolina	9,100	10,300	27,210	11,682	4,825
Ohio	1,494,746	1,775,642	2,233,596	1,999,180	2,078,754
Oklahoma	....	....	....	....	25,309 (Oklahoma and Oregon)
Oregon	7,864	4,153	5,450	531	
Pennsylvania	478,451	[c]717,053	[c]1,050,248	[c]2,063,082	[c]2,800,108
South Dakota	9,000	18,325	12,675	17,647	110,789
Tennessee	....	....	11,300	10,342	7,670
Texas	77,190	35,738	37,038	111,568	165,565
Utah	15,752	29,091	66,733	38,919	105,011
Virginia	....	8,000	6,000	5,303	2,500
Washington	15,575	58,395	68,133	89,174	30,725
West Virginia	14,381	33,860	72,438	103,010	423,532
Wisconsin	80,341	132,901	81,571	90,425	207,086
Wyoming	6,382	32,583	27,671	54,145	90,691
Total	4,724,412	6,362,944	7,149,300	8,138,680	10,601,171

[a] Includes small amounts for Idaho and Nevada.
[b] Includes Mississippi.
[c] Includes bluestone.

The following table shows the value and uses of the bluestone produced in New York and Pennsylvania in 1901 and 1902:

Value and uses of bluestone produced in New York and Pennsylvania in 1901 and 1902.

1901.

State.	Building purposes.	Flagging.	Curbing.	Gutter and crossings.	Coping, steps, sills, and lintels.	Other purposes.	Total value.
New York	$156,091	$230,453	$206,455	$32,466	$164,296	$48,363	$838,124
Pennsylvania	103,718	87,008	42,747	12,189	35,044	45,651	326,357
Total	259,809	317,461	249,202	44,655	199,340	94,014	1,164,481

1902.

State.	Building purposes.	Flagging.	Curbing.	Crushed stone.	Other purposes.	Total value.
New York	$302,947	$203,743	$152,241	$28,847	$9,935	$697,713
Pennsylvania	177,296	92,469	69,556	90,209	36,282	465,812
Total	480,243	296,212	221,797	119,056	46,217	1,163,525

SLATE.

The production of slate in 1902 increased in value from $4,787,525 in 1901 to $5,696,051, a gain of $908,526. This increase was principally in Pennsylvania and Vermont. California, Georgia, Maine, Maryland, and New York also increased, while New Jersey and Virginia decreased in value of production. Minnesota reported no production in 1902, and Arkansas was added to the list of producers.

The increase in production was from 1,304,379 squares, valued at $4,114,410, in 1901, to 1,435,168 squares, valued at $4,950,428, in 1902, an increase in quantity of 130,789 squares, and in value of $836,018. The increase in value of mill stock was from $673,115 in 1901 to $745,623 in 1902, or a gain of $72,508.

The increase in the average value per square of roofing slate produced in 1902 over that produced in 1901 is quite noticeable, the average value per square in 1902 being $3.45, while in 1901 the average value per square was $3.15. The highest average value in 1902 for a State production was $8 per square in Arkansas, and the lowest was $3.30 per square in Pennsylvania.

The following tables show the value of roofing and milled slate produced in the United States in 1901 and 1902, by States:

Value of roofing and mill slate produced in the United States in 1901 and 1902, by States.

1901.

State.	Roofing slate.		Value of milled stock.	Total value.
	Number of squares.	Value.		
California	2,500	$18,608		$18,608
Georgia	800	3,000		3,000
Maine	20,791	111,295	$91,030	202,325
Maryland	20,153	104,781	1,017	105,798
Minnesota			1,400	1,400
New Jersey	7,500	30,000		30,000
New York	15,786	91,805	9,155	100,960
Pennsylvania	853,028	2,591,625	392,639	2,984,264
Vermont	330,191	984,317	177,874	1,162,191
Virginia	53,630	178,979		178,979
Total	1,304,379	4,114,410	673,115	4,787,525

1902.

State.	Number of squares.	Value.	Value of milled stock.	Total value.
Arkansas	(a)	(a)		(a)
California	(a)	(a)		(a)
Georgia	(a)	(a)		(a)
Maine	26,468	$143,832	$62,726	$206,558
Maryland	22,569	117,155	929	118,084
New Jersey	(a)	(a)		(a)
New York	21,165	116,628	10,090	126,718
Pennsylvania	908,206	3,001,545	545,777	3,547,322
Vermont	400,029	1,338,817	126,101	1,464,918
Virginia	42,731	160,951		160,951
Other States [b]	14,000	71,500		71,500
Total	1,435,168	4,950,428	745,623	5,696,051

[a] Included in the statement for Other States.
[b] Includes Arkansas, California, Georgia, and New Jersey.

The following table shows the average value of roofing slate per square since 1890:

Average annual price per square of roofing slate for the entire country.

1890	$3.34	1897	$3.09
1891	3.49	1898	3.42
1892	3.56	1899	3.14
1893	3.55	1900	3.01
1894	3.11	1901	3.15
1895	3.23	1902	3.45
1896	3.36		

Value of slate produced in the United States, 1898-1902.

State.	1898.	1899.	1900.	1901.	1902.
Arkansas					(a)
California	$2,700	$6,642	$26,500	$18,608	(a)
Georgia	13,125		9,375	3,000	(a)
Maine	199,237	181,766	177,342	202,325	$206,558
Maryland	82,240	93,595	128,673	105,798	118,084
Massachusetts	958				
Minnesota	400		700	1,400	
New Jersey	800	(a)	13,600	30,000	(a)
New York	48,694	76,675	62,755	100,960	126,718
Pennsylvania	2,491,756	2,537,022	2,713,598	2,984,264	3,547,322
Tennessee		(a)	250		
Utah		(a)			
Vermont	732,684	872,673	917,462	1,162,191	1,464,918
Virginia	150,946	183,110	190,211	178,979	160,951
Other States		11,250			[b] 71,500
Total	3,723,540	3,962,733	4,240,466	4,787,525	5,696,051

[a] Included in Other States.
[b] Includes Arkansas, California, Georgia, and New Jersey.

EXPORTS.

The export trade in roofing slate, which rose so precipitately in value from $780,112 in 1897 to $1,370,075 in 1898, and which had decreased up to 1901, showed a slight increase in 1902. In 1902 the value of roofing slate exported, as shown in the figures of the Bureau of Statistics of the Department of Commerce and Labor, was $945,352, an increase of $47,090 over the value, $898,262, given for 1901. The chief exportation is to Great Britain, to which slate to the value of $731,556 was sent in 1902. In 1898 the value of roofing slate exported to Great Britain was $1,213,377. Exports of slate to British Australasia, which have been increasing for the last four years, are next in value, amounting to $79,319 in 1901 and to $121,921 in 1902. The exportation to Denmark is next. Beginning in 1898 with $8,150, the value of roofing slate exported to this country has since risen to $47,957 in 1902.

Most of this slate is shipped from New York, Philadelphia, Baltimore, and Boston.

The following table shows the ports and customs districts from which and to which slate has been exported since 1893:

Exports of slate from the United States, showing ports and customs districts from which and to which sent, from 1893 to 1901.

Port and customs district.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Baltimore, Md	......	......	......	$9,860	$101,581	$170,916	$99,083	$110,049	$135,571	$240,734
Bangor, Me	......	$445	......	350	....	....	....	577	1,144	449
Belfast, Me	......	......	......	......	....	....	....	....	....	375
Boston and Charlestown, Mass	$1,086	......	$443	609	1,020	385	40,622	65,531	93,972	48,299
Newport News, Va	......	......	......	......	18,170	65,290	42,220	19,950	12,910	6,650
New York, N. Y	36,306	19,684	31,092	242,559	557,099	986,638	968,395	592,288	388,590	374,264
Passamaquoddy, Me	......	......	192	......	120	....	....	....	....	164
Philadelphia, Pa	......	......	......	2,300	94,865	136,916	205,779	150,254	236,090	243,701
Portland and Falmouth, Me	......	......	......	......	270	....	....	....	....	....
Brazos de Santiago, Tex.	5	......	......	......	....	....	14	....	....	....
Corpus Christi, Tex	......	......	105	174	....	1,761	....	....	....	44
New Orleans, La	......	587	......	......	....	....	....	....	....	....
Paso del Norte, Tex	......	621	......	......	....	....	....	....	....	20
Puget Sound, Wash	......	......	......	......	....	22	67	....	1,436	1,343
San Diego, Cal	......	......	......	......	....	....	7	....	....	....
Arizona	......	......	......	......	....	....	....	....	20	790
Buffalo Creek, N. Y	13,428	13,696	4,748	5,903	2,378	4,141	6,364	6,584	19,193	18,014
Champlain, N. Y	869	1,869	1,961	1,617	613	3,015	937	2,320	2,446	6,561
Detroit, Mich	......	......	65	2,874	2,427	854	129	1,441	380	....
Huron, Mich	200	......	......	......	....	....	....	424	....	....
Memphremagog, Vt	......	......	......	......	....	....	....	....	644	246
North and South Dakota.	94	160	......	......	....	137	....	612	942	....
Oswegatchie, N. Y	......	......	......	......	....	....	....	487	4,915	3,702
Vermont	24	133	200	139	1,569	....	....	26	9	....
Total	52,012	37,195	38,806	266,385	780,112	1,370,075	1,363,617	950,543	898,262	945,352
Belgium	......	......	......	......	....	....	524	....	....	....
France	......	......	......	12,000	....	....	....	....	....	....
Germany	......	......	25	910	5,850	82,916	65,974	17,921	5,180	1,555
Netherlands	......	......	......	......	2,087	25	520	....	600	1,400
United Kingdom	1,400	4,800	3,000	197,440	695,980	1,213,377	1,188,962	813,918	727,088	731,556
Denmark	......	......	......	......	....	8,150	25,323	25,437	43,344	47,957
Norway and Sweden	......	......	......	......	....	270	669	859	1,857	25
Bermuda	1,046	336	1,550	2,312	1,395	157	230	202	3,222	443
Dominion of Canada:										
Nova Scotia, New Brunswick, etc	119	445	406	1,278	730	....	288	798	1,269	532
Quebec, Ontario, etc.	14,615	15,858	6,974	10,533	6,977	8,147	7,430	11,894	27,587	28,600
British Columbia	......	......	......	......	....	22	67	....	2,378	1,343
Newfoundland and Labrador	32	......	13	......	....	....	....	30	....	....
Central American States:										
Costa Rica	......	......	......	......	....	....	....	....	....	1,268
Guatemala	......	......	......	......	....	1,755	....	....	....	....
Honduras	......	587	......	......	....	....	....	....	....	....
Mexico	22	621	488	821	150	1,872	330	....	20	854
Miquelon, Langley, etc.	......	......	......	......	....	35	....	....	60	....
West Indies:										
British	......	3,803	4,419	1,159	1,860	2,356	1,400	2,049	1,067	6,609
Haiti	......	330	......	......	....	26	....	332	....	....

Exports of slate from the United States, showing ports and customs districts from which and to which sent, from 1893 to 1901—Continued.

Port and customs district.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Santo Domingo	......	......	$10	......	....	....	....	....	....	....
Cuba	......	$2,643	3,258	$90	....	$673	$16	....	....	....
Colombia	......	......	......	259	$100	....	....	$285	....	....
Guianas:										
British	......	712	702	440	165	600	....	....	....	....
Dutch	$3,145	......	340	......	1,640	1,325	2,275	650	....	$365
Peru	405	......	......	......	....	....	....	1,000	....	....
Uruguay	......	......	......	417	....	807	760	829	$424	195
China	......	......	......	......	....	110	....	....	....	....
East Indies—British	......	......	......	1,628	810	550	....	....	....	50
British Australasia	30,362	7,060	17,363	34,970	60,604	44,642	64,434	71,881	79,319	121,921
Hawaiian Islands	......	......	......	245	166	....	77	....	....	....
British Africa	866	......	258	1,883	1,598	2,218	4,335	2,458	4,847	679
Portuguese Africa	......	......	......	......	....	42	3	....	....	....
Total	52,012	37,195	38,806	266,385	780,112	1,370,075	1,363,617	950,543	898,262	945,352

MARBLE.

The marble production of 1902 was valued at $5,044,182. This is $78,483 more than the value of the production of 1901, which was $4,965,699. The production in Arkansas, California, Maryland, Massachusetts, Montana, New York, Oregon, Pennsylvania, Tennessee, Utah, and Washington increased in value, while the production of Georgia, New Mexico, and Vermont decreased slightly. Alabama and Connecticut, reporting no production in 1901, showed an output in 1902; and Alaska and Arizona reported no production in 1902. The production of Missouri and Oregon was small, and is included with the limestone figures for those States.

The following tables show the purposes for which the marble of the various producing States was sold by the quarrymen in 1901 and 1902:

Value of the marble product, by uses and States, 1901 and 1902.

1901.

State.	Rough.	Building.	Ornamental.	Monumental.	Interior.	Other.	Total.
Alabama							
Alaska	$4,500						$4,500
Arizona	300						300
Arkansas	200		$100				300
California	3,280	$1,550	1,812				6,642
Connecticut							
Georgia	268,761	241,683	16,500	$207,305	$166,300	$36,000	936,549
Iowa							
Maryland	8,100	45,000		15,000			68,100
Massachusetts	63,556	26,220	3,700	9,560	15,051	8,459	126,546
Missouri				2,100			2,100
Montana				1,500			1,500
New Mexico	4,200	3,000	300	3,100			10,600
New York	2,367	132,943	4,900	204,289	28,000	6,660	379,159
Oregon				500			500
Pennsylvania	18,078	111,069		25,060	400	2,940	157,547
Tennessee	162,513	13,000		14,000	305,124		494,637
Utah	320						320
Vermont	53,892	659,200	94,450	1,452,434	493,607		2,753,583
Washington	1,600	2,358	4,814	14,044			22,816
Total	591,667	1,236,023	126,576	1,948,892	1,008,482	54,059	4,965,699

Value of the marble product, by uses and States, 1901 and 1902—Continued.

1902.

State.	Rough.			Dressed.					Other purposes	Total.
	Building.	Monumental.	Other.	Building.	Monumental.	Ornamental.	Interior decoration.	Other purposes.		
Alabama	....	......	......	....	......	......	......	......	......	(a)
Alaska	....	......	......	....	......	......	......	......	......	....
Arizona	....	......	......	....	......	......	......	......	......	....
Arkansas	....	......	......	....	......	......	......	......	......	(a)
California	$13,400	$98	$19,700	....	$4,000	$100	$55,000	......	......	$92,298
Connecticut	....	......	......	....	......	......	......	......	......	(a)
Georgia	350,000	166,017	81,000	$50,000	7,500	......	6,000	......	......	660,517
Maryland	....	......	......	....	......	......	......	......	......	(a)
Massachusetts	51,695	......	......	81,394	......	6,000	15,056	......	$11,344	165,489
Missouri[b]	....	......	......	....	......	......	......	......	......	....
Montana	....	......	......	....	......	......	......	......	......	(a)
New Mexico	....	......	......	....	......	......	......	......	......	(a)
New York	83,230	75,342	8,433	267,013	143,080	200	......	......	......	577,298
Oregon[b]	....	......	......	....	......	......	......	......	......	....
Pennsylvania	22,446	......	......	110,977	24,000	......	......	......	3,000	160,423
Tennessee	227,337	26,000	4,500	....	9,000	......	240,419	$11,000	......	518,256
Utah	....	......	......	....	......	......	......	......	......	(a)
Vermont	353,534	677,528	25,070	433,265	758,390	......	321,689	58,688	......	2,628,164
Washington	7,000	......	......	31,873	......	......	19,200	1,000	......	61,176
Other States[c]	36,997	40,819	2,103	63,780	10,900	1,000	22,549	336	1,000	180,561
Total	1,146,639	985,804	3,180	1,038,302	956,870	7,300	679,913	71,024	15,241	5,044,182

[a] Includes Alabama, Arkansas, Connecticut, Maryland, Montana, New Mexico, and Utah.
[b] Production of Missouri and Oregon included under report on limestone.
[c] Included in Other States.

The following table shows the value of the marble produced in the United States from 1898 to 1902, inclusive, by States:

Value of marble, by States, from 1898 to 1902, inclusive.

State.	1898.	1899.	1900.	1901.	1902.
Alabama	....	....	$500	....	(a)
Alaska	....	....	....	$4,500	....
Arizona	....	....	5,000	300	....
Arkansas	....	$3,410	....	300	(a)
California	$40,200	6,500	17,500	6,642	$92,298
Colorado	....	10,776	....	....	....
Connecticut	....	....	....	....	(a)
Georgia	656,808	742,554	631,241	936,549	660,517
Idaho	4,400	....	1,250	....	....
Maryland	120,525	77,000	70,000	68,100	(a)
Massachusetts	38,210	59,416	130,735	126,546	165,489
Missouri	....	....	900	2,100	....
Montana	....	....	1,200	1,500	(a)
New Mexico	....	....	4,500	10,600	(a)
New York	342,072	338,816	332,518	379,159	577,298
Oregon	....	....	....	500	....

[a] Included in Other States.

Value of marble, by States, from 1898 to 1902, inclusive—Continued.

State.	1898.	1899.	1900.	1901.	1902.
Pennsylvania	$39,373	$139,506	$151,167	$157,547	$160,423
Tennessee	316,814	[a] 384,705	424,054	494,637	518,256
Utah	....	2,355	....	320	([b])
Vermont	2,067,938	2,241,806	2,484,852	2,753,583	2,628,164
Washington	3,600	4,837	11,836	22,816	61,176
Other States	....	....	....	....	[c] 180,561
Total	3,629,940	4,011,681	4,267,253	4,965,699	5,044,182

[a] Contains small amount from North Carolina.
[b] Included in Other States.
[c] Includes Alabama, Arkansas, Connecticut, Maryland, Montana, New Mexico, and Utah.

The following table shows the various uses to which the marble quarried in 1898, 1899, 1900, 1901, and 1902 was put:

Distribution and value of output of marble in 1898, 1899, 1900, 1901, and 1902 among various uses.

Use.	1898.	1899.	1900.	1901.	1902.
Sold by producers in rough state	$690,240	$640,535	$491,813	$591,667	$2,276,629
Dressed for building	968,353	1,176,208	1,080,969	1,236,023	1,038,102
Ornamental purposes	23,904	92,942	13,754	126,576	7,300
Dressed for monumental work	1,613,742	1,650,155	2,019,474	1,948,892	956,870
Interior decoration in buildings	304,714	389,040	555,092	1,008,482	679,913
Other uses	28,987	62,801	106,151	54,059	85,268
Total	3,629,940	4,011,681	4,267,253	4,965,699	5,044,182

LIMESTONE.

The limestone production in the United States in 1902, including limestone for blast-furnace flux, was valued at $30,231,003. In 1901 the value was $26,406,897, a gain in 1902 of $3,824,106. In 1901 the increase over the value for 1900, which was $20,354,019, was $6,052,878. This shows that, although there was a considerable gain in the production for 1902, the increase was very much less than the increase for the previous year.

Of the 42 States reporting a production in 1902, 29 showed an increase in value of output, and 13 a decrease. In 1901, 41 States reported, 35 with increased production, and 6 with decreased production. In order of importance Pennsylvania, Illinois, Ohio, Indiana, New York, Missouri, and Wisconsin give the largest value of production. The output of these States for 1902 was as follows: Pennsylvania, $5,420,287; Illinois, $3,222,608; Ohio, $3,201,718; Indiana, $2,865,691; New York, $2,419,121; Missouri, $1,697,139; and Wisconsin, $1,351,058.

In 1901 the rank and production was: Pennsylvania, $5,081,387; Indiana, $2,993,186; Illinois, $2,793,837; Ohio, $2,606,502; New York, $1,738,716; Missouri, $1,362,272, and Wisconsin, $1,225,448. From this it will be seen that while Pennsylvania kept first rank for both years, Indiana went from second place in 1901 to fourth place in 1902, Illinois from third to second, Ohio from fourth to third, and that the other States remained the same, New York fifth, Missouri sixth, and Wisconsin seventh.

The State next to these in rank in 1902 was Minnesota, with a production of $830,857, and in 1901 Iowa with a production of $777,484.

According to the uses to which the stone was put in 1902, the ranking States and the values of production were: Building stone, Indiana, $1,813,577, and Illinois, $640,443; flagstone, Indiana, $75,659, and Illinois, $70,491; curbstone, Indiana, $117,077, and Wisconsin, $50,251; lime, Pennsylvania, $1,329,095, and Ohio, $1,082,277; crushed stone, Illinois, $1,220,772; Pennsylvania, $1,136,832, and New York, $1,085,-458; limestone for flux, Pennsylvania, $2,461,426; Ohio, $630,325, and West Virginia, $268,059.

Under stone used for "other purposes" is included stone for chemical purposes, marble dust, paving stone, monumental stone, limestone used by glass factories and by sugar factories, and for various purposes not enumerated.

The total value of the limestone used for building stone increased from $5,219,310 in 1901 to $5,563,084 in 1902, or $343,774; the value of lime increased from $8,204,054 in 1901 to $9,335,618, or $1,131,564; the value of crushed stone increased from $5,271,642 in 1901 to $7,152,730 in 1902, or $1,881,088; the value of blast-furnace flux from

9,319,672 long tons (estimated), valued at $4,659,836 in 1901 to 12,139,248 long tons, valued at $5,271,252 in 1902, a gain in value of $611,416.

The following tables show the value of the production of limestone in the United States in 1901 and 1902, by States and uses:

Value of the production of limestone in the United States in 1901 and 1902, by States and uses.

1901.

State or Territory.	Building purposes.	Flagging and curbing.	Riprap rubble, etc.	Crushed stone.		
				Road making.	Railroad ballast.	Concrete.
Alabama	$42,695		$225			$2,500
Arkansas	3,466	$1,020	320	$1,000		
California	1,500		6,366	145,225	$60,900	5,023
Colorado			3,141	100		
Florida			6,250	3,670	2,750	
Georgia	3,000				9,860	3,721
Idaho	100		520			25
Illinois	384,949	101,410	477,435	452,143	478,452	225,151
Indiana	2,123,237	149,363	61,526	181,696	29,042	15,002
Iowa	272,501	8,117	85,342	83,055	30,562	70,285
Kansas	290,730	16,872	27,147	14,329	107,904	15,050
Kentucky	59,425	10,697	5,500	60,423	29,622	9,370
Maryland	14,138	1,796	420	43,887	8,000	1,776
Massachusetts	7,224		453			150
Michigan	47,785	380	5,098	31,605	18,200	75,643
Minnesota	375,308	20,773	39,477	17,918	200	2,150
Missouri	377,146	73,197	56,345	105,435	116,293	73,742
Montana	7,336	30	1,000			
Nebraska	44,015	810	26,312	10,904	5,025	51,380
New Jersey	2,460	61	750	1,275	650	
New York	265,024	5,055	13,997	188,277	146,077	293,530
North Carolina				4,668		
Ohio	341,389	13,869	41,451	489,940	299,599	64,347
Oklahoma	4,147	2,716	600	9	24,525	
Oregon				12,000		100
Pennsylvania	192,972	7,321	29,291	221,032	273,260	252,603
South Carolina				1,000		
South Dakota	225					
Tennessee	40,258	775	2,915	1,760	35,425	4,935
Texas	45,630	3,117	7,215	3,900		5,350
Utah	6,629			23		
Vermont	64			610		
Virginia	2,270		27,650	100	695	2,065
Washington						840
West Virginia		25		125	75,000	
Wisconsin	263,687	46,571	97,213	222,177	6,500	40,052
Wyoming			100			25
Total	5,219,310	463,975	1,024,059	2,298,286	1,758,541	1,214,815

Value of the production of limestone in the United States in 1901 and 1902, by States and uses—Continued.

1901—Continued.

State or Territory.	Lime.	Sold to lime burners.	Flux.	Other purposes.	Total.
Alabama	$201,586	$150	$354,267	$18,000	$619,423
Arizona	300				300
Arkansas	62,163	350			68,319
California	343,625	2,836	47,830	32,150	645,455
Colorado	102,466	4,480	121,839	13,773	245,799
Connecticut	139,374	38	1,012		140,424
Florida	39,150	50			51,870
Georgia	65,888		3,160		85,629
Idaho	20,606				21,251
Illinois	504,018		193,729	66,550	2,793,887
Indiana	223,340	1,200	193,469	15,311	2,993,186
Iowa	221,760			7,862	777,484
Kansas	6,550			604	478,986
Kentucky	12,290		6,998	5,242	199,567
Maine	709,251	500	5,521		715,272
Maryland	307,677	4,007	700		382,581
Massachusetts	234,261		1,843	108	244,089
Michigan	136,160	156,175	13,488	101,399	565,931
Minnesota	57,277			9,675	522,778
Missouri	546,549		7,607	5,958	1,362,272
Montana	22,250		113,250		143,866
Nebraska	500	4,281	10,640	550	154,717
New Jersey	62,707	1,708	40,587	199,540	309,738
New York	631,358	46,327	16,190	172,881	1,738,716
North Carolina	3,598				5,266
Ohio	726,883	24,822	550,346	53,856	2,606,502
Oklahoma				500	32,497
Oregon	12,420				24,520
Pennsylvania	1,249,996	151,104	2,243,692	460,118	5,081,387
Rhode Island	37,798		232		38,030
South Carolina	27,500				28,500
South Dakota	13,830		29,725		53,780
Tennessee	181,219		62,840	1,000	330,927
Texas	93,587		50,294	565	209,658
Utah	36,910		34,588	750	78,900
Vermont	204,400		64		205,158
Virginia	220,813		243,585	42,750	539,128
Washington	210,541	6,192	16,514	700	234,587
West Virginia	10,797		352,344		447,049
Wisconsin	522,661		23,682	2,905	1,225,448
Wyoming	1,215				1,340
Total	8,204,054	592,976	4,659,836	1,171,045	26,406,897

Value of the production of limestone in the United States in 1901 and 1902, by States and uses—Continued.

1902.

State or Territory.	Building purposes.	Flagging.	Curbing.	Lime made.	Stone sold to lime burners.	Crushed stone.		
						Road making.	Railroad ballast.	Concrete.
Alabama	$37,358		$1,275	$235,568		$7,890	$2,500	$2,500
Arkansas	1,900		1,500	82,853		15,510	7,000	
California	17,250		250	395,995		900	1,625	24,375
Colorado				46,345	$521			
Connecticut				203,899				
Florida	11,000			37,963		9,658	1,350	
Georgia	4,295	$17,500		71,724			12,310	
Idaho				13,049				
Illinois	640,443	70,491	39,296	485,644		588,796	399,537	232,439
Indiana	1,813,577	75,659	117,077	312,189		180,188	55,740	38,563
Iowa	195,009	6,893	2,374	114,051	95	103,074	21,298	29,000
Kansas	175,374	7,315	5,675	7,358		18,598	354,721	10,585
Kentucky	124,467	1,305	45,773	15,893		125,048	176,032	26,137
Maine				742,132				
Maryland	16,953		1,575	326,417	5,834	74,205	17,161	4,600
Massachusetts	12,378			324,480				1,093
Michigan	58,707	200	489	208,232	98,000	56,261	40,810	49,430
Minnesota	451,368	25,481	7,260	75,870	1,344	65,744		62,500
Missouri	429,115	536	32,444	515,780		193,327	141,185	168,229
Montana	6,375	1,400		8,775				
Nebraska	46,910	150	85	150	400	15,050	12,510	25,182
Nevada				2,800				
New Jersey	4,450			123,478				580
New York	480,141	3,420	857	561,228	43,531	514,916	267,189	302,489
North Carolina				2,090		21,063		
Ohio	329,808	5,604	4,718	1,082,277	62,218	454,170	317,281	180,300
Oklahoma	22,562	7,783	4,540	25			9,000	
Oregon				20,133				
Pennsylvania	209,215	3,971	4,572	1,429,643	16,690	215,533	575,244	358,578
Rhode Island South Carolina				70,124			350	
South Dakota	775			21,300				9,600
Tennessee	57,399	180	3,257	235,615		8,878	56,317	5,518
Texas	69,327	6,620	8,700	82,500			400	18,593
Utah	3,960			99,463		400		
Vermont	4,500			219,306		1,387		
Virginia	41,355			241,984			7,875	11,580
Washington				186,070				
West Virginia	25	400		181,608	8,760	1,455	153,696	2,200
Wisconsin	296,998	6,780	50,251	549,357		218,934	29,950	36,593
Wyoming	90			2,250				
Total	5,563,084	241,688	331,968	9,335,618	237,393	2,890,985	2,661,081	1,600,664

Value of the production of limestone in the United States in 1901 and 1902, by States and uses—Continued.

1902—Continued.

State or Territory.	Rubble.	Riprap.	Flux.	Other purposes.	Total.
Alabama	$1,735	$5,726	$465,065		$759,617
Arkansas		4,350		$50	113,163
California	5,250	1,400	5,250	44,548	496,843
Colorado			155,484	1,350	203,700
Connecticut			1,472		205,371
Florida		3,600			63,571
Georgia			5,760		111,589
Idaho			2,025		15,074
Illinois	353,699	154,624	214,881	42,758	3,222,608
Indiana	37,916	15,346	187,265	32,171	2,865,691
Iowa	144,339	32,588		1,263	649,984
Kansas	79,769	9,292		1,849	670,536
Kentucky		22,500	15,487	41,105	593,747
Maine			1,000	2,000	745,132
Maryland		22	3,263	3,000	453,030
Massachusetts			1,398		339,349
Michigan	3,101	5,740	32,246	68,164	621,380
Minnesota	106,693	33,447		1,150	830,857
Missouri	147,151	43,998	14,065	11,309	1,697,139
Montana	175		88,000		104,725
Nebraska	24,114	16,515	4,407		145,473
Nevada					2,800
New Jersey			53,142		181,650
New York	95,026	5,806	92,849	51,669	2,419,121
North Carolina					23,153
Ohio	32,163	46,786	630,325	56,068	3,201,718
Oklahoma	4,570			2,061	50,541
Oregon					20,133
Pennsylvania	4,419	42,092	2,461,426	98,904	5,420,287
Rhode Island South Carolina			1,190		71,664
South Dakota	180		54,750		86,605
Tennessee	3,045	2,264	108,860	700	482,033
Texas	8,765	2,325	23,432	8,000	228,662
Utah			82,810		186,663
Vermont	385		125		225,703
Virginia			220,001	11,318	534,113
Washington			22,239	5,505	213,814
West Virginia		163	268,059		616,366
Wisconsin	44,234	59,573	50,946	7,442	1,351,058
Wyoming			4,000		6,340
Total	1,096,729	508,157	5,271,252	492,384	30,231,003

The following table shows the production of limestone in the United States from 1898 to 1902, by States:

Value of limestone, 1898–1902, by States.

State.	1898.	1899.	1900.	1901.	1902.
Alabama	$242,295	$364,636	$533,608	$619,423	$759,617
Arizona	1,782	960	165	300	....
Arkansas	54,373	71,965	71,407	68,319	113,163
California	229,729	287,295	407,489	645,455	496,843
Colorado	109,310	96,456	160,587	245,799	203,700
Connecticut	142,057	162,388	148,060	140,424	205,371
Florida	91,330	44,002	128,381	51,870	63,571
Georgia	57,803	29,786	54,451	85,629	111,589
Idaho	3,080	3,325	34,587	21,251	15,074
Illinois	1,421,072	2,065,483	1,881,151	2,793,837	3,222,608
Indiana	1,686,572	2,173,833	2,344,818	2,993,186	2,865,691
Iowa	524,546	785,576	586,410	777,484	649,984
Kansas	305,605	379,001	339,466	478,986	670,536
Kentucky	83,960	178,861	178,252	199,567	593,747
Maine	1,283,468	1,028,375	691,312	715,272	745,132
Maryland	433,653	235,225	317,207	382,381	453,030
Massachusetts	174,822	168,147	209,359	244,039	339,349
Michigan	271,523	371,210	425,636	565,931	621,380
Minnesota	345,685	496,462	411,554	522,778	830,857
Missouri	735,275	977,399	1,079,343	1,362,272	1,697,139
Montana	63,196	113,718	141,093	143,866	104,725
Nebraska	78,493	125,017	107,305	154,717	145,473
Nevada	....	....	....	....	2,800
New Jersey	146,611	153,025	170,006	309,738	181,650
New York	1,533,936	1,545,699	1,730,162	1,738,716	2,419,121
North Carolina	1,605	....	....	8,266	23,153
Ohio	1,673,160	1,793,604	1,969,387	2,606,502	3,201,718
Oklahoma	3,000	50,550	25,586	32,497	50,541
Oregon	7,480	8,000	10,900	24,520	20,133
Pennsylvania	2,746,256	3,088,583	3,800,318	5,081,387	5,420,287
Rhode Island	10,215	18,239	16,828	38,030	71,664
South Carolina	34,000	17,650	38,415	28,500	
South Dakota	26,858	45,808	47,762	53,780	86,605
Tennessee	182,402	208,097	238,505	330,927	482,033
Texas	70,321	100,025	124,728	209,658	228,662
Utah	11,721	6,381	12,749	78,900	186,663
Vermont	174,150	282,173	188,100	205,138	225,703
Virginia	182,852	255,640	403,318	539,128	534,113
Washington	140,239	139,339	249,163	234,587	213,814
West Virginia	56,167	58,802	53,701	447,049	616,366
Wisconsin	698,454	826,486	989,685	1,225,448	1,351,058
Wyoming	....	742	3,065	1,340	6,340
Total	16,039,056	18,757,963	20,354,019	26,406,897	30,231,003

The following table shows the quantity and value of the blast-furnace flux produced in 1902, by States:

Production of blast-furnace flux in 1902, by States.

State.	Quantity.	Value.	State.	Quantity.	Value.
	Long tons.			*Long tons.*	
Alabama	1,001,884	$465,065	New York	178,019	92,849
California	3,500	5,250	Ohio	1,559,933	630,325
Colorado	402,735	155,484	Pennsylvania	5,645,857	2,461,426
Connecticut	2,942	1,472	Rhode Island	950	1,190
Georgia	14,400	5,760	South Dakota	97,768	54,750
Idaho	2,025	2,025	Tennessee	284,895	108,860
Illinois	483,348	214,881	Texas	33,393	23,432
Indiana	438,717	187,265	Utah	113,194	82,840
Kentucky	36,354	15,487	Vermont	250	125
Maine	2,000	1,000	Virginia	565,704	220,001
Maryland	3,654	3,263	Washington	23,917	22,239
Massachusetts	2,732	1,398	West Virginia	740,901	268,059
Michigan	58,567	32,246	Wisconsin	89,309	50,946
Missouri	25,115	14,065	Wyoming	10,000	4,000
Montana	198,000	88,000			
Nebraska	8,814	4,407	Total	12,139,248	5,271,252
New Jersey	110,371	53,142			

This is the first attempt that has been made to collect the statistics of the quantity of stone used by blast furnaces; the estimates formerly used were based on an average value of 50 cents per ton. This value has, however, been found to be rather high for some localities. The figures here given were obtained directly from the quarry, whether the quarries were owned by the blast-furnace operator or whether the stone was sold to the furnace. The value given is the value of the stone at the quarry.

CLAY-WORKING INDUSTRIES.

By Jefferson Middleton.

INTRODUCTION.

With the exception of the section on clay production, this report deals with the products of the clay-working industries and hence the tables are made up to show the products of clay and not the production of clay.

During the year under review, 1902, the unprecedented prosperity of 1901, chronicled in this report for that year, was in general continued as shown by the tables appended, though in some localities labor troubles may have interferred to some extent with the building trades, and in some regions, also, local conditions, such as the increased cost of fuel, seem to have curtailed the output of clay products. At the beginning of the year the prospects for continued prosperity were excellent, and they were probably fully realized. The number of firms reporting decreased from 6,421 in 1901 to 6,045 in 1902, a decrease of 376, or 5.86 per cent, but the product reported by these operators increased from $110,211,587 in 1901 to $122,169,531 in 1902, a gain of $11,957,944, or 10.85 per cent. This decrease in number of firms reporting can only be accounted for by the fact that many individual firms have combined and reported as one plant, as no plants of importance which reported in 1901, except one in Texas, are delinquent in 1902. This is further shown by the fact that the average value of the output per plant increased from $17,164 in 1901 to $20,210 in 1902. In 1900 the average value per plant reporting was $14,859. However, the remarkable advance in the cost of labor and building materials generally, which began in 1900, had not reached the stage realized in 1903 and does not seem to have had a very serious effect on the clay-working industries during 1902, though the gain of 1902 over 1901 was $2,041,298 less than the gain of 1901 over 1900. In other words, it is probable that the rise in the cost of labor and materials prevented the product from rising to something over $126,000,000.

The great coal strike of 1902 had in all probability but little direct effect on the brick and tile industry, though the pottery industry in the eastern States, where considerable anthracite coal is used, may have suffered to some extent from the strike. The increased cost of fuel which followed the strike will undoubtedly make itself felt in the brick and tile industry in the increased cost to the consumer.

One of the most significant features of the year was the successful installation of several plants for the manufacture of sand-lime brick. At the close of the year there were three or four plants of this character in operation in different sections of the country, with the prospect of a large increase in their number in the near future. There seems to be no doubt that the manufacture of this class of brick will be successfully carried on in many localities. It is equally certain that sand-lime brick will not wholly displace clay brick.

ACKNOWLEDGMENTS.

The publication of these figures would have been impossible without the cooperation of the clay workers of the country, to whom cordial thanks are hereby tendered. Mr. D. V. Purington has again been of material assistance in securing returns for Cook County, Ill., and the thanks of the writer are extended to him for this aid. Thanks are also extended to the officials in many of the cities who have supplied the information concerning the building operations of the principal cities of the country.

As in previous years, the State geological surveys of Iowa, Maryland, and North Carolina have cooperated in the collection of the figures for their States. The complete returns for these States are due to the efforts of the officers of the respective State geological surveys.

BUILDING OPERATIONS.

The following table shows the number of building permits and the value of the buildings erected under these permits in the leading cities of the United States in 1901 and 1902. These figures are from official sources, having been furnished in every case by the city officers in charge of the building departments. It will be noted that the figures for 1901 have been changed somewhat by the addition of four more cities, and also that there are changes in the figures for some of those published in the 1901 report, notably in those for New York City, where it was discovered that the figures published last year for this city covered also the city of Brooklyn and the Bronx. An effort was made to obtain figures for new buildings only, but it has been found that in so few of the cities are the records kept in such a manner as to segregate the permits for new buildings from permits for repairs that these figures cover both new buildings and repairs. Nor is it possible to separate the brick and stone buildings from those built of wood, but it is safe to assume that practically all permits in the larger cities are for brick or stone buildings and that in the smaller cities many of the buildings erected are of wood.

Building operations in the leading cities of the United States in 1901 and 1902.

City.	1901. Number of permits.	1901. Cost of buildings.	1902. Number of permits.	1902. Cost of buildings.
Allegheny, Pa	666	$1,510,750	642	$2,206,150
Atlanta, Ga	2,695	2,852,148	2,818	1,868,593
Baltimore, Md	1,300	4,599,318	1,525	3,752,411
Boston, Mass	1,023	12,923,059	1,073	10,147,055
Brooklyn, N.Y. [a]	1,994	18,198,617	2,009	18,548,062
Buffalo, N.Y	1,058	4,338,771	2,109	5,433,078
Cambridge, Mass	567	1,400,310	607	2,232,365
Chicago, Ill	6,053	34,962,075	6,099	48,242,990
Cincinnati, Ohio	2,669	3,505,450	2,571	4,669,585
Cleveland, Ohio	3,036	6,235,782	3,172	6,559,545
Columbus, Ohio	1,139	1,934,827	1,389	2,706,315
Dayton, Ohio	1,048	905,283	1,200	1,364,610
Denver, Colo	1,553	4,011,945	1,667	4,551,151
Detroit, Mich	2,764	5,961,600	2,576	5,496,500
Fall River, Mass	266	900,000	342	1,481,350
Grand Rapids, Mich	579	891,984	1,045	1,332,095
Hartford, Conn	733	2,612,100	621	1,105,000
Indianapolis, Ind	2,546	3,744,969	2,764	2,989,753
Jersey City, N.J	492	1,803,823	948	2,491,817
Kansas City, Mo	1,477	4,370,090	3,979	8,054,248
Los Angeles, Cal	2,826	4,376,917	4,863	9,603,132
Louisville, Ky	1,451	1,755,505	1,835	2,828,457
Memphis, Tenn	2,357	2,865,295	2,480	2,119,324
Milwaukee, Wis	1,484	5,024,695	2,141	5,655,423
Minneapolis, Minn	3,317	6,020,967	1,593	5,303,710
Nashville, Tenn	4,741	969,113	5,723	1,160,199
Newark, N.J	1,189	8,933,227	1,301	9,044,162
New Haven, Conn	260	1,674,010	276	847,680
New Orleans, La	1,797	2,247,191	1,707	2,916,262
New York, N.Y. [b]	5,594	123,121,406	2,877	89,882,778
Omaha, Nebr	640	1,196,699	561	1,626,045
Philadelphia, Pa	1,452	21,847,110	1,481	23,334,385
Pittsburg, Pa	3,092	17,911,682	2,405	15,811,728
Providence, R.I	793	4,028,575	671	2,554,050
Reading, Pa	627	1,272,050	533	1,072,600
Richmond, Va	254	1,020,000	330	1,193,000
Rochester, N.Y	592	1,868,571	812	2,913,142
St. Joseph, Mo	835	1,020,797	785	1,039,664
St. Louis, Mo	3,722	13,207,991	4,502	12,854,036
St. Paul, Minn. [c]	1,373	4,261,400	1,289	5,151,480
San Francisco, Cal	1,666	8,502,804	1,670	14,001,472
Scranton, Pa	614	1,776,768	820	1,534,342
Seattle, Wash	2,879	4,569,268	2,980	5,471,620
Syracuse, N.Y	325	1,406,439	284	1,075,900
Washington, D.C	1,057	5,106,031	1,111	6,736,607
Worcester, Mass	434	1,773,492	366	1,654,395
Total	79,029	365,420,904	84,555	362,618,266

[a] Figures for Brooklyn cover borough of Brooklyn only.
[b] Figures for New York cover the boroughs of Manhattan and the Bronx.
[c] Includes $948,989 in 1901 expended on public buildings, both State and Federal.

From this table it will be seen that the 46 cities reporting show that the number of permits issued in 1902 was 84,555 as compared with 79,029 in 1901, a gain of 5,526, or 6.99 per cent. The value of the buildings erected under these permits was $362,618,266 in 1902 as compared with $365,420,904 in 1901, a loss of $2,802,638, or 0.77 per cent. The average value of the buildings, assuming that one permit was issued for each building, was $4,624 in 1901, and $4,289 in 1902. The most notable feature of this table is the falling off both in the number of permits and in the value of the buildings in New York City. The former fell from 5,594 in 1901 to 2,877 in 1902, a decrease of nearly 50 per cent, and the value of the buildings declined from $123,121,406 to $89,882,778, a loss of $33,238,628, or 27 per cent. It will be noted that many of the large Atlantic seaboard cities show a considerable decrease, namely, Baltimore, from $4,599,318 in 1901, to $3,752,411 in 1902; Boston, from $12,923,059 in 1901 to $10,147,055 in 1902; Hartford, from $2,612,100 in 1901 to $1,105,000 in 1902; Providence, from $4,028,575 in 1901 to $2,554,050 in 1902. On the other hand other cities in the same region, such a Brooklyn, Cambridge, Jersey City, Newark, and Philadelphia show increases. Hence the conclusion must be drawn that building activity is governed largely by local conditions. It should be noted, however, that nearly all cities in the West show large increases in building. The average value per building in New York in 1901 was $22,010 and in 1902, $31,242, while in Philadelphia the average in 1901 was $15,046, and in 1902 $15,756. The average in Chicago was $5,776 in 1901 and $7,910 in 1902.

PRODUCTION.

In the following tables will be found statements of the values of the clay products in the United States in 1901 and 1902, by States and Territories.

Value of the products of clay in the United States in 1902, by States.

State.	Brick and tile.	Pottery.	Total.
Alabama	$989,865	$26,499	$1,016,364
Arizona	114,608	....	114,608
Arkansas	510,728	9,450	520,178
California	2,201,489	51,607	2,253,096
Colorado	2,166,668	34,315	2,200,983
Connecticut	[a] 1,100,781	[b] 116,897	[a] 1,217,678
Delaware	144,934	....	144,934
District of Columbia	258,430	9,197	267,627
Florida	175,442	(c)	175,442
Georgia	1,491,830	16,839	1,508,669
Hawaii	(d)	....	(d)
Idaho	93,048	....	93,048
Illinois	9,187,426	694,414	9,881,840
Indiana	4,628,449	655,284	5,283,733
Indian Territory	167,674	....	167,674
Iowa	2,797,949	45,387	2,843,336
Kansas	1,221,588	(c)	1,221,588
Kentucky	1,736,000	137,043	1,873,043
Louisiana	642,424	(c)	642,424
Maine	656,648	(c)	656,648
Maryland	1,380,062	525,300	1,905,362
Massachusetts	2,075,212	300,455	2,375,667
Michigan	1,660,942	83,098	1,744,040
Minnesota	1,513,006	370,725	1,883,731
Mississippi	501,785	14,424	516,209
Missouri	5,112,901	53,513	5,166,414
Montana	278,727	(c)	278,727
Nebraska	757,668	....	757,668
Nevada	45,600	....	45,600
New Hampshire	887,124	(c)	887,124
New Jersey	6,420,304	6,192,959	12,613,263
New Mexico	68,879	....	68,879
New York	7,484,682	929,431	8,414,113
North Carolina	781,009	14,512	795,521
North Dakota	141,214	....	141,214
Ohio	13,730,610	10,519,138	24,249,748
Oklahoma	235,975	....	235,975
Oregon	[e] 318,604	(c)	[e] 318,604
Pennsylvania	15,957,160	1,876,265	17,833,425
Rhode Island	(f)	....	(f)
South Carolina	596,706	16,805	613,511
South Dakota	63,425	....	63,425
Tennessee	862,427	50,698	913,125
Texas	1,595,612	98,202	1,693,814
Utah	353,255	5,750	359,005
Vermont	78,886	....	78,886
Virginia	1,573,842	3,991	1,577,833
Washington	891,877	13,354	905,231
West Virginia	1,352,080	1,166,464	2,518,544
Wisconsin	1,014,373	12,285	1,026,658
Wyoming	22,150	....	22,150
Other States	....	[g] 83,152	[g] 83,152
Total	98,042,078	24,127,453	122,169,531
Per cent of total	80.25	19.75	100.00

[a] Includes Rhode Island.
[b] Produced by Connecticut alone.
[c] Included in Other States.
[d] Included in Oregon.
[e] Includes Hawaii.
[f] Included in Connecticut.
[g] Comprising pottery totals for the following States: Florida, Kansas, Louisiana, Maine, Montana, New Hampshire, and Oregon. This total could not be distributed among the States to which it belongs without disclosing the operations of individual establishments.

Value of products of clay in the United States in 1901, by States.

State.	Brick and tile.	Pottery.	Total.
Alabama	$928,429	$18,362	$946,791
Arizona	92,986		92,986
Arkansas	395,858	11,405	407,263
California	1,735,721	33,434	1,769,155
Colorado	1,568,167	26,700	1,594,867
Connecticut	[a] 1,039,709	[b] 91,200	[a] 1,130,909
Delaware	131,164		131,164
District of Columbia	311,129	12,879	324,008
Florida	190,674	(c)	190,674
Georgia	1,527,853	17,230	1,545,083
Hawaii	(d)		(d)
Idaho	68,328		68,328
Illinois	8,960,041	682,449	9,642,490
Indiana	3,935,083	531,371	4,466,454
Indian Territory	117,224		117,224
Iowa	2,711,305	26,520	2,737,825
Kansas	981,020	(c)	981,020
Kentucky	1,374,846	139,697	1,514,543
Louisiana	612,595	3,108	615,703
Maine	734,678	(c)	734,678
Maryland	1,272,175	333,480	1,605,655
Massachusetts	1,589,469	281,368	1,870,837
Michigan	1,497,169	44,865	1,542,034
Minnesota	1,256,552	292,095	1,548,647
Mississippi	451,694	4,779	456,473
Missouri	4,409,906	64,647	4,474,553
Montana	539,221	(c)	539,221
Nebraska	806,473		806,473
Nevada	17,625		17,625
New Hampshire	765,964	(c)	765,964
New Jersey	5,781,805	5,900,073	11,681,878
New Mexico	81,345		81,345
New York	7,214,358	1,077,360	8,291,718
North Carolina	751,301	20,037	771,338
North Dakota	76,708		76,708
Ohio	11,526,424	10,048,561	21,574,985
Oklahoma	205,060		205,060
Oregon	[e] 263,891	(c)	[e] 263,891
Pennsylvania	13,656,730	1,665,012	15,321,742
Rhode Island	(f)		(f)
South Carolina	563,346	11,872	575,218
South Dakota	59,365		59,365
Tennessee	829,874	64,093	893,967
Texas	1,632,189	91,186	1,723,375
Utah	291,189	(c)	291,189
Vermont	77,554		77,554
Virginia	1,435,300	4,047	1,439,347
Washington	927,298	17,500	944,798
West Virginia	1,087,838	858,642	1,946,480
Wisconsin	1,234,144	13,400	1,247,544
Wyoming	28,950		28,950
Other States		[g] 76,488	[g] 76,488
Total	87,747,727	22,463,860	110,211,587
Per cent of total	79.62	20.38	100.00

[a] Includes Rhode Island.
[b] Produced by Connecticut alone.
[c] Included in Other States.
[d] Included in Oregon.
[e] Includes Hawaii.
[f] Included in Connecticut.
[g] Comprising pottery totals for the following States: Florida, Kansas, Maine, Montana, New Hampshire, Oregon, and Utah. This total could not be distributed among the States to which it belongs without disclosing the operations of individual establishments.

These tables show that the clay products increased in value from $110,211,587 in 1901 to $122,169,531 in 1902, an increase of $11,957,944, or 10.85 per cent, as compared with a gain in 1901 of $13,999,242, or 14.55 per cent, over 1900. Although the gain in 1902 over 1901 was not so large as that of some previous years, notably that of 1899 over 1898, still it is very satisfactory and represents a corresponding increase in production, and consequently a healthy growth of the industry, and not merely a gain in value caused by rising prices.

Of this total the coarser products—those used in the structural and engineering arts—composed $98,042,078, or 80.25 per cent of the whole, while the finer products contributed $24,127,453, or 19.75 per cent of the total. These proportions are practically what they have been for several years.

The following table shows the value of the clay products in the United States from 1897 to 1902, by States and Territories:

Value of the products of clay in the United States, 1897–1902. ([a])

State.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	$443,378	$456,597	$897,810	$712,727	$946,791	$1,016,364
Arizona	54,143	81,509	101,954	112,737	92,986	114,608
Arkansas	184,099	245,766	339,142	381,012	407,263	520,178
California	703,410	1,263,734	1,587,518	1,375,998	1,769,155	2,253,096
Colorado	406,863	766,767	1,071,388	1,200,519	1,594,867	2,200,983
Connecticut and Rhode Island	1,336,670	952,180	1,074,202	1,099,972	1,130,909	1,217,678
Delaware	68,458	160,555	168,485	156,274	131,164	144,934
District of Columbia	288,981	320,320	481,145	288,933	324,008	267,627
Florida	89,435	130,987	138,808	140,604	190,674	175,442
Georgia	962,513	857,258	1,263,995	1,193,218	1,545,083	1,508,669
Idaho	15,914	27,365	47,624	49,382	68,328	93,048
Illinois	5,498,574	6,866,715	7,259,825	7,708,859	9,642,490	9,881,840
Indiana	2,712,309	3,331,997	4,235,354	3,858,350	4,466,454	5,283,733
Indian Territory	14,135	35 633	35,075	30,233	117,224	167,674
Iowa	1,821,247	2,183,022	2,233,808	2,291,251	2,737,825	2,843,336
Kansas	256,518	444,975	839,767	1,016,750	981,020	1,221,588
Kentucky	806,368	1,000,940	1,358,428	1,481,324	1,514,543	1,873,043
Louisiana	370,910	517,059	554,729	507,694	615,703	642,424
Maine	800,739	600,029	662,685	724,934	734,678	656,648
Maryland	1,305,282	1,542,853	1,679,641	1,711,856	1,605,655	1,905,362
Massachusetts	2,179,396	1,809,070	2,181,710	1,833,101	1,870,837	2,375,667
Michigan	791,870	1,043,362	1,283,997	1,181,695	1,542,034	1,744,040
Minnesota	882,069	1,132,584	1,218,697	1,396,697	1,548,647	1,883,731
Mississippi	275,600	321,783	546,741	573,368	456,473	516,209
Missouri	2,536,528	3,112,716	3,666,616	3,736,567	4,474,553	5,166,414
Montana	231,649	275,026	314,340	350,489	539,221	278,727
Nebraska	351,385	513,565	843,315	683,958	806,473	757,668
Nevada			17,850	9,580	17,625	45,600
New Hampshire	465,172	439,189	570,287	485,013	765,964	887,124
New Jersey	6,180,847	8,706,357	10,787,273	10,928,423	11,681,878	12,613,263
New Mexico	33,270	41,940	108,090	41,898	81,345	68,879
New York	5,615,504	6,717,333	8,076,412	7,660,606	8,291,718	8,414,113
North Carolina	369,194	429,782	774,202	815,975	771,338	795,521
North Dakota	62,420	72,900	168,124	92,399	76,708	141,214
Ohio	11,067,684	13,167,627	16,500,625	18,304,628	21,574,985	24,249,748
Oklahoma	30,217	78,258	150,552	164,457	205,060	235,975
Oregon	115,798	131,864	327,374	281,385	[b] 263,891	[b] 318,604
Pennsylvania	7,874,695	9,714,683	14,103,245	13,391,748	15,321,742	17,833,425
South Carolina	290,497	259,232	605,329	711,336	575,218	613,511
South Dakota	21,800	30,770	46,500	43,440	59,365	63,425
Tennessee	612,293	520,038	948,853	915,578	893,967	913,125
Texas	1,197,039	817,797	1,221,119	1,171,017	1,723,375	1,693,814
Utah	135,781	180,992	216,449	234,221	291,189	359,005
Vermont	53,485	59,474	131,525	121,041	77,554	78,886
Virginia	812,046	894,383	1,093,784	1,305,195	1,439,347	1,577,833
Washington	190,720	250,988	591,277	625,459	944,798	905,231
West Virginia	1,115,254	1,098,575	1,451,539	2,016,765	1,946,480	2,518,544
Wisconsin	724,282	877,306	1,811,712	1,072,179	1,247,544	1,026,658
Wyoming	3,550	3,825	8,450	21,500	28,950	22,150
Other States					[c] 76,488	[d] 83,152
Total	62,359,991	74,487,680	95,797,370	96,212,345	110,211,587	122,169,531
Operating firms reporting	5,424	5,971	6,962	6,475	6,421	6,045

[a] In 1897 and 1898 the figures for California include the pottery products of Oregon and Washington; Colorado, those of Idaho, Montana, Nebraska, and Utah; Maryland, those of the District of Columbia; Georgia, those of Florida; Mississippi, those of Louisiana; New Hampshire, those of Maine; Minnesota, those of Wisconsin; and North Carolina, those of South Carolina. This is done in order that the operation of individual establishments may not be disclosed.

[b] Includes Hawaii.

[c] Comprising pottery totals for the following States: Florida, Kansas, Maine, Montana, New Hampshire, Oregon, and Utah. This total could not be distributed among the States to which it belongs without disclosing the operations of individual establishments.

[d] Comprising pottery totals for the following States: Florida, Kansas, Louisiana, Maine, Montana, New Hampshire, and Oregon. This total could not be distributed among the States to which it belongs without disclosing the operations of individual establishments.

The foregoing table shows the value of the products of clay by States and Territories for six years, together with the number of firms reporting, and is a condensed statement of the industry for the period covered.

It will be observed in this table that, notwithstanding the gain in the total value of clay products, there were eleven States which showed a decrease in the values of their products as compared with 1901. The States showing a decrease are: District of Columbia, $56,381, or 17.40 per cent; Florida, $15,232, or 7.99 per cent; Georgia, $36,414, or 2.36 per cent; Maine, $78,030, or 10.62 per cent; Montana, $260,494, or 48.31 per cent; Nebraska, $48,805, or 6.05 per cent; New Mexico, $12,466, or 15.32 per cent; Texas, $29,561, or 1.72 per cent; Washington, $39,567, or 4.19 per cent; Wisconsin, $220,886, or 17.71 per cent; and Wyoming, $6,800, or 23.49 per cent. None of these States showed a decrease in 1901 from 1900, and, as with the exception of one State—Texas—there was no important firm not reporting, the inference must be drawn that in these States there was a slight—very slight—falling off in the industry, governed, most probably, by local conditions. It will be observed that these States are not confined to any one section of the country, but are distributed north, south, east, and west. In 1901 the States showing a decrease were located mostly in the Southern States.

In the following table will be found a comparison of the several varieties of clay products made in 1901 and 1902, showing the actual gain or loss, together with the percentage of gain or loss:

Value of the products of clay in the United States in 1901 and 1902, with increase or decrease.

Product.	1901.	1902.	Increase in 1902.	Percentage of increase in 1902.
Common brick	$45,503,076	$48,885,869	$3,382,793	7.43
Front brick	4,709,737	5,318,008	608,271	12.92
Vitrified paving brick	5,484,134	5,744,530	260,396	4.75
Fancy or ornamental brick	372,131	335,290	[a] 36,841	[a] 9.90
Enameled brick	463,709	471,163	7,454	1.61
Fire brick	9,870,421	11,970,511	2,100,090	21.28
Stove lining	[b] 423,371	[b] 630,924	207,553	49.02
Drain tile	3,143,001	3,506,787	363,786	11.57
Sewer pipe	6,736,969	7,174,892	437,923	6.50
Ornamental terra cotta	3,367,982	3,526,906	158,924	4.72
Fireproofing, etc	1,860,269	3,175,593	1,315,324	70.71
Tile (not drain)	2,867,659	3,622,863	755,204	26.34
Miscellaneous	2,945,268	3,678,742	733,474	24.90
Total brick and tile	87,747,727	98,042,078	10,294,351	11.73
Total pottery	22,463,860	24,127,453	1,663,593	7.41
Total	110,211,587	122,169,531	11,957,944	10.85

[a] Decrease. [b] Stove lining for Vermont included in Vermont miscellaneous.

This table shows most strikingly the results of the canvass of this office and the lines along which there is the most activity. Again there was only one branch in which a decrease was recorded—that of fancy or ornamental brick, which showed a loss of $36,841, or 9.90 per cent.

This table shows a continuation of the highly satisfactory condition mentioned in the report for 1901, namely, an increase in every variety of product except one. In 1901 the product which showed a decrease was stove lining, a minor product, and in 1902 the decrease was in fancy or ornamental brick, another minor product. In 1901 the decrease in stove lining was 8.47 per cent; in 1902 the decrease in fancy or ornamental brick was 9.90 per cent.

Although there was more or less disturbance in the building trades in 1902, caused by strikes, still even the great value of the building brick in 1901—$51,048,653—was increased in 1902 to $55,010,330, a gain of $3,961,677, or 7.76 per cent, and as compared with the value in 1900, $43,099,512, the gain in this class of material in 1902 was $11,910,818, or 27.64 per cent, thus indicating the steady growth of the building industries. The common brick product increased from $45,503,076 in 1901 to $48,885,869 in 1902. a gain of $3.382.793, or 7.43 per cent.

The front-brick product increased in value from $4.709.737 in 1901 to $5,318,008 in 1902, a gain of $608.271, or 12.92 per cent. Although this increase is not so large as that of 1901 over 1900, it indicates that the use of high-grade brick in fronts is growing satisfactorily. That the paving-brick industry is in a good condition is shown by the increase over 1901 of $260,396 in the value of the product. The total value of this product was exceeded by only three other varieties of clay products—pottery being excluded—namely, common brick, fire brick, and sewer pipe. While the use of front brick is evidently increasing, the demand for fancy-shaped brick is falling off, as evidenced in the decrease in the value of this product from $372,131 in 1901 to $335,290 in 1902, a decrease of 9.90 per cent.

The enameled-brick industry seems to be advancing but slowly, as is shown by the increase of only $7,454 in the value of the product of 1902 over that of 1901. It is surprising that this product does not increase more rapidly.

The fire-brick industry is progressing with great rapidity, its product increasing in value from $9,870,421 in 1901 to $11,970,511 in 1902, an increase of $2,100,090, or 21.28 per cent. This increase is not surprising when the prosperity of the iron and steel industry from which it draws its chief support is taken into consideration.

The drain-tile industry was in a flourishing condition, as shown by the increase of $363,786 over the value of the product as reported for 1901. The total value of this product in 1901 was $3,143,001, and in 1902, $3,506,787. The gain in 1903 will undoubtedly be much larger, owing to the wet season in the Middle West.

The increasing use of vitrified sewer pipe is shown by the steady rise in value of this product since 1898, when it was $3,791,057, to 1902, when it was $7,174,892, a gain of $3,383,835, or 89.26 per cent. The gain in 1902 over 1901 was $437,923, or 6.50 per cent.

The ornamental and architectural terra-cotta industry also showed satisfactory gains in 1902 over 1901, though from the manifest popularity of this material one would look for more considerable gains than are shown by the figures here given. The gain in 1902 over 1901 was $158,924, or 4.72 per cent.

The most important increase in value of output, after common and fire brick, was in the fireproofing industry, where the gain was $1,315,324, or 70.71 per cent. This is explained in part, no doubt, by the fact that there is included in this column hollow building block and tile, which is becoming very popular in the Middle West; also by the large numbers of fireproof buildings now being constructed in the large cities.

The gain in popularity of the use of floor, wall, and mantel tile is indicated by the handsome increase in the value of these products, as shown by the returns—$755,204, or 26.34 per cent.

Not only did the brick and tile products increase in 1902, but the pottery products also continued to gain in a highly satisfactory manner, increasing from $22,463,860 in 1901 to $24,127,453 in 1902, a gain of $1,663,593, or 7.41 per cent.

The following table shows the output of clay products in the United States from 1894 to 1902 by varieties of products, together with the total for each year and the number of operating firms reporting:

Products of clay in the United States, 1894–1902, by varieties.

Year.	Number of operating firms reporting.	Common brick.			Front brick.		
		Quantity.	Value.	Average price per thousand.	Quantity.	Value.	Average price per thousand.
		Thousands.			*Thousands.*		
1894	....	6,152,420	$35,062,538	$5.70	(a)	(a)	....
1895	....	6,017,965	31,569,126	5.25	339,204	$4,399,367	$12.97
1896	5,293	5,703,279	29,664,043	5.20	270,335	3,390,941	12.54
1897	5,424	5,292,532	26,430,207	4.99	310,918	3,855,033	12.40
1898	5,971	5,867,415	30,980,704	5.28	295,833	3,572,385	12.08
1899	6,962	7,695,305	39,887,522	5.18	438,817	4,767,343	10.86
1900	6,475	7,140,622	38,621,514	5.41	344,516	3,864,670	11.09
1901	6,421	8,038,579	45,503,076	5.66	415,343	4,709,737	11.34
1902	6,045	8,475,067	48,885,869	5.77	458,391	5,318,008	11.60

Year.	Vitrified paving brick.			Fancy or ornamental brick (value).	Enameled brick (value).	Fire brick (value).	Stove lining (value).	Drain tile (value).
	Quantity.	Value.	Average price per thousand.					
	Thousands.							
1894	457,021	$3,711,073	$8.12	$1,128,608	(b)	$4,762,820	(c)	$5,803,168
1895	381,591	3,130,472	8.20	652,519	(b)	5,279,004	(c)	3,450,961
1896	320,407	2,794,585	8.72	763,140	(b)	4,944,723	(c)	2,613,513
1897	435,851	3,582,037	8.22	685,048	(b)	4,094,704	(c)	2,623,305
1898	474,419	4,016,822	8.47	358,372	$279,993	6,093,071	(c)	3,115,318
1899	580,751	4,750,424	8.18	476,191	329,969	8,641,882	$416,235	3,682,394
1900	546,679	4,764,124	8.71	289,698	323,630	9,830,517	462,541	2,976,281
1901	605,077	5,484,134	9.06	372,131	463,709	9,870,421	423,371	3,143,001
1902	617,192	5,744,530	9.31	335,290	471,163	11,970,511	630,924	3,506,787

Year.	Sewer pipe (value).	Ornamental terra cotta (value).	Fireproofing (value).	Tile, not drain (value).	Pottery (value).	Miscellaneous.[d]	Total value.
1894	$5,989,923	$1,476,185	$514,637	$1,688,724	(e)	$4,517,709	$64,655,385
1895	4,482,577	2,512,193	741,626	2,572,628	(e)	6,619,333	65,409,806
1896	4,588,503	2,359,983	1,706,504	1,618,127	$7,455,627	1,210,719	63,110,408
1897	4,069,531	1,841,422	1,979,259	1,476,638	10,309,209	1,413,595	62,359,991
1898	3,791,057	2,013,325	1,900,642	1,746,024	14,589,224	2,000,743	74,487,680
1899	4,560,334	2,027,532	1,665,066	1,276,300	17,250,250	6,065,928	95,797,370
1900	5,842,562	2,372,568	1,820,214	2,349,420	19,798,570	2,896,036	96,212,345
1901	6,736,969	3,367,982	1,860,269	2,867,659	22,463,860	2,945,268	110,211,587
1902	7,174,892	3,526,906	3,175,593	3,622,863	24,127,453	3,678,742	122,169,531

[a] Common and pressed brick not separately classified in 1894.
[b] Enameled brick not separately classified prior to 1898.
[c] Stove lining not separately classified prior to 1899.
[d] Including pottery products in 1894 and 1895.
[e] Pottery not separately classified in 1894 and 1895.

This table is interesting, inasmuch as it shows the history of the industries from the beginning of the statistical canvass by the Geological Survey. The total value of the brick and tile products has increased from $55,654,781 in 1896 to $98,042,078 in 1902, a gain of $42,387,297, or over 76 per cent, and the pottery products have increased in value from $7,455,627 in 1896 to $24,127,453, a gain of over 200 per cent. The number of common brick rose from 5,292,532,000 in 1897 to 8,475,067,000 in 1902, the average price rising with the output from $4.99 per thousand in 1897 to $5.77 in 1902. The average price of front brick ranged from $12.97 in 1895 to $10.86 in 1899, then rising steadily from the lowest figure in 1899 to $11.60 in 1902. The vitrified brick product rose from 320,407,000 in 1896 to 617,192,000 in 1902, while the average price increased from $8.18 per thousand in 1899 to $9.31 in 1902.

Along almost every line of the clay industry the output has increased, the most notable increases being in the fireproofing and fire brick industries.

RANK OF STATES.

In the following table will be found a statement of the rank of States, the total value of the products of clay, the percentage of the total products made by each State, and the number of operating firms reporting in each State in 1901 and 1902:

Rank of States and output of the products of clay in 1901 and 1902.

1902.

Rank.	State.	Number of operating firms reporting.	Value.	Per cent of total product.
1	Ohio	801	$24,249,748	19.85
2	Pennsylvania	511	17,833,425	14.60
3	New Jersey	154	12,613,263	10.32
4	Illinois	515	9,881,840	8.09
5	New York	262	8,414,113	6.89
6	Indiana	512	5,283,733	4.32
7	Missouri	235	5,166,414	4.23
8	Iowa	325	2,843,336	2.33
9	West Virginia	53	2,518,544	2.06
10	Massachusetts	90	2,375,667	1.94
11	California	89	2,253,096	1.84
12	Colorado	85	2,200,983	1.80
13	Maryland	68	1,905,362	1.56
14	Minnesota	110	1,883,731	1.54
15	Kentucky	111	1,873,043	1.53
16	Michigan	182	1,744,040	1.43
17	Texas	172	1,693,814	1.39
18	Virginia	98	1,577,833	1.29
19	Georgia	103	1,508,669	1.23
20	Kansas	55	1,221,588	1.00
21	Connecticut and Rhode Island	41	1,217,678	1.00
22	Wisconsin	150	1,026,658	.84
23	Alabama	103	1,016,364	.83
24	Tennessee	98	913,125	.75
25	Washington	66	905,231	.74
26	New Hampshire	37	887,124	.73
27	North Carolina	211	795,521	.65
28	Nebraska	98	757,668	62
29	Maine	62	656,648	54
30	Louisiana	60	642,424	53
31	South Carolina	70	613,511	.50
32	Arkansas	63	520,178	.43
33	Mississippi	76	516,209	.42
34	Utah	55	359,005	.29
35	Oregon and Hawaii	61	318,604	26
36	Montana	29	278,727	23
37	District of Columbia	15	267,627	22
38	Oklahoma	34	235,975	.19
39	Florida	24	175,442	.14
40	Indian Territory	22	167,674	.14
41	Delaware	21	144,934	.12
42	North Dakota	12	141,214	.12
43	Arizona	22	114,608	.09
44	Idaho	30	93,048	.08
45	Vermont	13	78,886	.06
46	New Mexico	12	68,879	.06
47	South Dakota	13	63,425	.05
48	Nevada	7	45,600	.04
49	Wyoming	9	22,150	.02
	Other States		[a] 83,152	.07
	Total	6,045	122,169,531	100.00

[a] Comprising pottery totals for the following States: Florida, Kansas, Louisiana, Maine, Montana, New Hampshire, and Oregon. This total could not be distributed among the States to which it belongs without disclosing the operations of individual establishments.

Rank of States and output of the products of clay in 1901 and 1902.

1901.

Rank.	State.	Number of operating firms reporting.	Value.	Per cent of total product.
1	Ohio	813	$21,574,985	19.58
2	Pennsylvania	507	15,321,742	13.90
3	New Jersey	160	11,681,878	10.60
4	Illinois	550	9,642,490	8.75
5	New York	276	8,291,718	7.52
6	Missouri	259	4,474,553	4.06
7	Indiana	540	4,466,451	4.05
8	Iowa	341	2,737,825	2.48
9	West Virginia	53	1,946,480	1.77
10	Massachusetts	90	1,870,837	1.70
11	California	92	1,769,155	1.61
12	Texas	201	1,723,375	1.56
13	Maryland	66	1,605,655	1.46
14	Colorado	91	1,594,867	1.45
15	Minnesota	116	1,548,647	1.41
16	Georgia	107	1,545,083	1.40
17	Michigan	180	1,542,034	1.40
18	Kentucky	117	1,514,543	1.37
19	Virginia	109	1,439,347	1.31
20	Wisconsin	170	1,247,544	1.13
21	Connecticut and Rhode Island	45	1,130,909	1.03
22	Kansas	58	981,020	.89
23	Alabama	118	946,791	.86
24	Washington	53	944,798	.86
25	Tennessee	119	893,967	.81
26	Nebraska	107	806,473	.73
27	North Carolina	293	771,338	.70
28	New Hampshire	37	765,964	.69
29	Maine	74	734,678	.67
30	Louisiana	61	615,703	.56
31	South Carolina	92	575,218	.52
32	Montana	32	539,221	.49
33	Mississippi	75	456,473	.41
34	Arkansas	75	407,263	.37
35	District of Columbia	15	324,008	.29
36	Utah	50	291,189	.26
37	Oregon and Hawaii	63	263,891	.24
38	Oklahoma	38	205,060	.19
39	Florida	24	190,674	.17
40	Delaware	23	131,164	.12
41	Indian Territory	18	117,224	.11
42	Arizona	23	92,986	.08
43	New Mexico	12	81,345	.07
44	Vermont	11	77,554	.07
45	North Dakota	9	76,708	.07
46	Idaho	32	68,328	.06
47	South Dakota	12	59,365	.05
48	Wyoming	9	28,950	.03
49	Nevada	5	17,625	.02
	Other States	....	*a*76,488	.07
	Total	6,421	110,211,587	100.00

a Comprising pottery totals for the following States: Florida, Kansas, Maine, Montana, New Hampshire, Oregon, and Utah. This total could not be distributed among the States to which it belongs without disclosing the operations of individual establishments.

The following table shows the rank of the several States and Territories in the value of products of clay from 1894 to 1902:

Rank of clay-producing States, in value of products of clay, 1894–1902.

State.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	31	28	26	24	26	23	26	23	23
Arizona	46	47	43	41	40	44	42	42	43
Arkansas	34	33	34	35	34	34	33	34	32
California	16	10	21	21	12	12	14	11	11
Colorado	27	22	29	25	25	21	16	14	12
Connecticut[a]	20	20	11	10	16	20	20	21	21
Delaware	43	41	41	39	39	38	39	40	41
District of Columbia	28	27	28	30	30	33	35	35	37
Florida	40	39	39	38	38	41	40	39	39
Georgia	18	15	15	14	18	15	17	16	19
Idaho	44	44	46	46	47	45	44	46	44
Illinois	2	3	4	5	4	5	4	4	4
Indiana	6	6	7	6	6	6	6	7	6
Indian Territory	(b)	(b)	(b)	47	45	47	47	41	40
Iowa	8	9	9	9	8	8	8	8	8
Kansas	33	32	32	32	27	25	22	22	20
Kentucky	19	19	18	17	15	14	12	18	15
Louisiana	24	25	25	26	24	31	31	30	30
Maine	17	21	13	18	21	27	25	29	29
Maryland	11	13	10	11	10	11	11	13	13
Massachusetts	9	8	8	8	9	9	10	10	10
Michigan	10	11	12	19	14	15	18	17	16
Minnesota	15	12	20	15	11	18	13	15	14
Mississippi	38	36	33	31	31	32	30	33	33
Missouri	7	7	6	7	7	7	7	6	7
Montana	37	35	31	33	32	36	34	32	36
Nebraska	23	34	36	28	23	24	28	26	28
Nevada	....	....	....	....	....	48	49	49	48
New Hampshire	26	23	22	23	28	30	32	28	26
New Jersey	5	5	5	3	3	3	3	3	3
New Mexico	(b)	(b)	(b)	43	44	43	46	43	46
New York	4	4	3	4	5	4	5	5	5
North Carolina	30	26	24	27	29	26	24	27	27
North Dakota	42	42	42	40	42	39	43	45	42
Ohio	1	1	1	1	1	1	1	1	1
Oklahoma	[b] 41	[b] 43	[b] 45	44	41	41	38	38	38
Oregon[d]	36	37	38	37	37	35	36	37	35
Pennsylvania	3	2	2	2	2	2	2	2	2
Rhode Island	29	29	30	(c)	(c)	(c)	(c)	(c)	(c)
South Carolina	32	30	27	29	35	28	27	31	31
South Dakota	45	45	44	45	46	46	45	47	47
Tennessee	22	24	23	22	22	22	23	25	24
Texas	13	14	14	12	19	17	19	12	17
Utah	35	40	37	36	36	37	37	36	34
Vermont	39	38	40	42	43	42	41	44	45
Virginia	14	18	17	16	17	19	15	19	18
Washington	25	31	35	34	33	29	29	24	25
West Virginia	21	17	16	13	13	13	9	9	9
Wisconsin	12	16	19	20	20	10	21	20	22
Wyoming	47	46	47	48	48	49	48	48	49

[a] Including Rhode Island in 1897, 1898, 1899, 1900, 1901, and 1902.
[b] In 1894, 1895, and 1896 Indian Territory and New Mexico were included with Oklahoma Territory.
[c] Included with Connecticut in 1897, 1898, 1899, 1900, 1901, and 1902.
[d] Including Hawaii in 1901 and 1902.

Every State and Territory produces more or less of the products of clay, though, as shown by this table, the first ten States are found in a belt stretching from the Atlantic Ocean to the Missouri River in the northern portion of our country.

Ohio, as heretofore, is the leading State in the production of clay products, producing $24,249,748 worth of product, or 19.85 per cent of the total. In 1901 this State produced clay products valued at $21,574,985, or 19.58 per cent of the total. Pennsylvania was second, with a product valued at $17,833,425, or 14.60 per cent of the total; in 1901 this State was second, with $15,321,742 worth of product. Until the twelfth place is reached there has been no change in the relative rank of the States except Indiana and Missouri, which exchanged places. Colorado has risen from fourteenth to twelfth and Texas has fallen from twelfth in 1901 to seventeenth in 1902. Maryland maintained its position as thirteenth in rank, and Minnesota rose from fifteenth to fourteenth, Kentucky from eighteenth to fifteenth and Michigan from seventeenth to sixteenth. Virginia rose from nineteenth to eighteenth place; Georgia fell from sixteenth to nineteenth, and Kansas rose from twenty-second to twentieth. Connecticut and Rhode Island maintained the same position in both years, namely, twenty-first, and Wisconsin fell from twentieth in 1901 to twenty-second in 1902. The remaining States are rather unimportant so far as changes in relative rank are concerned, the greatest changes being in the cases of Montana and New Mexico, which dropped four and three numbers, respectively.

BRICK AND TILE.

PRODUCTION.

The following tables show the production and value of building brick and other structural products of clay, together with fire brick, paving brick, and other clay products used in engineering work, in 1901 and 1902, the former year being presented for comparative purposes:

Brick and tile products of the United States in 1902.

State.	Common brick. Quantity.	Common brick. Value.	Common brick. Average price per thousand.	Front brick. Quantity.	Front brick. Value.	Front brick. Average price per thousand.
	Thousands.			*Thousands.*		
Alabama	128,106	$730,907	$5.71	43	$500	$11.63
Arizona	15,696	114,580	7.30			
Arkansas	69,997	456,170	6.52	3,258	29,760	9.13
California	181,040	1,291,941	7.14	6,099	119,302	19.56
Colorado	147,318	986,882	6.70	31,737	334,332	10.53
Connecticut and Rhode Island	156,885	896,171	5.71	(a)	(a)	9.09
Delaware	13,972	115,684	8.28	1,800	25,250	14.03
District of Columbia	25,081	185,480	7.40	(a)	(a)	14.17
Florida	31,711	170,852	5.39			
Georgia	223,705	1,114,527	4.98	5,150	46,560	9.04
Idaho	12,440	92,309	7.42	(a)	(a)	10.00
Illinois	1,023,681	5,131,621	5.01	20,943	240,466	11.48
Indiana	305,233	1,710,385	5.60	24,866	215,202	8.65
Indian Territory	20,654	135,749	6.57	(a)	(a)	11.24
Iowa	228,142	1,575,959	6.91	7,504	80,711	10.76
Kansas	115,855	606,726	5.24	25,817	229,990	8.91
Kentucky	112,728	659,612	5.85	6,172	47,027	7.62
Louisiana	99,025	597,833	6.04	(a)	(a)	10.00
Maine	59,060	377,059	6.38	(a)	(a)	10.00
Maryland	141,235	879,995	6.23	3,457	45,375	13.13
Massachusetts	241,376	1,529,671	6.34	3,631	69,230	19.07
Michigan	237,254	1,331,752	5.61	5,684	42,792	7.53
Minnesota	190,035	1,085,515	5.71	6,280	75,850	12.08
Mississippi	85,730	496,735	5.79	328	3,350	10.21
Missouri	292,134	1,832,118	6.27	30,744	358,089	11.65
Montana	18,292	130,339	7.13	930	16,213	17.43
Nebraska	100,788	638,901	6.34	6,648	87,415	13.15
Nevada	4,666	40,600	8.70	(a)	(a)	20.00
New Hampshire	125,442	861,975	6.87	842	9,149	10.87
New Jersey	300,583	1,506,224	5.01	42,926	552,000	12.86
New Mexico	6,305	40,364	6.40	2,082	20,811	10.00
New York	1,061,712	5,021,132	4.73	18,963	249,573	13.16
North Carolina	131,316	692,813	5.28	995	8,375	8.42
North Dakota	18,995	131,022	6.90	(a)	(a)	13.40
Ohio	538,552	3,091,847	5.74	63,815	674,822	10.57
Oklahoma	32,048	230,665	7.20	(a)	(a)	12.00
Oregon [b]	27,369	208,647	7.62	540	15,500	28.70
Pennsylvania	949,718	6,074,352	6.40	77,746	966,530	12.43
South Carolina	117,710	560,409	4.76	773	5,380	6.96
South Dakota	7,678	60,100	7.83	75	1,325	17.67
Tennessee	106,106	606,883	5.72	3,462	35,686	10.31
Texas	217,461	1,353,489	6.22	6,844	73,619	10.76
Utah	39,924	236,875	5.93	9,412	84,979	9.00
Vermont	10,808	60,886	5.63			
Virginia	192,337	1,185,362	6.16	20,433	344,139	16.84
Washington	73,325	577,407	7.87	2,400	51,771	21.57
West Virginia	81,166	527,661	6.50	(a)	(a)	14.33
Wisconsin	152,127	919,883	6.05	7,724	70,303	9.10
Wyoming	2,546	21,800	8.56	(c)	(c)	14.00
Other States [d]				8,238	86,632	10.52
Total	8,475,067	48,885,869	5.77	458,391	5,318,008	11.60
Per cent of brick and tile products		49.86			5.42	
Per cent of total of clay products		40.01			4.35	

[a] Included in Other States.
[b] Includes Hawaii.
[c] Value of front brick for Wyoming included in Wyoming miscellaneous.
[d] Includes all products made by less than three producers in one State in order that the operations of individual establishments may not be disclosed.

Brick and tile products in the United States in 1902—Continued.

State.	Vitrified paving brick.			Fancy or ornamental brick (value).	Fire brick (value).	Stove lining (value).	Draintile (value).
	Quantity.	Value.	Average price per thousand.				
	Thousands.						
Alabama	(a)	(a)	$11.00	....	$222,660	....	(a)
Arkansas	(a)	(a)	9.00	....	13,500	....	(a)
California	....	....	....	(a)	96,491	$1,250	$10,459
Colorado	1,549	$17,915	11.57	$14,185	609,495	....	4,705
Connecticut and Rhode Island	(a)	(a)	9.10	(a)	(a)	12,750	....
Delaware	....	....	....	....	....	....	(a)
District of Columbia	....	....	....	(a)	....	....	(a)
Florida	....	....	....	....	(a)	....	(a)
Georgia	....	....	....	(a)	(a)	....	(a)
Idaho	....	....	....	....	(a)	....	....
Illinois	91,116	839,784	9.22	11,893	199,048	....	693,783
Indiana	45,933	441,494	9.61	10,398	66,725	....	807,516
Indian Territory	....	....	....	....	(a)	....	....
Iowa	23,905	232,056	9.71	1,690	850	....	672,212
Kansas	37,937	285,156	7.52	(a)	(a)	....	6,625
Kentucky	(a)	(a)	13.80	....	605,448	(a)	26,039
Louisiana	(a)	(a)	10.00	....	....	(a)	....
Maine	(a)	(a)	19.99	(a)	(a)	....	5,777
Maryland	(a)	(a)	$15.51	(a)	277,290	21,540	2,105
Massachusetts	....	....	....	(a)	54,342	133,752	....
Michigan	(a)	(a)	12.26	(a)	....	....	96,645
Minnesota	....	....	....	(a)	(a)	....	2,219
Mississippi	....	....	....	....	....	....	1,700
Missouri	22,288	194,250	8.72	49,411	739,385	(a)	35,887
Montana	(a)	(a)	15.00	(a)	113,112	....	....
Nebraska	3,250	25,150	7.74	(a)	....	....	....
New Hampshire	....	....	....	....	(a)	....	....
New Jersey	1,014	10,437	10.29	11,407	819,580	8,477	33,020
New Mexico	(a)	(a)	7.75	(a)	....	....	....
New York	27,009	322,250	11.93	....	402,006	132,832	110,301
North Carolina	(a)	(a)	10.00	....	1,203	....	8,600
North Dakota	....	....	....	....	(a)	....	....
Ohio	186,786	1,643,532	8.80	46,027	1,327,982	192,460	894,713
Oklahoma	(a)	(a)	9.00	....	....	....	....
Oregon [b]	....	....	....	(a)	750	....	18,097
Pennsylvania	76,024	716,887	9.43	20,972	6,080,213	116,653	9,317
South Carolina	....	....	....	....	29,806	(a)	(a)
South Dakota	....	....	....	....	(a)	....	....
Tennessee	(a)	(a)	10.49	(a)	39,318	....	10,323
Texas	(a)	(a)	9.23	4,557	17,781	....	2,766
Utah	....	....	....	(a)	12,400	....	6,200
Vermont	....	....	....	....	....	(c)	....
Virginia	....	....	....	(a)	13,847	....	4,240
Washington	4,700	74,329	15.81	(a)	18,662	....	7,649
West Virginia	60,549	578,777	9.56	....	23,633	....	1,226
Wisconsin	....	....	....	(a)	(a)	....	17,763
Other States [d]	35,132	362,513	10.32	164,750	184,990	11,210	16,900
Total	617,192	5,744,530	9.31	[e] 806,453	11,970,511	630,924	3,506,787
Per cent of brick and tile products	....	5.86	....	.82	12.21	.64	3.58
Per cent of total of clay products	....	4.70	....	.66	9.80	.52	2.87

[a] Included in Other States.
[b] Includes Hawaii.
[c] Stove lining for Vermont included in Vermont miscellaneous.
[d] Includes all products made by less than three producers in one State in order that the operations of individual establishments may not be disclosed.
[e] Including enameled brick, valued at $471,163, made in the following States: California, Illinois, Maryland, Missouri, New Jersey, Ohio, and Pennsylvania. [New Jersey and Pennsylvania, with products respectively of $202,740, and $57,183, were the only States in which there were three or more producers of enameled brick.]

Brick and tile products of the United States in 1902—Continued.

State.	Sewer pipe (value).	Ornamental terra cotta (value).	Fireproofing (value).	Tile (not drain) (value).	Miscellaneous (value).[b]	Total value.
Alabama				(a)	$500	$989,865
Arizona					28	114,608
Arkansas				(a)	10,187	510,728
California	$381,076	$173,194	$18,645	(a)	49,001	2,201,489
Colorado	(a)		(a)	(a)	72,304	2,166,668
Connecticut and Rhode Island			(a)			1,100,781
Delaware						144,934
District of Columbia	37,820		(a)		25,000	258,430
Florida	(a)					175,442
Georgia	174,008	91,000	21,650			1,491,830
Idaho					180	93,048
Illinois	360,149	1,000,765	358,015	$257,049	22,403	9,187,426
Indiana	311,223	(a)	342,854	579,896	92,556	4,628,449
Indian Territory						167,674
Iowa	(a)	(a)	103,824	2,590	51,157	2,797,949
Kansas	(a)		(a)		31,449	1,221,588
Kentucky	(a)			237,469		1,736,000
Louisiana					23,571	642,424
Maine	(a)					656,648
Maryland	(a)	(a)		(a)	31,318	1,380,062
Massachusetts		(a)	(a)	67,418	9,015	2,075,212
Michigan	(a)		3,290	(a)		1,660,942
Minnesota	(a)	(a)	41,000	(a)	360	1,513,006
Mississippi						501,785
Missouri	903,279	(a)	99,690	103,356	430,544	5,112,901
Montana	(a)				11,033	278,727
Nebraska						757,668
Nevada						45,600
New Hampshire						887,124
New Jersey	(a)	861,730	965,047	795,153	649,139	6,420,304
New Mexico					480	68,879
New York	209,105	(a)	123,497	125,680	106,825	7,484,682
North Carolina	(a)		(a)			781,009
North Dakota						141,214
Ohio	2,646,134	18,289	757,613	1,156,371	1,279,471	13,730,610
Oklahoma						235,975
Oregon[c]	(a)		3,315		45	318,604
Pennsylvania	550,481	243,800	138,839	232,431	749,502	15,957,160
South Carolina						596,706
South Dakota						63,425
Tennessee	(a)		(a)			862,427
Texas	(a)			(a)	6,665	1,595,612
Utah	(a)				878	353,255
Vermont					[d]18,000	78,886
Virginia			(a)			1,573,842
Washington	118,462	35,225		(a)	5,161	891,877
West Virginia	(a)			(a)	500	1,352,080
Wisconsin				(a)	1,120	1,014,373
Wyoming					[e]350	22,150
Other States[f]	1,483,155	1,102,903	198,314	65,450		(g)
Total	7,174,892	3,526,906	3,175,593	3,622,863	3,678,742	98,042,078
Per cent of brick and tile products	7.32	3.60	3.24	3.70	3.75	100.00
Per cent of total of clay products	5.87	2.89	2.60	2.97	3.01	80.25

[a] Included in Other States.

[b] Including adobes, aquarium ornaments, boiler and locomotive brick and tile, burnt-clay ballast, carboy stoppers, chemical brick and tile; chimney blocks, pipes, and tops; clay furnaces, retorts and settings; conduits for underground wires, crucibles, curbing blocks, fire-clay insulators, fire mortar, flue lining, furnace brick and tile, gas logs, glasshouse supplies, grave markers, ground fire brick, muffles, oven tile, paving blocks, porous cups, saggers, stone pumps, wall coping, web tile, sewer and well brick.

[c] Includes Hawaii.

[d] Stove lining for Vermont included in Vermont miscellaneous.

[e] Value of front brick for Wyoming included in Wyoming miscellaneous.

[f] Includes all products made by less than three producers in one State in order that the operations of individual establishments may not be disclosed.

[g] The total of Other States is distributed among the States to which it belongs, in order that they may be fully represented in the totals.

Brick and tile products of the United States in 1901.

State.	Common brick.			Front brick.		
	Quantity.	Value.	Average price per thousand.	Quantity.	Value.	Average price per thousand.
	Thousands.			*Thousands.*		
Alabama	128,914	$742,691	$5.76	795	$6,990	$8.79
Arizona	13,533	92,986	6.87	....	....	....
Arkansas	56,501	368,359	6.52	1,205	11,570	9.60
California	146,522	943,250	6.44	3,787	86,425	22.82
Colorado	116,160	760,867	6.55	16,563	196,147	11.84
Connecticut and Rhode Island	160,696	822,079	5.12	(a)	(a)	15.04
Delaware	15,963	126,092	7.90	(a)	(a)	16.00
District of Columbia	23,175	179,184	7.73	(a)	(a)	15.16
Florida	32,253	185,759	5.76	(a)	(a)	8.00
Georgia	222,111	1,182,553	5.32	5,325	55,700	10.46
Idaho	8,391	66,514	7.93	(a)	(a)	9.26
Illinois	930,561	5,188,654	5.58	19,241	204,980	10.65
Indiana	315,966	1,624,133	5.14	27,293	234,775	8.60
Indian Territory	17,603	110,774	6.29	(a)	(a)	10.00
Iowa	249,318	1,611,040	6.46	8,785	88,164	10.04
Kansas	108,365	555,928	5.13	5,495	50,340	9.13
Kentucky	115,977	621,756	5.36	2,486	16,535	6.65
Louisiana	94,981	560,375	5.27	(a)	(a)	10.00
Maine	69,819	407,354	5.83	2,530	22,350	8.83
Maryland	113,457	676,708	5.96	5,772	76,792	13.30
Massachusetts	170,455	1,060,493	6.22	6,950	98,892	14.23
Michigan	215,836	1,095,254	5.07	9,476	64,031	6.76
Minnesota	157,727	852,303	5.40	5,506	55,016	9.99
Mississippi	76,716	443,939	5.79	650	6,455	9.93
Missouri	276,821	1,595,031	5.76	26,301	298,158	11.34
Montana	51,739	357,210	6.90	1,248	18,432	14.77
Nebraska	109,060	668,863	6.13	6,806	85,260	12.53
Nevada	2,020	16,425	8.13	(a)	(a)	12.00
New Hampshire	114,532	741,589	7.35	(a)	(a)	8.25
New Jersey	351,886	1,675,746	4.76	29,239	473,138	16.18
New Mexico	9,885	72,045	7.29	(a)	(a)	9.50
New York	1,016,237	4,947,599	4.87	18,721	254,696	13.60
North Carolina	132,699	682,469	5.14	990	8,070	8.15
North Dakota	10,948	69,508	6.35	(a)	(a)	16.00
Ohio	489,275	2,725,512	5.57	69,405	612,718	8.83
Oklahoma	28,137	196,735	6.99	875	7,850	8.97
Oregon [b]	23,422	172,058	7.35	354	8,469	23.92
Pennsylvania	875,631	5,357,079	6.12	70,207	844,087	12.02
South Carolina	144,601	546,028	3.78	168	1,188	7.07
South Dakota	7,235	54,365	7.51	(a)	(a)	20.00
Tennessee	92,502	610,968	6.60	3,073	32,350	10.53
Texas	222,459	1,396,889	6.28	10,138	95,492	9.42
Utah	23,262	134,164	5.77	17,490	139,591	7.98
Vermont	11,872	61,554	5.18	....	....	....
Virginia	171,624	1,139,894	6.64	17,650	267,028	15.13
Washington	61,595	477,960	7.76	6,995	147,881	21.14
West Virginia	60,004	348,452	5.81	(a)	(a)	7.12
Wisconsin	187,173	1,151,838	6.15	6,527	54,379	8.33
Wyoming	2,960	24,050	8.12	(c)	(c)	14.00
Other States [d]	....	....	....	7,297	85,788	11.76
Total	8,038,579	45,503,076	5.66	415,343	4,709,737	11.34
Per cent of brick and tile products	....	51.86	....	....	5.37	....
Per cent of total of clay products	....	41.29	....	....	4.27	....

[a] Included in Other States.
[b] Includes Hawaii.
[c] Value of front brick for Wyoming included in Wyoming miscellaneous.
[d] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed.

Brick and tile products of the United States in 1901—Continued.

State.	Vitrified brick. Quantity.	Vitrified brick. Value.	Vitrified brick. Average price per thousand.	Fancy or ornamental brick (value).	Fire brick (value).	Stove lining (value).	Drain tile (value).
	Thousands.						
Alabama	(*a*)	(*a*)	$11.00	....	$132,783	....	(*a*)
Arizona	....	....	....	....	....	....	....
Arkansas	(*a*)	(*a*)	10.00	$950	13,580	....	(*a*)
California	(*a*)	(*a*)	12.00	4,540	87,665	(*a*)	$50,156
Colorado	(*a*)	(*a*)	13.00	3,453	292,269	(*a*)	(*a*)
Connecticut and Rhode Island	....	....	....	....	(*a*)	(*a*)	....
Delaware	....	....	....	....	....	....	(*a*)
District of Columbia	....	....	....	(*a*)	....	....	2,652
Florida	....	....	....	....	....	....	1,515
Georgia	(*a*)	(*a*)	7.69	12,200	35,000	(*a*)	(*a*)
Idaho	....	....	....	....	....	....	(*a*)
Illinois	99,572	$899,454	9.03	13,105	212,510	....	694,588
Indiana	31,468	320,221	10.18	8,160	51,526	(*a*)	772,241
Indian Territory	....	....	....	....	(*a*)	....	....
Iowa	24,270	241,108	9.93	2,229	1,810	....	534,935
Kansas	41,574	312,994	7.53	(*a*)	(*a*)	....	3,300
Kentucky	(*a*)	(*a*)	12.71	(*a*)	377,741	(*a*)	29,498
Louisiana	....	....	....	....	....	....	....
Maine	(*a*)	(*a*)	20.02	....	(*a*)	....	3,830
Maryland	(*a*)	(*a*)	15.00	11,000	342,055	$40,237	2,402
Massachusetts	....	....	....	63,040	57,945	135,570	....
Michigan	(*a*)	(*a*)	12.30	(*a*)	....	(*a*)	98,972
Minnesota	....	....	....	(*a*)	(*a*)	....	6,739
Mississippi	....	....	....	....	....	....	(*a*)
Missouri	25,860	225,247	8.71	62,108	620,116	9,520	45,114
Montana	....	....	....	1,900	152,650	....	....
Nebraska	3,850	28,150	7.31	(*a*)	....	....	(*a*)
Nevada	....	....	....	....	....	....	....
New Hampshire	....	....	....	....	(*a*)	....	....
New Jersey	2,251	22,024	9.78	11,514	780,327	(*a*)	22,612
New Mexico	(*a*)	(*a*)	7.00	(*a*)	....	....	....
New York	29,950	343,343	11.46	(*a*)	293,944	115,054	73,554
North Carolina	(*a*)	(*a*)	10.00	(*a*)	3,720	(*a*)	5,042
North Dakota	....	....	....	....	(*a*)	....	....
Ohio	175,757	1,443,537	8.21	49,021	1,287,059	(*a*)	707,409
Oklahoma	....	....	....	....	(*a*)	....	(*a*)
Oregon [b]	....	....	....	(*a*)	962	....	11,991
Pennsylvania	73,498	670,081	9.12	74,726	4,791,083	86,190	7,409
South Carolina	....	....	....	....	14,925	(*a*)	(*a*)
South Dakota	....	....	....	....	(*a*)	....	....
Tennessee	6,624	67,129	10.13	(*a*)	37,100	....	15,961
Texas	(*a*)	(*a*)	8.70	1,339	23,337	....	904
Utah	....	....	....	....	5,100	....	(*a*)
Vermont	....	....	....	....	....	(*c*)	....
Virginia	....	....	....	20,429	3,971	....	3,978
Washington	7,774	139,162	17.90	(*a*)	24,542	....	3,343
West Virginia	62,805	555,389	8.84	(*a*)	102,300	....	1,485
Wisconsin	(*a*)	(*a*)	7.50	2,105	(*a*)	....	22,727
Wyoming	....	....	....	....	....	....	....
Other States [d]	19,824	216,295	10.91	30,312	124,401	36,800	20,644
Total	605,077	5,481,134	9.06	[e] 835,840	9,870,421	423,371	3,143,001
Per cent of brick and tile products	....	6.25	....	.95	11.25	.48	3.58
Per cent of total products of clay	....	4.98	....	.76	8.96	.38	2.85

[a] Included in Other States.
[b] Includes Hawaii.
[c] Stove lining for Vermont included in Vermont miscellaneous.
[d] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed.
[e] Including enameled brick valued at $463,709, made in the following States: California, Illinois, Maryland, Missouri, New Jersey, Ohio, Pennsylvania, Tennessee, and Wisconsin. New Jersey and Ohio, with products, respectively, of $177,128 and $11,887, were the only States in which there were three or more producers of enameled brick.

Brick and tile products of the United States in 1901—Continued.

State.	Sewer pipe (value).	Ornamental terra cotta (value).	Fireproofing (value).	Tile, not drain (value).	Miscellaneous (value). [a]	Total value.
Alabama					$1,800	$928,429
Arizona						92,986
Arkansas						395,858
California	$285,599	$141,380	$12,825	(b)	70,781	1,735,721
Colorado	(b)	(b)	(b)	(b)	167,512	1,568,167
Connecticut and Rhode Island			(b)		109,500	1,039,709
Delaware						131,164
District of Columbia	95,000				32,000	311,129
Florida	(b)				2,500	190,674
Georgia	151,500	71,800	(b)	(b)	1,460	1,527,853
Idaho					272	68,328
Illinois	348,716	812,015	263,276	$229,746	28,121	8,960,041
Indiana	253,626	(b)	91,081	478,130	50,790	3,935,083
Indian Territory						117,224
Iowa	54,500		59,270	11,903	106,346	2,711,305
Kansas	(b)		(b)		40,000	981,020
Kentucky	100,705		(b)	(b)		1,374,846
Louisiana					27,220	612,595
Maine	(b)					734,678
Maryland	(b)	(b)		16,586	12,586	1,272,175
Massachusetts		(b)	(b)	(b)	13,301	1,589,469
Michigan	(b)		1,880		637	1,497,169
Minnesota	(b)		35,700	(b)	650	1,256,552
Mississippi				(b)		451,694
Missouri	788,513	223,554	59,043	60,202	359,160	4,409,906
Montana	(b)		(b)	(b)	639	539,221
Nebraska					11,700	806,473
Nevada						17,625
New Hampshire						765,964
New Jersey	(b)	920,664	610,864	486,122	458,316	5,781,805
New Mexico						81,345
New York	96,770	754,911	98,947	140,890	94,532	7,214,358
North Carolina	(b)		(b)		5,000	751,301
North Dakota						76,708
Ohio	2,735,703	(b)	357,284	996,005	599,682	11,526,424
Oklahoma						205,060
Oregon [c]	(b)		(b)	(b)	188	263,891
Pennsylvania	438,998	314,900	101,652	188,525	716,913	13,656,730
South Carolina					250	563,346
South Dakota						59,365
Tennessee	(b)		(b)	(b)		829,874
Texas	(b)			2,950	6,778	1,632,189
Utah	(b)				1,834	291,189
Vermont					[d] 16,000	77,554
Virginia						1,435,300
Washington	118,584	(b)	(b)			927,298
West Virginia	(b)			(b)	2,500	1,087,838
Wisconsin			(b)	(b)	1,400	1,234,144
Wyoming					[e] 4,900	28,950
Other States [f]	1,268,755	128,758	168,447	256,600		(g)
Total	6,736,969	3,367,982	1,860,269	2,867,659	2,945,268	87,747,727
Per cent of brick and tile products	7.68	3.84	2.12	3.27	3.35	100.00
Per cent of total products of clay	6.11	3.06	1.69	2.60	2.67	79.62

[a] Including adobes, assayers' supplies, boiler and locomotive tile and tank blocks, burnt clay ballast, chemical brick, patent chimney brick, chimney pipe and tops, clay furnaces and retorts, conduit for underground wires, crucibles, cupola brick, fence posts and stubs, fire clay mortar, flue lining, frost-proof cellar brick, furnace mantels, gas logs and settings, glass-melting pots and glass-house furnace blocks, grave markers, hollow bricks, muffles, supports, and slides, porous cups, runner brick, sidewalk tile, stone pumps, terra-cotta vases, vitrified sewer brick, wall coping, water pipe, and well brick and tile.

[b] Included in Other States.

[c] Includes Hawaii.

[d] Includes stove lining for Vermont.

[e] Includes value of front brick for Wyoming.

[f] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed.

[g] The total of Other States is distributed among the States to which it belongs, in order that they may be fully represented in the totals.

These tables show in detail the clay products of the country in two years of great prosperity, when the products shown were valued at $98,042,078 and $87,747,727, respectively. The percentage of these products to the total was 80.25 in 1902 as compared with 79.62 in 1901. The common brick composed 49.86 per cent of the value of the brick and tile products and 40.01 per cent of the total clay products, whereas in 1901 these figures were 51.86 and 41.29, respectively, and in 1900 they were 50.54 and 40.14, respectively. The next most important product in point of value was the fire brick, which was valued at $11,970,511, or 12.21 per cent of the brick and tile products and and 9.80 per cent of the total clay products. In 1901 this product was valued at $9,870,421, or 11.25 per cent of the brick and tile products and 8.96 per cent of the whole. The average price per thousand for common brick increased only 11 cents, or from $5.66 to $5.77. Next to fire brick, the most important brick product in point of value is vitrified paving brick, which was valued at $5,744,530, or $9.31 per thousand, constituting 5.86 per cent of the brick and tile products and 4.70 per cent of the total clay products. In 1901 this product was valued at $5,484,134, or $9.06 per thousand, and constituted 6.25 per cent of the brick and tile products, or 4.98 per cent of the total clay products.

The front brick product was next in importance, being valued at $5,318,008 in 1902 as compared with $4,709,737 in 1901. The relative proportions of this product in the two years were 5.37 per cent of the brick and tile products and 4.27 per cent of the total products in 1901 and 5.42 per cent and 4.35 per cent, respectively, in 1902.

The fireproofing industry, while it has made great gains proportionately, is still relatively an unimportant branch of the industry, the product being valued at $3,175,593 in 1902, or only 3.24 per cent of brick and tile products and 2.60 per cent of the total clay products; in 1901 this product was valued at $1,860,269, or 2.12 per cent of the brick and tile products and 1.69 per cent of the total clay products.

RANK OF STATES.

The following tables show the rank of the States in the output of brick and tile products as distinguished from pottery products, and the percentage of the total made by each State and Territory in 1901 and 1902, and may be of interest to those engaged exclusively in this line of industry:

Rank of States and output of brick and tile products in 1901 and 1902.

1902.

Rank.	State.	Value.	Per cent of total product.
1	Pennsylvania	$15,957,160	16.28
2	Ohio	13,730,610	14.00
3	Illinois	9,187,426	9.37
4	New York	7,484,682	7.63
5	New Jersey	6,420,304	6.55
6	Missouri	5,112,901	5.22
7	Indiana	4,628,449	4.72
8	Iowa	2,797,949	2.85
9	California	2,201,489	2.25
10	Colorado	2,166,668	2.21
11	Massachusetts	2,075,212	2.12
12	Kentucky	1,736,000	1.78
13	Michigan	1,660,942	1.69
14	Texas	1,595,612	1.63
15	Virginia	1,573,842	1.61
16	Minnesota	1,513,006	1.54
17	Georgia	1,491,830	1.52
18	Maryland	1,380,062	1.41
19	West Virginia	1,352,080	1.38
20	Kansas	1,221,588	1.25
21	Connecticut and Rhode Island	1,100,781	1.12
22	Wisconsin	1,014,373	1.03
23	Alabama	989,865	1.01
24	Washington	891,877	.91
25	New Hampshire	887,124	.90
26	Tennessee	862,427	.88
27	North Carolina	781,009	.80
28	Nebraska	757,668	.77
29	Maine	656,648	.67
30	Louisiana	642,424	.66
31	South Carolina	596,706	.61
32	Arkansas	510,728	.52
33	Mississippi	501,785	.51
34	Utah	353,255	.36
35	Oregon *a*	318,604	.33
36	Montana	278,727	.28
37	District of Columbia	258,430	.26
38	Oklahoma	235,975	.24
39	Florida	175,442	.18
40	Indian Territory	167,674	.17
41	Delaware	144,934	.15
42	North Dakota	141,214	.14
43	Arizona	114,608	.12
44	Idaho	93,048	.09
45	Vermont	78,886	.08
46	New Mexico	68,879	.07
47	South Dakota	63,425	.06
48	Nevada	45,600	.05
49	Wyoming	22,150	.02
	Total	98,042,078	100.00

a Includes Hawaii.

Rank of States and output of brick and tile products in 1901 and 1902.

1901.

Rank.	State.	Value.	Per cent of total product.
1	Pennsylvania	$13,656,730	15.56
2	Ohio	11,526,424	13.14
3	Illinois	8,960,041	10.21
4	New York	7,214,358	8.22
5	New Jersey	5,781,805	6.59
6	Missouri	4,409,906	5.02
7	Indiana	3,935,083	4.48
8	Iowa	2,711,305	3.09
9	California	1,735,721	1.98
10	Texas	1,632,189	1.86
11	Massachsetts	1,589,469	1.81
12	Colorado	1,568,167	1.79
13	Georgia	1,527,853	1.74
14	Michigan	1,497,169	1.71
15	Virginia	1,435,300	1.64
16	Kentucky	1,374,846	1.57
17	Maryland	1,272,175	1.45
18	Minnesota	1,256,552	1.43
19	Wisconsin	1,234,144	1.41
20	West Virgina	1,087,838	1.24
21	Connecticut and Rhode Island	1,039,709	1.18
22	Kansas	981,020	1.12
23	Alabama	928,429	1.06
24	Washington	927,298	1.06
25	Tennessee	829,874	.95
26	Nebraska	806,473	.92
27	New Hampshire	765,964	.87
28	North Carolina	751,301	.86
29	Maine	734,678	.84
30	Louisiana	612,595	.70
31	South Carolina	563,346	.64
32	Montana	539,221	.61
33	Mississippi	451,694	.51
34	Arkansas	395,858	.45
35	District of Columbia	311,129	.35
36	Utah	291,189	.33
37	Oregon[a]	263,891	.30
38	Oklahoma	205,060	.23
39	Florida	190,674	.22
40	Delaware	131,164	.15
41	Indian Territory	117,224	.13
42	Arizona	92,986	.11
43	New Mexico	81,345	.09
44	Vermont	77,554	.09
45	North Dakota	76,708	.09
46	Idaho	68,328	.08
47	South Dakota	59,365	.07
48	Wyoming	28,950	.03
49	Nevada	17,625	.02
	Total	87,747,727	100.00

[a] Includes Hawaii.

Ohio, although the leading State in point of total value of clay products, must bow to Pennsylvania when the coarser products only are considered, the value of these products in these two States in 1902 being, respectively, $13,730,610, or 14 per cent of the total brick and tile products, and $15,957,160, or 16.28 per cent of the total. In 1901 these States produced brick and tile products, valued as follows: Pennsylvania, $13,656,730, or 15.56 per cent, and Ohio $11,526,424, or 13.14 per cent. Inspection of other tables will show that the reason for this is the enormous brick and fire brick production of Pennsylvania, while Ohio's chief brick and tile products are vitrified brick, drain tile, sewer pipe, fireproofing, and floor, wall, and art tile.

HUDSON RIVER REGION.

The following table shows the production of common brick along the Hudson River, from Troy, N. Y., to New York City, including Bergen County, N. J. This region is probably the most active brick-making region in the world. Of New York's 1,061,712,000 common brick, the largest output of this variety of brick of any State of the Union, 782,932,000, or 73.74 per cent of the total output of the State, were produced in this portion of the State. This output of common brick is exceeded by only two States in the entire country—Illinois and Pennsylvania, the great clay-working State of Ohio producing only a little more than two-thirds as much as this portion of New York; and the State of Indiana, itself a large producer of common brick, made less than 40 per cent of the output of this comparatively small region. It is interesting to note that there were in 1902 only 11 States besides New York that marketed more common brick (209,905,000) than one county along the Hudson—Rockland County, namely: Georgia, 223,705,000; Illinois, 1,023,681,000; Indiana, 305,-233,000; Iowa, 228,142,000; Massachusetts, 241,376,000; Michigan, 237,254,000; Missouri, 292,134,000; New Jersey, 300,583,000; Ohio, 538,552,000; Pennsylvania, 949,718,000, and Texas, 217,461,000.

Of New Jersey's product of common brick, 300,583,000, one county on the Hudson, Bergen, included in this table, produced 50,133,000, or 16.68 per cent of the total. The explanation of this large product is in the fact that it supplies the market of Greater New York and vicinity, the largest consuming market for brick in the country.

The average price per thousand varied from $4.01 in Ulster County to $5.29 in Columbia County, the average for the New York portion of this product being $4.42, as compared with $4.70 in 1901. The average for both States was $4.42, as compared with $4.67 in 1901. The average for Bergen County brick in 1902 was $4.38, as compared with $4.27 in 1901.

As in 1901, the figures embraced in this table include principally the product made along the river, which is shipped by water to New York City, but in the northern counties brick are included which are used locally:

Common brick of the Hudson River district, from Cohoes to New York City.

1901.

County.	Number of firms reporting.	Quantity.	Value.	Average price per thousand.
		Thousands.		
Albany	9	43,624	$221,818	$5.08
Columbia	4	44,200	219,000	4.95
Dutchess	18	139,895	630,190	4.50
Greene	4	32,810	176,713	5.39
Orange	10	78,254	388,507	4.96
Rensselaer	8	10,018	45,564	4.55
Rockland	36	213,885	994,348	4.65
Ulster	20	161,688	697,010	4.31
Westchester	9	59,750	310,425	5.21
Total for New York	118	784,124	3,683,575	4.70
Bergen County, N. J	9	46,030	196,640	4.27
Total	127	830,154	3,880,215	4.67

1902.

County.	Number of firms reporting.	Quantity.	Value.	Average price per thousand.
Albany	11	40,550	$184,674	$4.55
Columbia	5	58,500	309,625	5.29
Dutchess	19	133,081	585,873	4.40
Greene	4	30,101	134,748	4.48
Orange	8	88,900	412,950	4.65
Rensselaer	7	11,200	56,350	5.03
Rockland	33	209,905	898,605	4.28
Ulster	23	159,130	638,063	4.01
Westchester	9	51,565	242,795	4.71
Total for New York	119	782,932	3,463,683	4.42
Bergen county, N. J.	8	50,133	219,696	4.38
Total	127	833,065	3,683,379	4.42

PRICES.

The following tables show the average prices per thousand of the various kinds of brick in 1901 and 1902 by States and Territories:

Average value per thousand of various kinds of brick in 1902, by States.

COMMON BRICK.

Hawaii	$14.40	Missouri	$6.27
Nevada	8.70	Maryland	6.23
Wyoming	8.56	Texas	6.22
Delaware	8.28	Virginia	6.16
Washington	7.87	Wisconsin	6.05
South Dakota	7.83	Louisiana	6.04
Oregon	7.44	Utah	5.93
Idaho	7.42	Kentucky	5.85
District of Columbia	7.40	Mississippi	5.79
Arizona	7.30	Ohio	5.74
Oklahoma	7.20	Tennessee	5.72
California	7.14	Alabama	5.71
Montana	7.13	Minnesota	5.71
Iowa	6.91	Vermont	5.63
North Dakota	6.90	Michigan	5.61
Rhode Island	6.88	Indiana	5.60
New Hampshire	6.87	Connecticut	5.58
Colorado	6.70	Florida	5.39
Indian Territory	6.57	North Carolina	5.28
Arkansas	6.52	Kansas	5.24
West Virginia	6.50	Illinois	5.01
New Mexico	6.40	New Jersey	5.01
Pennsylvania	6.40	Georgia	4.98
Maine	6.38	South Carolina	4.76
Massachusetts	6.34	New York	4.73
Nebraska	6.34		

FRONT BRICK.

Oregon	$28.70	Indian Territory	$11.24
Connecticut	23.00	New Hampshire	10.87
Washington	21.57	Iowa	10.76
Nevada	20.00	Texas	10.76
California	19.56	Ohio	10.57
Massachusetts	19.07	Colorado	10.53
South Dakota	17.67	Tennessee	10.31
Montana	17.43	Mississippi	10.21
Virginia	16.84	Idaho	10.00
West Virginia	14.33	Louisiana	10.00
District of Columbia	14.17	Maine	10.00
Delaware	14.03	New Mexico	10.00
Wyoming	14.00	Arkansas	9.13
North Dakota	13.40	Wisconsin	9.10
New York	13.16	Georgia	9.04
Nebraska	13.15	Rhode Island	9.00
Maryland	13.13	Utah	9.00
New Jersey	12.86	Kansas	8.91
Pennsylvania	12.43	Indiana	8.65
Minnesota	12.08	North Carolina	8.42
Oklahoma	12.00	Kentucky	7.62
Missouri	11.65	Michigan	7.53
Alabama	11.63	South Carolina	6.96
Illinois	11.48		

VITRIFIED BRICK.

Maine	$19.99	Indiana	$9.61
Washington	15.81	West Virginia	9.56
Maryland	15.51	Pennsylvania	9.43
Montana	15.00	Texas	9.23
Kentucky	13.80	Illinois	9.22
Michigan	12.26	Rhode Island	9.10
New York	11.93	Arkansas	9.00
Colorado	11.57	Oklahoma	9.00
Alabama	11.00	Ohio	8.80
Tennessee	10.49	Missouri	8.72
New Jersey	10.29	New Mexico	7.75
Louisiana	10.00	Nebraska	7.74
North Carolina	10.00	Kansas	7.52
Iowa	9.71		

Average value per thousand of various kinds of brick in 1901, by States.

COMMON BRICK.

Hawaii	$15.50	Pennsylvania	$6.12
Nevada	8.13	Rhode Island	6.00
Wyoming	8.12	Maryland	5.96
Idaho	7.93	Maine	5.83
Delaware	7.90	West Virginia	5.81
Washington	7.76	Mississippi	5.79
District of Columbia	7.73	Utah	5.77
South Dakota	7.51	Alabama	5.76
New Hampshire	7.35	Florida	5.76
New Mexico	7.29	Missouri	5.76
Oklahoma	6.99	Illinois	5.58
Montana	6.90	Ohio	5.57
Arizona	6.87	Minnesota	5.40
Oregon	6.67	Kentucky	5.36
Virginia	6.64	Georgia	5.32
Tennessee	6.60	Louisiana	5.27
Colorado	6.55	Vermont	5.18
Arkansas	6.52	Indiana	5.14
Iowa	6.46	North Carolina	5.14
California	6.44	Kansas	5.13
North Dakota	6.35	Michigan	5.07
Indian Territory	6.29	Connecticut	4.99
Texas	6.28	New York	4.87
Massachusetts	6.22	New Jersey	4.76
Wisconsin	6.15	South Carolina	3.78
Nebraska	6.13		

FRONT BRICK.

Oregon	$23.92	Indian Territory	$10.00
Connecticut	23.00	Louisiana	10.00
California	22.82	Minnesota	9.99
Washington	21.14	Mississippi	9.93
South Dakota	20.00	Arkansas	9.60
New Jersey	16.18	New Mexico	9.50
Delaware	16.00	Texas	9.42
District of Columbia	15.16	Idaho	9.26
Virginia	15.13	Kansas	9.16
Rhode Island	15.00	Oklahoma	8.97
Montana	14.77	Maine	8.83
Massachusetts	14.23	Ohio	8.83
Wyoming	14.00	Alabama	8.79
New York	13.60	Indiana	8.60
Maryland	13.30	Wisconsin	8.33
Nebraska	12.53	New Hampshire	8.25
Pennsylvania	12.02	North Carolina	8.15
Nevada	12.00	Florida	8.00
Colorado	11.84	Utah	7.98
Missouri	11.34	West Virginia	7.12
Illinois	10.65	South Carolina	7.07
Tennessee	10.53	Michigan	6.76
Georgia	10.46	Kentucky	6.65
Iowa	10.04		

VITRIFIED BRICK.

Maine	$20.02	Iowa	$9.93
Washington	17.90	New Jersey	9.78
Maryland	15.00	Pennsylvania	9.12
Colorado	13.00	Illinois	9.03
Kentucky	12.71	West Virginia	8.84
Michigan	12.30	Missouri	8.71
California	12.00	Texas	8.70
New York	11.46	Ohio	8.21
Alabama	11.00	Georgia	7.69
Indiana	10.18	Kansas	7.53
Tennessee	10.13	Wisconsin	7.50
Arkansas	10.00	Nebraska	7.31
North Carolina	10.00	New Mexico	7.00

Hawaii again leads in the average price per thousand received for common brick, the price being $14.40, as compared with $15.50 in 1901; Nevada is again second, with an average of $8.70 per thousand, as compared with $8.13 in 1901. The far Western States monopolize the prices which range above $7 per thousand, except Delaware and the District of Columbia, where the average price per thousand was $8.28 and $7.40, respectively. New York, South Carolina, and New Jersey vie with each other as to which can produce the cheapest brick. In 1902 New York took the lead, where the average price was $4.73 per thousand, while in South Carolina the average price was $4.76 per thousand. In 1901 the lowest priced brick were made in South Carolina, and were valued at $3.78 per thousand, while in New Jersey in that year they were valued at $4.76 and in New York at $4.87 per thousand. The State in which the product was nearest in 1902 the general average ($5.77) was Mississippi, where it was $5.79 per thousand.

The front brick ranged in value from $28.70 per thousand in Oregon to $6.96 per thousand in South Carolina, Alabama coming nearest to the general average of $11.60, the average in that State being $11.63 per thousand. In 1901 the range was from $23.92 in Oregon to $6.65 in Kentucky.

The vitrified brick ranged in value from $19.99 per thousand in Maine to $7.52 per thousand in Kansas. In 1901 the prices varied from $20.02 in Maine to $7 per thousand in New Mexico.

POTTERY.

INTRODUCTION.

That the year 1902 was another exceedingly prosperous year among the potters of the United States is shown most conclusively by the following tables, which record the largest sales ever made by the American pottery trade, the total value of the output being $24,127,453, an increase of $1,663,593, or 7.41 per cent. This gain, however, was not as large as that of 1901 over 1900, which was $2,665,290, or 13.46 per cent. If this rate of increase had been maintained in 1902 the total value of the pottery products would have been $25,487,496. This proportional decrease may have been caused by the high cost and scarcity of fuel during the latter part of the year because of the great strike in the anthracite region of Pennsylvania.

During the year 1902 there were many new pottery plants projected, but they were not in most cases completed in time to be factors in the market during that year. In 1903, however, they are expected to make quite an increase in the product reported.

It should be gratifying to the potters of this country to know that the proportion of domestic pottery to the total consumption is steadily growing, reaching the highest point in 1902, when of the entire consumption 72.91 per cent was of domestic manufacture.

PRODUCTION.

The following tables show the value of the pottery products of the United States, by varieties of products by States, in 1901 and 1902:

Value of pottery products of the United States in 1902, by States.

PLAIN.

State.	Red earthenware.	Stoneware.	Yellow and rockingham ware.	C. C. ware.	White granite semiporcelain ware and semivitreous porcelain ware.
Alabama	$1,125	$25,074	(a)		
Arkansas		9,450			
California	30,315	9,697			
Colorado	2,675	(b)	(b)	(b)	
Connecticut	15,400	(b)			
District of Columbia	8,697				
Florida	(b)	(b)			
Georgia	3,310	13,154	(b)	(b)	
Illinois	19,400	582,708	(b)	(b)	(b)
Indiana	4,650	24,130			(b)
Iowa	7,050	36,337			
Kansas		(b)			
Kentucky	16,221	120,822			
Louisiana	(b)				
Maine		(b)			
Maryland	13,651		(c)	$190,722	
Massachusetts	123,115	26,992		(d)	
Michigan	44,098				
Minnesota	10,798	357,625			
Mississippi	273	3,716	(e)		
Missouri	6,401	39,419	(c)		
Montana	(b)				
New Hampshire					
New Jersey	16,300	43,100	(c)	445,820	$468,830
New York	31,873	54,535		(b)	
North Carolina	658	13,854			
Ohio	99,727	1,086,575	$129,591	385,365	2,891,698
Oregon	(b)	(b)			
Pennsylvania	120,323	373,654	(b)		254,856
South Carolina	2,970	13,835			
Tennessee	2,320	48,378			
Texas	8,226	88,176		(d)	
Utah	5,750				
Virginia	(b)	(b)			
Washington	2,029	11,325			
West Virginia		15,018		(b)	260,274
Wisconsin	10,785				
Other States e	6,411	69,346	78,822	155,382	141,878
Total plain	614,551	3,066,920	208,413	1,177,289	4,017,536

DECORATED.

State.	Red earthenware.	Stoneware.	Yellow and rockingham ware.	C. C. ware.	White granite semiporcelain ware and semivitreous porcelain ware.
Illinois	(b)	(b)			(b)
Maryland				(b)	(b)
New Jersey		(b)		$135,447	$962,440
New York	(b)				
Ohio	$26,422	$98,962		344,161	3,865,963
Pennsylvania	3,250	(b)	(b)	(b)	844,155
West Virginia				(f)	600,738
Other States e	91,163	6,353	$3,030	159,000	264,382
Total decorated	120,835	105,315	3,030	638,608	6,537,678
Grand total	735,386	3,172,235	211,443	1,815,897	10,555,214
Per cent of total clay products	.60	2.60	.17	1.49	8.64
Per cent of pottery products	3.05	13.15	.88	7.52	43.75

a Yellow and rockingham ware for Alabama included in Alabama miscellaneous.
b Included in Other States.
c Yellow and rockingham ware for Maryland, Mississippi, Missouri, and New Jersey is included in the miscellaneous column of each of these States.
d C. C. ware for Massachusetts and Texas is included in the miscellaneous column of each of these States.
e Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed. The total of other States (plain pottery) is distributed among the States to which it belongs, in order that they may be fully represented in the totals.
f C. C. ware for West Virginia included in West Virginia miscellaneous.

Value of pottery products of the United States in 1902, by States—Continued.

PLAIN.

State.	China.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.
Alabama				$300	$26,499
Arkansas					9,450
California		([b])		11,595	51,607
Colorado				88	21,285
Connecticut			([c])	13,881	66,547
District of Columbia					8,697
Florida					([d])
Georgia				25	16,839
Illinois				4,950	660,975
Indiana		([c])	([c])		583,741
Iowa				2,000	45,387
Kansas					([d])
Kentucky					137,043
Louisiana					([d])
Maine					([d])
Maryland				5,927	210,300
Massachusetts				75,197	225,304
Michigan				39,000	83,098
Minnesota					368,423
Mississippi				10,435	14,424
Missouri				3,600	19,420
Montana					([d])
New Hampshire				([c])	([d])
New Jersey	$321,169	$2,792,322	$358,496	153,576	4,650,914
New York	([c])	([c])	391,319	31,164	674,051
North Carolina					14,512
Ohio	([c])	([c])	415,874	494,450	5,799,648
Oregon					([d])
Pennsylvania	([c])	146,000		5,210	993,097
South Carolina					16,805
Tennessee					50,698
Texas				1,800	98,202
Utah					5,750
Virginia				3,786	3,991
Washington					13,354
West Virginia		([c])			454,124
Wisconsin					10,785
Other States[e]	216,242	601,340	184,566	7,692	[f] 63,044
Total plain	[g] 588,712	3,539,662	1,350,255	864,676	15,428,014

DECORATED.

State.	China.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.
Illinois					$33,439
Maryland					315,000
New Jersey	$359,199	([c])		$30,000	1,542,045
New York	([c])			50,000	255,380
Ohio	([h])			383,982	4,719,490
Pennsylvania	([c])				883,168
West Virginia				111,602	712,340
Other States[e]	231,843	$16,000		71,808	[i] 238,577
Total decorated	[j] 630,581	16,000		647,392	8,699,439
Grand total	[k] 1,219,293	3,555,662	$1,350,255	1,512,068	24,127,453
Per cent of total clay products	1.00	2.91	1.10	1.24	19.75
Per cent of pottery products	5.05	14.74	5.59	6.27	100.00

[a] Including art and chemical pottery, faïence, flemish ware, grueby pottery; porcelain casters, filter tubes, door and shutter knobs, shuttle eyes and thread guides; porcelain hardware trimmings, lettuce-leaf ware, pins, stilts and spurs for potters' use, terra vitrea, tobacco pipes, toy marbles, wash boards, white earthenware, and white-lined earthenware.
[b] Sanitary ware for California included in California miscellaneous.
[c] Included in Other States.
[d] Included in *f* ($63,044).
[e] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed. The total of other States (plain pottery) is distributed among the States to which it belongs, in order that they may be fully represented in the totals.
[f] Made up of State totals of Florida, Kansas, Louisiana, Maine, Montana, New Hampshire, and Oregon.
[g] Including bone china, delft, and belleek ware, valued at $51,301, made in New Jersey alone.
[h] Decorated china for Ohio included in Ohio miscellaneous.
[i] Made up of State totals of Colorado, Connecticut, District of Columbia, Florida, Indiana, Louisiana, Massachusetts, Minnesota, Missouri, New Hampshire, and Wisconsin in order to prevent disclosing the operations of individual establishments.
[j] Including decorated bone china, delft, and belleek ware, valued at $39,539, made in New Jersey alone.
[k] Includes the total ($90,840) of bone china, delft, and belleek ware, which was made in New Jersey alone.

Value of pottery products of the United States in 1901, by States.

PLAIN.

State.	Red earthenware.	Stoneware.	Yellow and rockingham ware.	C. C. ware.	White granite and semiporcelain ware.	Semivitreous porcelain ware.
Alabama	$1,030	$17,252		(a)		
Arkansas	(b)	10,898				
California	20,672	6,587				
Colorado	(a)	(a)			(a)	
Connecticut	18,200	(a)				
District of Columbia	12,879					
Florida	(a)	(a)				
Georgia	5,229	11,181	(a)	(a)		
Illinois	6,600	585,649	(a)			(a)
Indiana	6,650	47,721			(a)	
Iowa	18,300	(c)				
Kansas		(a)				
Kentucky	19,929	115,768				
Louisiana	(a)					
Maine	(a)	(a)				
Maryland	13,374		(a)	(d)	(a)	
Massachusetts	122,704	22,291		(a)		(a)
Michigan	42,465					
Minnesota	10,000	279,295				
Mississippi	854	3,520				
Missouri	13,800	48,827				
Montana	(a)					
New Hampshire						(a)
New Jersey	21,489	60,000	(e)	$293,455	$718,613	$60,321
New York	27,472	48,596		(a)		
North Carolina	2,015	17,470		(a)		
Ohio	72,746	735,977	$131,843	424,066	1,580,900	1,306,221
Oregon	(a)	(a)				
Pennsylvania	109,233	320,800	(a)		(a)	60,000
South Carolina	2,995	8,852				
Tennessee	(a)	62,093	(a)			
Texas	18,851	71,325				
Utah	(a)					
Virginia	(a)	(a)				
Washington	(f)	14,762				
West Virginia		13,069		(a)	130,073	(a)
Wisconsin	8,900					
Other States d	13,294	61,064	80,669	267,687	323,903	122,700
Total plain	589,681	2,562,997	212,512	985,208	2,753,489	1,549,242

DECORATED.

State.	Red earthenware.	Stoneware.	Yellow and rockingham ware.	C. C. ware.	White granite and semiporcelain ware.	Semivitreous porcelain ware.
California	(a)					
Maryland					(a)	(a)
Massachusetts	(g)					
New Jersey		(a)		$150,000	$767,650	(a)
New York						
Ohio	$71,322	$72,284	(h)	302,255	1,129,826	$2,213,787
Pennsylvania	1,400				697,000	(a)
West Virginia					243,800	(a)
Other States d	41,295	7,845			89,000	727,641
Total decorated	114,017	80,129	(h)	452,255	2,927,276	2,941,428
Grand total	703,698	2,643,126	$212,512	1,437,463	5,680,765	4,490,670
Per cent of total clay products	.64	2.40	.19	1.30	5.15	4.07
Per cent of pottery products	3.13	11.77	.95	6.40	25.29	19.99

a Included in Other States.
b Red earthenware for Arkansas included in Arkansas miscellaneous.
c Stoneware for Iowa included in Iowa miscellaneous.
d Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed. The total of other States (plain pottery) is distributed among the States to which it belongs, in order that they may be fully represented in the total
e Yellow and rockingham ware for New Jersey included in New Jersey miscellaneous.
f Red earthenware for Washington included in Washington miscellaneous.
g Decorated earthenware for Massachusetts included in Massachusetts miscellaneous.
h Decorated yellow and rockingham ware for Ohio included in Ohio miscellaneous.

Value of pottery products of the United States in 1901, by States—Continued.

State.	China.	Bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.
PLAIN.						
Alabama						$18,312
Arkansas					$507	11,405
California					275	27,534
Colorado						26,700
Connecticut				(b)		43,700
District of Columbia						12,879
Florida			(b)			(c)
Georgia			(b)	(b)	300	17,230
Illinois					9,200	676,149
Indiana			(b)	(b)		467,371
Iowa					5,620	23,920
Kansas						(c)
Kentucky						135,697
Louisiana						1,830
Maine						(c)
Maryland					2,500	171,480
Massachusetts					4,615	210,610
Michigan					2,400	44,865
Minnesota						289,295
Mississippi					405	4,779
Missouri						62,627
Montana						(c)
New Hampshire						(c)
New Jersey	$344,224	$237,835	$2,194,354	$342,479	88,357	4,361,127
New York	242,868		(b)	310,214	33,932	815,656
North Carolina			(b)		500	20,012
Ohio	(b)		(b)	325,664	400,957	5,311,674
Oregon						(c)
Pennsylvania			(b)		38,676	816,612
South Carolina						11,847
Tennessee						64,093
Texas			(d)		310	90,486
Utah						(c)
Virginia					3,072	4,047
Washington					2,738	17,500
West Virginia			(b)			297,842
Wisconsin					1,000	9,900
Other States[e]	150,300		565,746	163,005		[f] 58,003
Total plain	737,392	237,835	2,760,100	1,141,362	595,364	14,125,182
DECORATED.						
California			(b)			$5,900
Maryland						162,000
Massachusetts					$70,758	70,758
New Jersey	$321,724	(g)	(b)		82,861	1,538,946
New York	(h)				261,704	261,704
Ohio	(b)				851,500	4,736,887
Pennsylvania						848,400
West Virginia			(b)			560,800
Other States[e]	95,913		$117,550		21,563	[i] 153,283
Total decorated	417,637	(g)	117,550		1,288,386	8,338,678
Grand total	1,155,029	$237,835	2,877,650	$1,141,362	1,883,750	22,463,860
Per cent of total clay products	1.05	.22	2.61	1.04	1.71	20.38
Per cent of pottery products	5.14	1.06	12.81	5.08	8.38	100.00

[a] Including art and chemical pottery, casters, cuspidors, enameled earthenware and terra cotta, faience ware, flemish ware, jardiniers and pedestals, lead pots, pins, stilts and spurs for potters' use; porcelain door, picture, and shutter knobs; porcelain filter tubes, shuttle eyes and thread guides; porcelain hardware trimmings, tobacco pipes, toy marbles, umbrella stands, washboards, white earthenware, and white-lined earthenware.

[b] Included in Other States.

[c] Included in f ($58,003).

[d] Sanitary ware for Texas included in Texas miscellaneous.

[e] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed. The total of other States (plain pottery) is distributed among the States to which it belongs, in order that they may be fully represented in the total.

[f] Made up of State totals of Florida, Kansas, Maine, Montana, New Hampshire, Oregon, and Utah.

[g] Decorated bone china, delft, and belleek ware for New Jersey included in New Jersey miscellaneous.

[h] Decorated china for New York included in New York miscellaneous.

[i] Made up of State totals of Alabama, Connecticut, Florida, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Missouri, New Hampshire, North Carolina, Oregon, South Carolina, Texas, and Wisconsin, in order to prevent the disclosure of the operations of individual establishments.

These tables show that while the pottery industry was in a highly prosperous condition in 1902, the gain in that year was not so great as in the preceding year, the gains being $2,665,290 in 1901, or 13.46 per cent, and $1,663,593 in 1902, or 7.41 per cent.

As in previous years the white ware, principally for domestic use, composes by far the larger part of the pottery produced in this country, though the commoner grades, such as earthenware and stoneware, have a more general geographical distribution. The following table gives the value of the pottery products, by States, and of the plain and decorated ware made in each State, for 1901 and 1902:

Value of the pottery products of the United States in 1902, by States.

State.	Plain.	Decorated.	Total.
Alabama	$26,499	....	$26,499
Arkansas	9,450	....	9,450
California	51,607	....	51,607
Colorado	21,285	$13,030	34,315
Connecticut	66,547	50,350	116,897
District of Columbia	8,697	500	9,197
Florida	(a)	(a)	(a)
Georgia	16,839	....	16,839
Illinois	660,975	33,439	694,414
Indiana	583,741	71,543	655,284
Iowa	45,387	....	45,387
Kansas	(a)	....	(a)
Kentucky	137,043	....	137,043
Louisiana	(a)	(a)	(a)
Maine	(a)	....	(a)
Maryland	210,300	315,000	525,300
Massachusetts	225,304	75,151	300,455
Michigan	83,098	....	83,098
Minnesota	368,423	2,302	370,725
Mississippi	14,424	....	14,424
Missouri	49,420	4,093	53,513
Montana	(a)	....	(a)
New Hampshire	(a)	(a)	(a)
New Jersey	4,650,914	1,542,045	6,192,959
New York	674,051	255,380	929,431
North Carolina	14,512	....	14,512
Ohio	5,799,648	4,719,490	10,519,138
Oregon	(a)	....	(a)
Pennsylvania	993,097	883,168	1,876,265
South Carolina	16,805	....	16,805
Tennessee	50,698	....	50,698
Texas	98,202	....	98,202
Utah	5,750	....	5,750
Virginia	3,991	....	3,991
Washington	13,354	....	13,354
West Virginia	454,124	712,340	1,166,464
Wisconsin	10,785	1,500	12,285
Other States [b]	63,044	20,108	83,152
Total	15,428,014	8,699,439	24,127,453
Per cent of total	63.94	36.06	100.00

[a] Included in Other States.

[b] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed.

Value of the pottery products of the United States in 1901, by States.

State.	Plain.	Decorated.	Total.
Alabama	$18,312	$50	$18,362
Arkansas	11,405	....	11,405
California	27,534	5,900	33,434
Colorado	26,700	....	26,700
Connecticut	43,700	47,500	91,200
District of Columbia	12,879	....	12,879
Florida	(a)	(a)	(a)
Georgia	17,230	....	17,230
Illinois	676,149	6,300	682,449
Indiana	467,371	64,000	531,371
Iowa	23,920	2,600	26,520
Kansas	(a)	....	(a)
Kentucky	135,697	4,000	139,697
Louisiana	1,830	1,278	3,108
Maine	(a)	....	(a)
Maryland	171,480	162,000	333,480
Massachusetts	210,610	70,758	281,368
Michigan	44,865	....	44,865
Minnesota	289,295	2,800	292,095
Mississippi	4,779	....	4,779
Missouri	62,627	2,020	64,647
Montana	(a)	....	(a)
New Hampshire	(a)	(a)	(a)
New Jersey	4,361,127	1,538,946	5,900,073
New York	815,656	261,704	1,077,360
North Carolina	20,012	25	20,370
Ohio	5,311,674	4,736,887	10,048,561
Oregon	(a)	(a)	(a)
Pennsylvania	816,612	848,400	1,665,012
South Carolina	11,847	25	11,872
Tennessee	64,093	....	64,093
Texas	90,486	700	91,186
Utah	(a)	....	(a)
Virginia	4,047	....	4,047
Washington	17,500	....	17,500
West Virginia	297,842	560,800	858,642
Wisconsin	9,900	3,500	13,400
Other States[b]	58,003	18,485	76,488
Total	14,125,182	8,338,678	22,463,860
Per cent of total	62.88	37.12	100.00

[a] Included in Other States.
[b] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed.

It will be seen that while decorated ware is reported from nineteen States, in only eleven was the product valued at more than $10,000. In 1901 twenty-four States reported decorated ware, out of which only nine reported a product valued at over $10,000. The total value of this variety of ware in 1902 was $8,699,439, or 36.06 per cent of the total, while in 1901 it was valued at $8,338,678, or 37.12 per cent of the total. New Jersey, Ohio, Pennsylvania, and West Virginia were, as heretofore, the leading producing States. These States produced decorated were valued at $7,857,043, or 90.32 per cent of the total. In 1901 these States produced 92.16 per cent of the total decorated ware, or to the value of $7,685,033.

It will be seen that the plain ware aggregated $15,428,014, or 63.94 per cent of the total, and the decorated $8,699,439, or 36.06 per cent of the total. In 1901 these percentages were 62.88 and 37.12, respectively. This was a gain in the value of plain ware of $1,302,832, or 9.22 per cent. The value of the decorated ware increased from $8,338,678 in 1901 to $8,699,439 in 1902, a gain of $360,761, or 4.33 per cent. In 1900 these values were, plain, $13,392,770, or 67.65 per cent of the total, and, decorated, $6,405,800, or 32.35 per cent.

The separation of the products into plain and decorated ware is not as satisfactory as it might be, owing to the fact that there are fewer than three producers of the several varieties in many of the States, thus making it necessary to combine the products in order to prevent the disclosing of individual returns.

The following table shows the value of the pottery products in the United States, by varieties, decorated and plain, in 1902 and 1901:

Value of pottery products in the United States in 1902, by varieties.

	Plain.	Decorated.	Total.	Number of producers.	Percentage of pottery product.
Red earthenware	$614,551	$120,835	$735,386	195	3.05
Stoneware	3,066,920	105,315	3,172,235	245	13.15
Yellow or rockingham ware	247,240	3,030	250,270	17	1.04
C. C. ware	1,244,089	750,210	1,994,299	23	8.26
White granite, semiporcelain, and semivitreous porcelain ware	4,017,536	6,537,678	10,555,214	60	43.75
China	537,411	685,024	1,222,435	10	5.07
Bone china, delft, and belleek ware	51,301	39,539	90,840	4	.38
Sanitary ware	3,544,662	16,000	3,560,662	31	14.76
Porcelain electrical supplies	1,350,255		1,350,255	23	5.59
Miscellaneous[a]	754,049	441,808	1,195,857	63	4.95
Total	15,428,014	8,699,439	24,127,453		
Per cent of total	63.94	36.06	100.00		

[a] Including art and chemical pottery, faïence, flemish ware; grueby pottery; porcelain casters; filter tubes; door and shutter knobs; shuttle eyes and thread guides; porcelain hardware trimmings, lettuce leaf ware, pins, stilts, and spurs for potters' use, terra vitrea, tobacco pipes, toy marbles; washboards, white earthenware, and white-lined earthenware.

It will be noticed that the figures given here do not quite agree with those given on preceding pages. This is accounted for by the fact that in the former table it was necessary to combine some of the products in order to prevent disclosing individual returns. The figures given in this table, however, are accurate and represent the actual value of these varieties of pottery in the United States, as reported to this office, though the figures given in the former table are as accurate as can be given for the State totals. It appears from this table that 63.94 per cent of the pottery products was plain ware and 36.06 per cent decorated. In 1901 62.88 per cent of the product was plain and 37.12 per cent decorated.

The product of greatest value was the white granite and semivitreous porcelain ware, which was valued at $10,555,214 as compared with $10,171,435 in 1901, a gain of $383,779, or 3.77 per cent. In 1902 this product was 43.75 per cent of the total pottery products, and in 1901 it was 45.28 per cent of the total. The product of next greatest value is that of sanitary ware, which was valued at $3,560,662, or 14.76 per cent of the total, and which was closely followed by stoneware, valued at $3,172,235, or 13.15 per cent of the total. The china-ware product shows a slight falling off of from $1,353,828 in 1901 to $1,222,435 in 1902. The number of producers reporting sanitary ware increased from 19 in 1901 to 31 in 1902.

The white ware, including that made for sanitary purposes (which is of a white body), and porcelain electrical supplies, aggregated $18,773,705, or 77.81 per cent of the total. In 1901 it was valued at $17,252,464, or 76.80 per cent of the total. The yellow or rockingham ware, which for several years prior to 1901 showed a decrease, but in 1901 showed an increase, fell off again from $308,600 in 1901 to $250,270 in 1902, a loss of $58,330, or 18.90 per cent. The stoneware product, although reported from the largest number of States (red earthenware excepted), and by more operators—245—is, nevertheless, relatively one of minor importance. The product in 1902 was valued at $3,172,235, or 13.15 per cent of the total, as compared with $2,648,426, or 11.79 per cent, in 1901, a gain of $523,809, or 19.78 per cent. The number of firms reporting these various wares is interesting, ranging from 4 reporting bone china, delft, and belleek ware, a gain of one over 1901, to 245 reporting stoneware, a decrease of 21 since 1901. The number of firms reporting china and white granite was 10 and 60 for each of the years 1901 and 1902. There is no footing to the column for the reason that its addition would not be the number of operating firms, since many operators report several varieties of ware.

RANK OF STATES.

The following tables show the rank of States in the production of pottery, together with the value of the product of each State, the percentage of the total product made by each State in 1901 and 1902, and the number of firms reporting in each State:

Rank of States and output of pottery products in 1902.

Rank.	State.	Number of firms reporting.	Value.	Per cent of total product.
1	Ohio	113	$10,519,138	43.60
2	New Jersey	51	6,192,959	25.67
3	Pennsylvania	47	1,876,265	7.78
4	West Virginia	8	1,166,464	4.83
5	New York	21	929,431	3.85
6	Illinois	25	694,414	2.88
7	Indiana	13	655,284	2.72
8	Maryland	12	525,300	2.18
9	Minnesota	2	370,725	1.54
10	Massachusetts	18	300,455	1.24
11	Kentucky	11	137,043	.57
12	Connecticut	5	116,897	.48
13	Texas	20	98,202	.41
14	Michigan	4	83,098	.34
15	Missouri	15	53,513	.22
16	California	12	51,607	.21
17	Tennessee	10	50,698	.21
18	Iowa	9	45,387	.19
19	Colorado	6	34,315	.14
20	Alabama	24	26,499	.11
21	Georgia	18	16,839	.07
22	South Carolina	10	16,805	.07
23	North Carolina	26	14,512	.06
24	Mississippi	8	14,424	.06
25	Washington	4	13,354	.06
26	Wisconsin	4	12,285	.05
27	Arkansas	3	9,450	.04
28	District of Columbia	3	9,197	.04
29	Utah	3	5,750	.02
30	Virginia	3	3,991	.02
	Florida, Kansas, Louisiana, Maine, Montana, New Hampshire, and Oregon	10	83,152	.34
	Total	518	24,127,453	100.00

Rank of States and output of pottery products in 1901.

Rank.	State.	Number of firms reporting.	Value.	Per cent of total product.
1	Ohio	109	$10,048,561	44.73
2	New Jersey	50	5,900,073	26.26
3	Pennsylvania	48	1,665,012	7.41
4	New York	25	1,077,360	4.80
5	West Virginia	9	858,642	3.82
6	Illinois	23	682,449	3.04
7	Indiana	14	531,371	2.37
8	Maryland	9	333,480	1.48
9	Minnesota	2	292,095	1.30
10	Massachusetts	18	281,368	1.25
11	Kentucky	10	139,697	.62
12	Connecticut	5	91,200	.41
13	Texas	26	91,186	.41
14	Missouri	16	64,647	.29
15	Tennessee	16	64,093	.29
16	Michigan	5	44,865	.20
17	California	10	33,434	.15
18	Colorado	4	26,700	.12
19	Iowa	8	26,520	.12
20	North Carolina	33	20,037	.09
21	Alabama	22	18,362	.08
22	Washington	5	17,500	.08
23	Georgia	18	17,230	.07
24	Wisconsin	4	13,400	.06
25	District of Columbia	3	12,879	.06
26	South Carolina	12	11,872	.05
27	Arkansas	5	11,405	.05
28	Mississippi	6	4,779	.02
29	Virginia	4	4,047	.02
30	Louisiana	3	3,108	.01
	Florida, Kansas, Maine, Montana, New Hampshire, Oregon, and Utah	10	76,488	.34
	otal	532	22,463,860	100.00

Ohio continues to lead in the pottery industry, both as to number of producers and value of product, producing ware valued at $!0,519,138, or 43.60 per cent of the total. In 1901 her product was valued at $10,048,561, or 44.73 per cent of the total. This was a gain of $470,577, or 4.68 per cent. New Jersey, Pennsylvania, and West Virginia hold second, third, and fourth places, respectively, West Virginia displacing New York, which has fallen to fifth place. New Jersey's output increased in value from $5,900,073, or 26.26 per cent of the whole, in 1901 to $6,192,959, or 25.67 per cent of the total, in 1902, an increase of $292,886, or 4.96 per cent. Pennsylvania also showed an increase from $1,665,012, or 7.41 per cent of the total, in 1901 to $1,876,265, or 7.78 per cent of the total, in 1902, a gain of $211,253, or 12.69 per cent. West Virginia's product increased in value from $858,642, or 3.82 per cent of the total, in 1901 to $1,166,464, or 4.83 per cent of the total, in 1902, a gain of $307,822, or 35.85 per cent. The first five States produced ware worth $20,684,257, or 85.73 per cent of the total, and the output of the first 10 States was valued at $23,230,435, or 96.29 per cent of the total.

The following table gives the number of potteries reporting during the years from 1899 to 1902, inclusive, showing those idle and those operating:

Number of operating and idle potteries in the United States reporting in 1899, 1900, 1901, and 1902.

State.	1899.	1900.			1901.			1902.		
	Operating.	Operating.	Idle.	Total.	Operating.	Idle.	Total.	Operating.	Idle.	Total.
Alabama	30	27	3	30	22	2	24	24	4	28
Arkansas	8	7	0	7	5	0	5	3	0	3
California	13	10	3	13	10	2	12	12	0	12
Colorado	4	3	0	3	4	1	5	6	1	7
Connecticut	4	5	0	5	5	0	5	5	0	5
District of Columbia	3	3	0	3	3	0	3	3	0	3
Florida	1	1	0	1	1	0	1	1	0	1
Georgia	30	25	1	26	18	3	21	18	3	21
Idaho	1	2	0	2	0	1	1	0	1	1
Illinois	28	29	0	29	24	3	27	25	2	27
Indiana	21	15	2	17	14	1	15	13	1	14
Iowa	12	7	0	7	8	3	11	9	1	10
Kansas	4	3	1	4	1	2	3	2	1	3
Kentucky	10	10	0	10	11	1	12	11	0	11
Louisiana	3	3	1	4	3	1	4	2	0	2
Maine	2	1	1	2	2	0	2	1	1	2
Maryland	9	8	1	9	10	0	10	12	1	13
Massachusetts	18	18	1	19	18	0	18	18	0	18
Michigan	4	4	0	4	5	0	5	4	0	4
Minnesota	4	3	0	3	2	0	2	2	0	2
Mississippi	11	7	0	7	6	0	6	8	0	8
Missouri	21	18	2	20	16	1	17	15	0	15
Montana	1	1	0	1	1	0	1	1	0	1
Nebraska	1	0	1	1	0	1	1	0	1	1
New Hampshire	1	1	0	1	1	0	1	1	0	1
New Jersey	46	43	2	45	50	2	52	51	3	54
New York	25	25	2	27	25	1	26	21	4	25
North Carolina	47	39	4	43	33	4	37	26	3	29
Ohio	118	113	6	119	109	8	117	113	7	120
Oregon	3	3	0	3	2	0	2	2	0	2
Pennsylvania	50	47	3	50	48	3	51	47	5	52
South Carolina	15	13	1	14	12	0	12	10	2	12
Tennessee	19	19	1	20	16	1	17	10	1	11
Texas	27	24	1	25	26	3	29	20	3	23
Utah	4	4	1	5	2	0	2	3	0	3
Virginia	6	6	3	9	4	3	7	3	3	6
Washington	6	5	3	8	5	0	5	4	1	5
West Virginia	6	6	2	8	9	0	9	8	0	8
Wisconsin	3	3	0	3	4	0	4	4	0	4
Other States	......	......	....	......	......	....	......	......	....	......
Total	619	561	46	607	535	47	582	518	49	567

The total number of potteries reporting decreased from 582 in 1901 to 567 in 1902. It will be noted that this decrease occurred mostly in the unimportant States, generally in the South, and while the important States show slight increases, the total decrease would have been less but for the fact that the combination of potteries in some of the leading States resulted in a smaller number of reports, though in the higher grades of ware the number of plants represented in these figures is undoubtedly larger than ever before.

TRENTON, N. J., AND EAST LIVERPOOL, OHIO.

In the following tables will be found statements of the pottery products of Trenton, N. J., and East Liverpool, Ohio, in 1901 and 1902, the great pottery centers of the country.

Value of pottery products of Trenton, N. J., and East Liverpool, Ohio, in 1902.

Product.	Trenton.	East Liverpool.	Total.
Yellow and rockingham ware	....	$90,911	$90,911
C. C. ware	$581,267	694,526	1,275,793
White granite, semiporcelain, and semivitreous porcelain ware	1,426,270	4,175,421	5,601,691
China	680,368	(a)	680,368
Bone china delft, and belleek ware	90,840	....	90,840
Sanitary ware	2,408,339	....	2,408,339
Porcelain electrical supplies	358,496	273,232	631,728
Miscellaneous [b]	151,831	[a] 362,123	513,954
Total	5,697,411	5,596,213	11,293,624
Per cent of total pottery product	23.61	23.20	46.81

[a] In order to prevent disclosing the operations of individual establishments the value of china for East Liverpool is included in East Liverpool miscellaneous.
[b] Including stilts, pins, and spurs for potters' use, porcelain casters, and porcelain door and shutter knobs.

Value of pottery products of Trenton, N. J., and East Liverpool, Ohio, in 1901.

Product.	Trenton.	East Liverpool.	Total.
Yellow and rockingham ware	....	(a)	....
C. C. ware	$443,455	$612,074	$1,055,529
White granite, semiporcelain, and semivitreous porcelain ware	1,711,225	4,061,020	5,772,245
China	660,948	(a)	660,948
Bone china, delft, and belleek ware	270,696	....	270,696
Sanitary ware	1,788,030	....	1,788,030
Porcelain electrical supplies	339,279	(a)	339,279
Miscellaneous [b]	106,060	[c] 633,563	739,623
Total	5,319,693	5,306,657	10,626,350
Per cent of total pottery product	23.68	23.62	47.30

[a] Included in miscellaneous in order to prevent disclosing the operations of individual establishments.
[b] Including stilts, pins, and spurs for potters' use, porcelain casters and door knobs, and toy marbles.
[c] Also includes yellow and rockingham ware, china, and porcelain electrical supplies.

The great equality in the value of the product of these two centers noted in previous years continued in 1902, although the lead of Trenton in that year was greater than in 1901, when they were practically equal, there being only $13,036 difference in value of the product of the two places. The value of the products reported from Trenton in 1902 was $5,697,411, and those reported from East Liverpool were valued at $5,596,213, a difference of $101,198, or 1.81 per cent in favor of Trenton as against East Liverpool. The percentage of the total pottery products made by these cities was, for Trenton, 23.61; for East

Liverpool, 23.20, or 46.81 per cent of the total pottery products being made in these two cities alone. The value of the products made in these two cities, $11,293,624, which is practically all white ware, is 60.16 per cent of the total of the white-ware products of the entire United States. Of the total pottery of New Jersey, which was valued at $6,192,959, or 25.67 per cent of the total for the United States, Trenton produced $5,697,411, or 92 per cent, and East Liverpool produced 53.20 per cent of Ohio's pottery products. Trenton makes no yellow nor rockingham ware; East Liverpool makes no sanitary ware. While sanitary and white granite are Trenton's chief products, C. C. and white granite are East Liverpool's leading products, the latter being about 75 per cent of East Liverpool's entire output.

CONSUMPTION.

The gradual increase in the percentage of domestic ware consumed, noted in previous reports, continued in 1902, when the home product was 72.91 per cent of the consumption as compared with 71.39 per cent in 1901, 70.75 per cent in 1900, 69.99 per cent in 1899, and 68.49 per cent in 1898. The imports of pottery in 1902 were valued at $9,570,534 and the exports of domestic ware for the same period were valued at $604,646, of which the earthenware and stoneware were valued at $555,340, or 91.85 per cent, and the china exported was valued at $49,306, or 8.15 per cent. To arrive at the consumption, however, these exports should be deducted, which would leave the net imports at $8,965,888, and this, added to the domestic product of $24,127,453, makes a total consumption of $33,093,341.

CLAY.

PRODUCTION.

In the following tables will be found statistics of the production of clay in 1901 and 1902. In compiling these figures only the clay sold by the miner has been considered, that which is manufactured by the producer not being taken into account.

As in other branches of the mining industry, the field work was done in cooperation with the Census Office. For census purposes only those operators whose principal business is the mining, preparation, and sale of clay were considered clay miners. Hence the considerable quantity of clay sold by those whose principal business is the manufacture of clay products is not included in the tables for 1902 which follow:

Production and value of clay in the United States in 1902, by States.

[Quantity in tons of 2,000 pounds.]

State.	Kaolin.				Ball clay.			
	Raw.		Prepared.		Raw.		Prepared.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	(a)	(a)						
California								
Colorado	(a)	(a)			(a)	(a)		
Connecticut b	660	$2,057	24,797	$185,058			10,000	$60,000
Delaware	(a)	(a)	14,294	110,446				
Georgia	14,530	63,613	(a)	(a)				
Illinois								
Kentucky					(a)	(a)		
Maryland								
Missouri	(a)	(a)			(a)	(a)		
New Jersey	1,576	1,761			697	$3,991	(a)	(a)
New York	3,495	3,799						
Ohio c								
Pennsylvania			21,389	128,730	(a)	(a)	(a)	(a)
South Carolina	28,237	105,707	(a)	(a)				
Tennessee					(a)	(a)		
Texas								
West Virginia								
Wisconsin	(a)	(a)	(a)	(a)				
Other States d	9,845	12,666	4,990	32,940	29,303	64,533	10,527	42,562
Total	58,343	189,603	65,470	457,174	30,000	68,524	20,527	102,562

State.	Fire clay.				Stoneware clay.			
	Raw.		Prepared.		Raw.		Prepared.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	39,340	$18,292						
California	5,724	6,886			(a)	(a)		
Colorado	40,982	38,719			(a)	(a)		
Connecticut b	2,522	2,219	12,500	$5,000	500	$125		
Delaware	(a)	(a)	(a)	(a)				
Georgia					(a)	(a)		
Illinois	(a)	(a)	(a)	(a)	23,040	18,565	(a)	(a)
Kentucky	17,562	11,256						
Maryland	6,785	7,808			1,177	1,441		
Missouri	117,187	130,020			2,979	1,656		
New Jersey	281,508	327,580	(a)	(a)	34,397	59,270		
New York	1,043	2,045			(a)	(a)		
Ohio c	52,257	28,300	56,326	41,000	15,836	11,836	(a)	(a)
Pennsylvania	84,600	93,575	15,920	30,340	(a)	(a)		
South Carolina					(a)	(a)		
Tennessee	(a)	(a)			1,700	1,694		
Texas	(a)	(a)			290	435		
West Virginia	(a)	(a)	(a)	(a)	(a)	(a)		
Wisconsin								
Other States d	125,022	69,355	67,618	78,790	7,228	10,160	4,432	$8,660
Total	774,532	736,055	152,364	155,130	87,147	105,182	4,432	8,660

a Included in Other States.
b Including Florida, Indiana, Massachusetts, Michigan, North Carolina, Utah, Vermont, and Washington.
c In miscellaneous raw clay for Ohio is included 7,120 tons of sand, valued at $9,320.
d Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed.

Production and value of clay in the United States in 1902, by States—Continued.

State.	Miscellaneous.[a]				Total.	
	Raw.		Prepared.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama					40,065	$19,742
California	15,259	$13,059			23,483	24,445
Colorado	20,568	15,361	2,370	$2,726	75,913	67,434
Connecticut[b]	1,974	395			52,953	254,854
Delaware					123,319	171,714
Georgia	750	750			18,595	76,480
Illinois	2,748	2,336			52,152	38,463
Kentucky					26,562	44,256
Maryland	920	806			8,882	10,055
Missouri					121,401	134,862
New Jersey	157,225	136,471	6,765	15,586	494,800	612,721
New York	3,420	7,340			8,909	14,535
Ohio[c]	14,639	12,559			142,440	101,305
Pennsylvania	[d]32,037	[d]26,636			161,546	288,811
South Carolina	432	377			29,136	107,325
Tennessee	3,300	3,382	60	60	14,650	27,171
Texas					310	455
West Virginia					57,506	43,266
Wisconsin	75	338			2,735	23,178
Other States[e]					(*f*)	(*f*)
Total	253,347	219,810	9,195	18,372	1,455,357	2,061,072

[a] Including brick clay, pipe clay, slip clay, terra-cotta clay, and wad clay.
[b] Including Florida, Indiana, Massachusetts, Michigan, North Carolina, Utah, Vermont, and Washington.
[c] In miscellaneous raw clay for Ohio is included 7,120 tons of sand, valued at $9,320.
[d] Sand.
[e] Includes all products made by less than three producers in one State, in order that the operations of individual establishments may not be disclosed.
[f] The total of Other States is distributed among the States to which it belongs, in order that they may be fully represented in the totals.

Production and value of clay in the United States in 1901, by States.

[Quantity in tons of 2,000 pounds.]

State.	Kaolin.				Ball clay.			
	Raw.		Prepared.		Raw.		Prepared.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	(a)	(a)						
Arizona b	260	$965	12,900	$75,000				
California								
Colorado	(a)	(a)						
Delaware			14,051	110,883				
Georgia	8,280	41,400	415	2,715				
Illinois								
Indiana								
Kentucky					8,900	$29,700		
Maryland								
Massachusetts	(a)	(a)	(a)	(a)				
Missouri	1,670	4,495	(a)	(a)	(a)	(a)		
Montana								
New Jersey	3,541	4,040			(a)	(a)	(c)	(c)
New York	(d)	(d)						
North Carolina			11,616	107,222				
Ohio								
Pennsylvania	4,625	8,637	15,422	97,254				
South Carolina	(a)	(a)						
Tennessee	910	1,192			(a)	(a)		
Texas								
West Virginia								
Wisconsin			(a)	(a)	(a)	(a)		
Other States e	18,170	81,170	5,393	49,550	12,108	39,207		
Total	37,456	141,899	59,797	442,624	21,008	68,907		

a Included in Other States.
b Including Connecticut, Florida, Michigan, New Hampshire, North Dakota, Oregon, Utah, Vermont, Virginia, and Washington.
c Prepared ball clay for New Jersey included in New Jersey miscellaneous.
d Raw kaolin for New York included in New York miscellaneous.
e Including all products made by less than three operators in one State, in order that the operations of individual establishments may not be disclosed.

Production and value of clay in the United States in 1901, by States—Continued.

[Quantity in tons of 2,000 pounds.]

State.	Fire clay.				Stoneware clay.			
	Raw.		Prepared.		Raw.		Prepared.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	31,512	$15,758	(a)	(a)	(a)	(a)		
Arizona[b]			1,429	$13,286	400	$738		
California	13,676	8,396	(a)	(a)	(a)	(a)		
Colorado	(a)	(a)	(a)	(a)	(a)	(a)		
Delaware			(c)	(c)				
Georgia	(a)	(a)			(a)	(a)		
Illinois	38,000	31,200	5,261	3,403	21,051	17,855		
Indiana	16,546	14,396	(a)	(a)	4,099	4,509	(a)	(a)
Kentucky	(a)	(a)	(a)	(a)	(a)	(a)		
Maryland	3,828	2,628			3,283	3,780		
Massachusetts	(a)	(a)			(a)	(a)		
Missouri	126,771	123,857	15,806	151,531	2,677	2,187	(a)	(a)
Montana	(a)	(a)	(a)	(a)				
New Jersey	225,421	328,370	16,023	63,579	26,538	46,290	(a)	(a)
New York	25,565	51,730			1,234	1,500		
North Carolina					795	405		
Ohio	93,961	69,910	64,471	61,172	19,199	15,173		
Pennsylvania	60,812	57,508	51,459	149,797	2,796	2,343		
South Carolina			(a)	(a)				
Tennessee	(a)	(a)			(a)	(a)		
Texas	(a)	(a)	(a)	(a)	(a)	(a)		
West Virginia	(d)	(d)	64,995	256,694				
Wisconsin								
Other States[e]	44,698	43,203	29,512	68,090	5,757	6,973	4,400	$12,860
Total	680,793	746,956	248,956	767,552	87,829	101,753	4,400	12,860

[a] Included in Other States.
[b] Including Connecticut, Florida, Michigan, New Hampshire, North Dakota, Oregon, Utah, Vermont, Virginia, and Washington.
[c] Prepared fire clay for Delaware included in Delaware miscellaneous.
[d] Raw fire clay for West Virginia included in West Virginia miscellaneous.
[e] Including all products made by less than three operators in one State, in order that the operations of individual establishments may not be disclosed.

Production and value of clay in the United States in 1901, by States—Continued.

[Quantity in tons of 2,000 pounds.]

State.	Miscellaneous.[a]				Total.	
	Raw.		Prepared.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama					34,932	$18,698
Arizona[b]	615	$905	1,000	$3,000	16,604	93,894
California	13,288	12,460			28,085	22,535
Colorado	19,488	17,539	12,963	11,201	59,113	59,774
Delaware			[c]500	[c]2,000	11,551	112,883
Georgia					8,832	44,315
Illinois	20,891	10,673			85,203	63,131
Indiana					30,745	25,705
Kentucky	[illegible]	280			21,719	43,004
Maryland	4,300	1,600			11,411	8,008
Massachusetts	575	575			2,505	9,680
Missouri	2,822	2,259			151,266	295,333
Montana			75	300	18,675	55,205
New Jersey	109,260	96,510	[d]7,360	[d]38,908	392,946	594,894
New York	[e]2,900	[e]6,450			29,699	59,680
North Carolina					12,411	107,627
Ohio	182	168	3,278	6,362	181,091	152,785
Pennsylvania			9,433	17,892	144,547	333,431
South Carolina	16,000	63,000			33,168	113,700
Tennessee	1,300	1,550			12,880	32,957
Texas					839	1,384
West Virginia	[f]200	[f]100	245	549	65,440	257,313
Wisconsin	200	100			4,508	10,966
Other States[g]					([h])	([h])
Total	192,077	214,169	34,854	80,212	1,367,170	2,576,932

[a] Including brick clay, clay for boiler covering and wall paper, pipeclay, paper clay, silica clay, slip clay, and terra-cotta clay.
[b] Including Connecticut, Florida, Michigan, New Hampshire, North Dakota, Oregon, Utah, Vermont, Virginia, and Washington.
[c] Includes prepared fire clay for Delaware.
[d] Includes prepared ball clay for New Jersey.
[e] Includes 1,500 tons of Albany slip clay valued at $5,000; also includes raw kaolin for New York.
[f] Includes raw fire clay for West Virginia.
[g] Including all products made by less than three operators in one State, in order that the operations of individual establishments may not be disclosed.
[h] The total of Other States is distributed among the States to which it belongs, in order that they may be fully represented in the totals.

From these tables it will be seen that the total production of clay increased from 1,367,170 short tons in 1901 to 1,455,357 short tons in 1902, a gain of 88,187 tons, or 6.45 per cent, and that the value of the product decreased from $2,576,932 in 1901 to $2,061,072 in 1902, a loss of $515,860, or 20.02 per cent.

In addition to the foregoing figures for 1902, there were sold by clayworkers in a raw or prepared condition (but unburned) 265,884 short tons of clay, valued at $510,394. As clay of this kind has been included in the statistics of the production of clay, as published by this office in previous years, these figures should be added for comparative purposes to those given in the foregoing table for 1902, so that the total should be 1,721,241 short tons, valued at $2,571,466. In 1901 the product was 1,367,170 tons valued at $2,576,932. There was, therefore, an increase in 1902 of 354,071 tons, or 25.90 per cent, in output, but a decrease of $5,466, or a little over one-fifth of 1 per cent, in value.

As in 1901, New Jersey is the leading clay-mining State, producing 494,800 tons, or 34 per cent of the total, valued at $612,721, or 29.73 per cent of the total; in 1901 its product was valued at $594,894, or 23.09 per cent of the total. Pennsylvania is again second, with a product of 161,546 tons, valued at $288,811, or 14.01 per cent of the total value. In 1901 Pennsylvania's product was valued at $333,431, or 12.94 per cent of the total.

Production and value of clay in the United States in 1902, by varieties.

	Raw.		Prepared.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Kaolin	58,343	$189,603	65,470	$457,174	123,813	$646,777
Ball	30,000	68,524	20,527	102,562	50,527	171,086
Fire	774,532	736,055	152,364	155,130	926,896	891,185
Stoneware	87,147	105,182	4,432	8,660	91,579	113,842
Miscellaneous[a]	253,347	219,810	9,195	18,372	262,542	238,182
Total	1,203,369	1,319,174	251,988	741,898	1,455,357	2,061,072

[a] In miscellaneous raw clay are included 39,157 tons of sand, valued at $35,956.

Production and value of clay in the United States in 1901, by varieties.

	Raw.		Prepared.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Kaolin	37,456	$141,899	59,797	$442,624	97,253	$584,523
Ball	21,008	68,907	([a])	([a])	21,008	68,907
Fire	680,793	746,956	248,956	767,552	929,749	1,514,508
Stoneware	87,829	101,753	4,400	12,860	92,229	114,613
Miscellaneous	192,077	214,169	34,854	80,212	226,931	294,381
Total	1,019,163	1,273,684	348,007	1,303,248	1,367,170	2,576,932

[a] Included in miscellaneous.

It will be seen from these tables that of the total production of 1,455,357 short tons of clay mined in 1902, 1,203,369 tons, or 82.69 per cent, were sold without any preparation whatever after mining, and 251,988 short tons, or 17.31 per cent, were washed, ground, or prepared in some other manner at the mine.

IMPORTS.

In the following tables will be found a statement of the clay and the products of clay imported into the United States in recent years:

Classified imports of clay, 1885–1902.

Calendar year.	Kaolin or china clay.		All other clays.						Total.	
			Unwrought.		Wrought.		Common blue.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
1885	10,626	$83,722	9,736	$76,899	3,554	$29,839	....	....	23,916	$190,460
1886	16,590	123,093	13,740	113,875	1,654	20,730	....	....	31,984	257,698
1887	23,486	141,360	17,645	139,405	2,187	22,287	....	....	43,318	303,052
1888	18,150	102,050	20,604	152,694	6,832	53,245	....	....	45,586	307,989
1889	19,843	113,538	19,237	145,983	8,142	64,971	....	....	47,222	324,492
1890	29,923	270,141	21,049	155,486	2,978	29,143	....	....	53,950	454,770
1891	39,901	294,458	16,094	118,689	6,297	56,482	....	....	62,292	469,629
1892	49,468	375,175	20,132	155,047	4,551	64,818	5,172	59,971	79,323	655,011
1893	49,713	374,460	14,949	113,029	6,090	67,280	4,304	51,889	75,056	606,658
1894	62,715	465,501	13,146	98,776	4,768	60,786	2,528	28,886	83,157	653,949
1895	75,447	531,714	18,419	125,417	5,160	60,775	3,869	40,578	102,895	758,484
1896	76,718	536,081	13,319	88,029	4,514	56,701	4,983	54,695	99,534	735,506
1897	71,938	493,431	9,405	56,264	7,839	52,232	4,562	50,954	93,744	652,881
1898	85,586	573,595	16,130	98,434	1,412	24,959	5,312	58,280	108,440	755,268
1899	92,521	615,717	19,614	118,679	1,716	31,948	9,223	106,618	123,074	872,962
1900	111,959	698,720	21,626	126,203	3,195	45,431	7,327	92,013	144,107	962,367
1901	117,756	663,379	27,597	156,838	5,707	75,721	6,136	73,839	157,196	969,777
1902	133,062	883,092	25,831	138,032	2,680	47,093	6,978	86,588	168,551	1,154,805

Value of earthenware, china, brick, and tile imported and entered for consumption in the United States, 1867–1902.

Year ending—	Brown earthen and common stone ware.	China and porcelain, not decorated.	China and porcelain, decorated.	Other earthen, stone, or crockery ware, glazed, etc.	Brick, fire brick, and tile.	Total.
June 30—						
1867	$48,618	$418,493	$439,824	$4,280,924	....	$5,187,859
1868	47,208	309,960	403,555	3,244,958	....	4,005,681
1869	34,260	400,894	555,425	3,468,970	....	4,459,549
1870	47,457	420,442	530,805	3,461,524	....	4,460,228
1871	96,695	391,374	571,032	3,573,254	....	4,632,355
1872	127,346	470,749	814,134	3,896,664	....	5,308,893
1873	115,253	479,617	867,206	4,289,868	....	5,751,944
1874	70,544	397,730	676,656	3,686,794	....	4,831,724
1875	68,501	436,883	654,965	3,280,867	....	4,441,216
1876	36,744	409,539	718,156	2,948,517	....	4,112,956
1877	30,403	326,956	668,514	2,746,186	....	3,772,059
1878	18,714	389,133	657,485	3,031,393	....	4,096,725
1879	19,868	296,591	813,850	2,914,567	....	4,044,876
1880	31,504	334,371	1,188,847	3,945,666	....	5,500,388
1881	27,586	321,259	1,621,112	4,413,369	....	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	....	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	....	8,686,061
1884	50,172	982,499	2,664,231	(*a*)	$666,595	4,363,497
1885	44,701	823,334	2,834,718	....	963,422	4,666,175
December 31—						
1886	37,820	865,446	3,350,145	....	951,293	5,204,704
1887	43,079	967,694	3,888,509	....	1,008,360	5,907,642
1888	55,558	1,054,854	4,207,598	....	886,314	6,204,324
1889	48,824	1,148,026	4,580,321	....	788,391	6,565,562
1890	56,730	974,627	3,562,851	....	563,568	5,157,776
1891	99,983	1,921,643	6,288,088	....	353,736	8,663,450
1892	63,003	2,022,814	6,555,172	....	380,520	9,021,509
1893	57,017	1,732,481	6,248,255	....	338,143	8,375,896
1894	47,114	1,550,950	5,392,648	....	189,631	7,180,343
1895	61,424	2,117,425	8,055,473	....	211,473	10,445,795
1896	41,585	1,511,542	7,729,942	....	247,455	9,530,524
1897	*b* 32,227	1,406,019	7,057,261	....	146,668	8,642,175
1898	*b* 54,672	1,002,729	5,905,209	....	117,324	7,079,934
1899	*b* 40,164	1,125,892	6,740,884	....	134,691	8,041,631
1900	*b* 65,214	1,059,152	7,617,756	....	169,951	8,912,073
1901	*b* 51,551	1,094,078	8,385,514	....	150,268	9,681,411
1902	*b* 58,926	1,016,010	8,495,598	....	235,737	9,806,271

a Not separately classified after 1883. *b* Including rockingham ware.

EXPORTS.

In the following table will be found a statement of the exports of clay products from the United States from 1895 to 1902, inclusive:

Exports of clay wares of domestic manufacture from the United States, 1895–1902.

Year.	Brick.				Pottery.			Grand total (value.)
	Building.		Fire (value).	Total (value).	Earthen and stone ware (value).	China (value).	Total (value.)	
	Quantity.	Value.						
	Thousands.							
1895	4,757	$34,732	$88,729	$123,461	$114,425	$24,872	$139,297	$262,758
1896	5,258	32,759	102,636	135,395	144,641	24,702	169,343	304,738
1897	4,606	30,383	110,626	141,009	177,320	30,283	207,603	348,612
1898	4,708	32,317	146,632	178,949	212,769	39,052	251,821	430,770
1899	9,872	77,783	214,375	292,158	467,925	43,807	511,732	803,890
1900	12,526	128,800	594,237	723,037	489,942	68,852	558,794	1,281,831
1901	9,072	74,210	467,379	541,589	476,957	49,863	526,820	1,068,409
1902	3,995	31,304	470,130	501,434	555,340	49,306	604,646	1,106,080

It will be noted that the exports of brick and tile continue to decline, though the exports of earthenware and stoneware showed an increase in 1902.

CLAY PRODUCTS IN THE VARIOUS STATES.

The following tables give the statistics of the products of clay, by States, from 1898 to 1902, inclusive, for the more important clay-working States, and will be of interest to those who desire to compare the growth of the industries in these States for several years:

CALIFORNIA.

Clay products of California, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	108,076,000	129,512,000	119,906,000	146,522,000	181,040,000
Value	$598,823	$800,210	$698,583	$943,250	$1,291,941
Average per M	$5.54	$6.18	$5.83	$6.44	$7.14
Pressed—					
Quantity	2,342,000	3,642,000	1,751,000	3,787,000	6,099,000
Value	$54,700	$59,918	$32,584	$86,425	$119,302
Average per M	$23.36	$16.45	$18.61	$22.82	$19.56
Vitrified—					
Quantity		(a)		(a)	
Value		(a)		(a)	
Average per M		$10.00		$12.00	
Fancy or ornamental, value	(a)	(a)	(a)	$4,540	(a)
Fire value	$22,455	$28,798	$48,461	$87,665	$96,491
Stove lining do	(d)	$1,350	$2,100	(a)	$1,250
Draintile do	$9,660	$9,298	$8,141	$50,156	$10,459
Sewer pipe do	$404,633	$479,537	$357,867	$285,599	$381,076
Ornamental terra cotta do	$82,800	$76,000	$74,800	$141,380	$173,194
Fireproofing do	(a)	$7,100	$15,500	$12,825	$18,645
Tile, not drain do	(a)	$3,400	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware value	$23,751	$29,663	$22,387	$28,159	$40,012
Yellow and rockingham ware value		(a)			
Sanitary ware do		(a)		(a)	(a)
Miscellaneous b do	c $66,912	$92,244	$115,575	$129,156	$120,726
Total value	$1,263,734	$1,587,518	$1,375,998	$1,769,155	$2,253,096
Number of operating firms reporting	83	79	72	92	89
Rank of State	11	12	14	11	11

a Included in miscellaneous.
b Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
c Including pottery products of Washington and Oregon.
d Stove lining not separately classified prior to 1899.

CONNECTICUT AND RHODE ISLAND.

Clay products of Connecticut and Rhode Island, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	121,180,000	150,665,000	164,431,000	160,696,000	156,885,000
Value	$674,880	$751,239	$862,334	$822,079	$896,171
Average per M	$5.57	$4.99	$5.24	$5.12	$5.71
Pressed—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$15.37	$8.78	$15.02	$15.04	$9.09
Vitrified—					
Quantity	(a)	(a)	(a)	....	(a)
Value	(a)	(a)	(a)	....	(a)
Average per M	$12.58	$10.00	$12.00	....	$9.10
Fancy or ornamental, value	(a)	(a)	(a)	....	(a)
Fire ....value	(a)	(a)	(a)	(a)	(a)
Stove lining ....do	(b)	(a)	....	(a)	$12,750
Draintile ....do	....	....	(a)	....	....
Sewer pipe ....do	....	....	(a)	....	....
Fireproofing ....do	(a)	(a)	(a)	(a)	(a)
Tile, not drain ....do	(a)	....	(a)	....	....
Pottery:					
Earthernware and stoneware ....value	$16,100	$53,250	$44,250	$48,200	$48,100
Miscellaneous[c] ....do	$261,200	$269,713	$193,388	$260,630	$260,657
Total value	$952,180	$1,074,202	$1,099,972	$1,130,909	$1,217,678
Number of operating firms reporting	48	45	47	45	41
Rank of Connecticut and Rhode Island	16	20	20	21	21

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

GEORGIA.

Clay products of Georgia, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	114,309,000	201,991,000	195,463,000	222,111,000	223,705,000
Value	$530,346	$968,310	$982,083	$1,182,553	$1,114,527
Average per M	$4.64	$4.79	$5.02	$5.32	$4.98
Pressed—					
Quantity	2,433,000	8,505,000	5,591,000	5,325,000	5,150,000
Value	$26,250	$78,175	$49,800	$55,700	$46,560
Average per M	$10.79	$9.19	$8.91	$10.46	$9.04
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	....
Value	(a)	(a)	(a)	(a)	....
Average per M	$8.02	$6.25	$10.00	$7.69	....
Fancy or ornamental, value	....	(a)	(a)	$12,200	(a)
Fire value	$25,650	$24,400	$35,502	$35,000	(a)
Stove lining do	(b)	(a)	(a)	(a)	....
Draintile do	(a)	(a)	(a)	(a)	(a)
Sewer pipe do	$181,000	$100,612	(a)	$151,500	$174,008
Ornamental terra cotta do	(a)	(a)	$66,000	$71,800	$91,000
Fireproofing do	(a)	(a)	(a)	(a)	$21,650
Tile, not drain do	(a)	....	....	(a)	....
Pottery:					
Earthenware and stoneware value	$16,800	$28,268	$20,043	$16,410	$16,464
Yellow and rockingham ware value	(a)	....	(a)	(a)	(a)
Miscellaneous[c] do	[d]$77,212	$64,230	[d]$39,790	$19,920	$44,460
Total value	$857,258	$1,263,995	$1,193,218	$1,545,083	$1,508,669
Number of operating firms reporting	57	109	99	107	103
Rank of State	19	16	17	16	19

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
[d] Including pottery for Florida.

ILLINOIS.

Clay products of Illinois, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	573,450,000	664,684,000	685,161,000	930,561,000	1,023,681,000
Value	$3,205,674	$3,231,332	$3,981,577	$5,188,654	$5,131,621
Average per M	$5.59	$4.86	$5.84	$5.58	$5.01
Pressed—					
Quantity	26,953,000	26,941,000	26,040,000	19,241,000	20,943,000
Value	$246,416	$252,244	$240,989	$204,980	$240,466
Average per M	$9.14	$9.36	$9.25	$10.65	$11.48
Vitrified—					
Quantity	72,399,000	88,047,000	87,724,000	99,572,000	91,116,000
Value	$641,753	$700,524	$720,089	$899,454	$839,784
Average per M	$8.86	$7.96	$8.21	$9.03	$9.22
Fancy or ornamental, value	$30,453	$27,868	$15,705	$13,105	$11,893
Fire ... value	$117,465	$132,759	$175,239	$212,510	$199,048
Draintile ... do	$823,847	$1,026,192	$734,249	$694,588	$693,783
Sewer pipe ... do	$200,312	$229,040	$271,035	$348,716	$360,149
Ornamental terra cotta ... do	$510,000	(a)	(a)	$812,015	$1,000,765
Fireproofing ... do	$244,374	$198,360	$76,347	$263,276	$358,015
Tile, not drain ... do	$146,063	$130,085	$229,729	$229,746	$257,049
Pottery:					
Earthenware and stoneware ... value	$437,537	$624,927	$641,473	$598,549	$602,708
Yellow and rockingham ware ... value	(a)	(a)	...	(a)	(a)
C. C. and white granite ware ... value	(a)	(a)	(a)	...	$56,256
Semivitreous porcelain ware ... value	...	(a)	...	(a)	(b)
Miscellaneous c ... do	$262,821	$706,494	$622,407	$176,897	$130,303
Total value	$6,866,715	$7,259,825	$7,708,859	$9,642,490	$9,881,840
Number of operating firms reporting	635	643	569	550	515
Rank of State	4	5	4	4	4

a Included in miscellaneous.
b Included in C. C. and white granite ware.
c Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

INDIANA.

Clay products of Indiana, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	298,954,000	364,675,000	274,383,000	315,966,000	305,233,000
Value	$1,461,331	$1,727,697	$1,391,873	$1,624,133	$1,710,385
Average per M	$4.89	$4.74	$5.08	$5.14	$5.60
Pressed—					
Quantity	9,883,000	14,317,000	19,084,000	27,293,000	24,866,000
Value	$101,935	$139,978	$172,752	$234,775	$215,202
Average per M	$10.31	$9.78	$9.05	$8.60	$8.65
Vitrified—					
Quantity	28,316,000	28,120,000	30,326,000	31,468,000	45,933,000
Value	$265,496	$258,471	$331,276	$320,221	$441,494
Average per M	$9.38	$9.19	$10.92	$10.18	$9.61
Fancy or ornamental, value	$9,437	$8,841	$7,310	$8,160	$10,398
Fire ... value	$32,626	$72,350	$40,976	$51,526	$66,725
Stove lining ... do	(b)	...	(a)	(a)	...
Draintile ... do	$637,248	$839,046	$674,602	$772,241	$807,516
Sewer pipe ... do	$134,980	$161,935	$279,719	$253,626	$311,223
Ornamental terra cotta ... do	$43,100	(a)	(a)	(a)	(a)
Fireproofing ... do	$74,629	$62,575	$116,581	$91,081	$342,854
Tile, not drain ... do	$247,990	$328,041	$343,985	$478,130	$579,896
Pottery:					
Earthenware and stoneware ... value	$42,742	$54,606	$48,544	$54,371	$28,780
Yellow and rockingham ware ... value	...	(a)	...	...	...
C. C. and white granite ware ... value	(a)	(a)	(a)	(a)	(a)
Semivitreous porcelain ware ... value	...	(a)	...	...	(e)
Sanitary ware ... do	(a)	(a)	(a)	(a)	(a)
Miscellaneous [c] ... do	$280,483	$581,814	[d]$450,732	$578,190	$769,260
Total value	$3,331,997	$4,235,354	$3,858,350	$4,466,454	$5,283,733
Number of operating firms reporting	615	639	567	540	512
Rank of State	6	6	6	7	6

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
[d] Porcelain electrical supplies for Indiana included with New York.
[e] Included in C. C. and white granite ware.

IOWA.

Clay products of Iowa, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	198,417,000	220,384,000	222,744,000	249,318,000	228,142,000
Value	$1,189,067	$1,328,050	$1,386,641	$1,611,040	$1,575,959
Average per M	$5.99	$6.03	$6.23	$6.46	$6.91
Pressed—					
Quantity	6,730,000	17,280,000	8,013,000	8,785,000	7,504,000
Value	$54,832	$160,890	$79,682	$88,164	$80,711
Average per M	$8.15	$9.31	$9.94	$10.04	$10.76
Vitrified—					
Quantity	35,821,000	29,555,000	17,338,000	24,270,000	23,905,000
Value	$293,213	$225,044	$151,386	$241,108	$232,056
Average per M	$8.19	$7.61	$8.73	$9.93	$9.71
Fancy or ornamental, value	$993	$4,700	$1,750	$2,229	$1,690
Fire ...value	$6,275	(a)	$2,145	$1,810	$850
Stove lining ...do	(b)	...	(a)	...	...
Draintile ...do	$346,415	$359,568	$377,586	$534,935	$672,212
Sewer pipe ...do	$33,000	(a)	$52,462	$54,500	(a)
Ornamental terra cotta ...do	(a)	...	...	...	(a)
Fireproofing ...do	$2,161	...	$25,900	$59,270	$103,824
Tile, not drain ...do	$429	...	$5,450	$11,903	$2,590
Pottery:					
Earthenware and stoneware ...value	$31,075	$30,080	$31,339	$26,200	$43,387
Sanitary ware ...do	(a)	...	...	...	...
Miscellaneous[c] ...do	$225,562	$125,476	$176,910	$106,666	$130,057
Total value	$2,183,022	$2,233,808	$2,291,251	$2,737,825	$2,843,336
Number of operating firms reporting	368	372	358	341	325
Rank of State	8	8	8	8	8

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

KENTUCKY.

Clay products of Kentucky, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	86,701,000	103,994,000	113,863,000	115,977,000	112,728,000
Value	$433,508	$546,535	$608,334	$621,756	$659,612
Average per M	$5.00	$5.26	$5.34	$5.36	$5.85
Pressed—					
Quantity	3,659,000	2,505,000	2,282,000	2,486,000	6,172,000
Value	$27,004	$20,275	$21,098	$16,535	$47,027
Average per M	$7.38	$8.09	$9.25	$6.65	$7.62
Vitrified—					
Quantity	(a)	5,919,000	(a)	(a)	(a)
Value	(a)	$60,398	(a)	(a)	(a)
Average per M	$9.00	$10.20	$12.00	$12.71	$13.80
Fancy or ornamental, value	....	(a)	(a)	(a)	....
Fire ... value	$202,077	$334,630	$393,220	$377,741	$605,448
Stove lining ... do	(b)	....	(a)	(a)	(a)
Draintile ... do	$21,033	$36,132	$26,727	$29,498	$26,039
Sewer pipe ... do	(a)	(a)	(a)	$100,705	(a)
Ornamental terra cotta .. do	....	....	(a)	....	....
Fireproofing ... do	....	(a)	(a)	(a)	....
Tile, not drain ... do	(a)	(a)	(a)	(a)	$237,469
Pottery:					
Earthenware and stoneware ... value	$89,686	$104,605	$131,497	$139,697	$137,043
Miscellaneous [c] ... do	$227,632	$255,853	$300,448	$228,611	$160,405
Total value	$1,000,940	$1,358,428	$1,481,324	$1,514,543	$1,873,043
Number of operating firms reporting	92	111	118	117	111
Rank of State	15	14	12	18	15

[a] Included in miscellaneous.
[b] Stove lining, not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

MARYLAND.

Clay products of Maryland, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	121,831,000	111,479,000	117,830,000	113,457,000	141,235,000
Value	$722,473	$682,247	$724,013	$676,708	$879,995
Average per M	$5.93	$6.12	$6.14	$5.96	$6.23
Pressed—					
Quantity	5,890,000	14,335,000	4,439,000	5,772,000	3,457,000
Value	$87,433	$157,918	$60,729	$76,792	$45,375
Average per M	$14.84	$11.02	$13.68	$13.30	$13.13
Vitrified—					
Quantity	50,000	50,000	74,000	(*a*)	(*a*)
Value	$600	$700	$595	(*a*)	(*a*)
Average per M	$12.00	$14.00	$8.04	$15.00	$15.51
Fancy or ornamental, value	$3,669	$6,997	$9,886	$11,000	(*a*)
Fire ... value	$334,672	$325,812	$321,666	$342,055	$277,290
Stove lining ... do	(*b*)	$32,457	$36,049	$40,237	$21,540
Draintile ... do	$1,649	$3,673	$2,363	$2,402	$2,105
Sewer pipe ... do	....	(*a*)	(*a*)	(*a*)	(*a*)
Ornamental terra cotta ... do	(*a*)	....	(*a*)	(*a*)	(*a*)
Tile, not drain ... do	(*a*)	(*a*)	(*a*)	$16,586	(*a*)
Pottery:					
Earthenware and stoneware ... value	[c] $8,854	$15,225	$8,115	$13,374	$13,651
Yellow and rockingham ware ... value	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)
C. C. and white granite ware ... value	(*a*)	(*a*)	(*a*)	$176,637	$505,722
Miscellaneous[d] ... do	$383,503	$454,612	$548,440	$249,864	$159,684
Total value	$1,542,853	$1,679,641	$1,711,856	$1,605,655	$1,905,362
Number of operating firms reporting	74	66	55	66	68
Rank of State	10	11	11	13	13

a Included in miscellaneous.
b Stove lining not separately classified prior to 1899.
c Including District of Columbia.
d Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

MASSACHUSETTS.

Clay products of Massachusetts, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	195,228,000	230,437,000	198,693,000	170,455,000	241,376,000
Value	$1,074,106	$1,256,767	$1,123,586	$1,060,493	$1,529,671
Average per M	$5.50	$5.45	$5.65	$6.22	$6.34
Pressed—					
Quantity	6,526,000	3,710,000	4,884,000	6,950,000	3,631,000
Value	$134,170	$79,280	$87,575	$98,892	$69,230
Average per M	$20.56	$21.37	$17.93	$14.23	$19.07
Vitrified—					
Quantity	(a)	....	....	....	....
Value	(a)	....	....	....	....
Average per M	$9.00	....	....	....	....
Fancy or ornamental, value	(a)	(a)	(a)	$63,040	(a)
Fire .... value..	$175,180	$22,792	$69,400	$57,945	$54,342
Stove lining .... do....	(b)	$143,547	$144,044	$135,570	$133,752
Draintile .... do....	....	(a)	....	....	....
Sewer pipe .... do....	(a)	....	....	....	....
Ornamental terra cotta .. do....	$29,730	(a)	(a)	(a)	(a)
Fireproofing .... do....	(a)	$70,573	(a)	(a)	(a)
Tile, not drain .... do....	$19,594	....	(a)	(a)	$67,418
Pottery:					
Earthenware and stoneware .... value..	$182,824	$198,866	$176,902	$204,038	$206,808
C. C. and white granite ware .... value..	(a)	(a)	(a)	(a)	(a)
Miscellaneous[c] .... do....	$193,466	$409,885	[d]$231,594	$250,859	$314,446
Total value	$1,809,070	$2,181,710	$1,833,101	$1,870,837	$2,375,667
Number of operating firms reporting	106	111	101	90	90
Rank of State	9	9	10	10	10

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
[d] Includes pottery products of Maine.

MICHIGAN.

Clay products of Michigan, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	163,490,000	200,144,000	180,892,000	215,836,000	237,254,000
Value	$769,089	$933,176	$863,250	$1,095,254	$1,331,752
Average per M	$4.70	$4.66	$4.77	$5.07	$5.61
Pressed—					
Quantity	2,357,000	4,290,000	8,421,000	9,476,000	5,684,000
Value	$15,705	$58,920	$48,411	$64,031	$42,792
Average per M	$6.66	$13.73	$5.75	$6.76	$7.53
Vitrified—					
Quantity	3,198,000	(a)	(a)	(a)	(a)
Value	$34,395	(a)	(a)	(a)	(a)
Average per M	$10.76	$12.00	$12.42	$12.30	$12.26
Fancy or ornamental, value	$5,500	(a)	(a)	(a)	(a)
Fire value	(a)	(a)	(a)		
Stove lining do	(b)			(a)	
Draintile do	$149,911	$140,171	$114,747	$98,972	$96,645
Sewer pipe do	$45,567	$50,300	$57,916	(a)	(a)
Ornamental terra cotta do			(a)		
Fireproofing do	$2,800	$5,900	$2,350	$1,880	$3,290
Tile, not drain do			(a)		(a)
Pottery:					
Earthenware and stoneware value	$17,900	$29,641	$34,317	$42,465	$44,098
Miscellaneous [c] do	$2,495	$65,889	$60,704	$239,432	$225,463
Total value	$1,043,362	$1,283,997	$1,181,695	$1,542,034	$1,744,040
Number of operating firms reporting	178	196	189	180	182
Rank of State	14	15	18	17	16

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

MINNESOTA.

Clay products of Minnesota, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	128,327,000	145,333,000	152,497,000	157,727,000	190,035,000
Value	$626,110	$754,499	$811,457	$852,303	$1,085,515
Average per M	$4.87	$5.19	$5.32	$5.40	$5.71
Pressed—					
Quantity	2,250,000	3,955,000	4,520,000	5,506,000	6,280,000
Value	$22,370	$41,230	$46,830	$55,016	$75,850
Average per M	$9.94	$10.42	$10.36	$9.99	$12.08
Vitrified—					
Quantity	(a)	....	(a)	....	....
Value	(a)	....	(a)	....	....
Average per M	$20.00	....	$6.00	....	....
Fancy or ornamental, value	(a)	(a)	(a)	(a)	(a)
Fire ... value	(a)	....	(a)	(a)	(a)
Draintile ... do	$5,170	$11,400	$2,745	$6,739	$2,219
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Ornamental terra cotta .. do	(a)	....	....	....	(a)
Fireproofing ... do	$16,800	(a)	(a)	$35,700	$41,000
Tile, not drain ... do	(a)	....	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware ... value	[b] $303,215	$206,365	$278,795	$292,095	$370,725
Miscellaneous [c] ... do	$158,919	$205,203	$256,870	$306,794	$308,422
Total value	$1,132,584	$1,218,697	$1,396,697	$1,548,647	$1,883,731
Number of operating firms reporting	113	116	114	116	110
Rank of State	12	18	13	15	14

[a] Included in miscellaneous.
[b] Including pottery for Wisconsin.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

MISSOURI.

Clay products of Missouri, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	221,497,000	253,220,000	195,930,000	276,821,000	292,134,000
Value	$1,056,425	$1,345,792	$1,057,497	$1,595,031	$1,832,118
Average per M	$4.77	$5.31	$5.40	$5.76	$6.27
Pressed—					
Quantity	23,755,000	30,062,000	22,013,000	26,301,000	30,744,000
Value	$271,540	$281,797	$228,070	$298,158	$358,089
Average per M	$11.43	$9.37	$10.36	$11.34	$11.65
Vitrified—					
Quantity	28,036,000	22,594,000	28,019,000	25,860,000	22,288,000
Value	$264,092	$188,787	$252,783	$225,247	$194,250
Average per M	$9.42	$8.36	$9.02	$8.71	$8.72
Fancy or ornamental, value	$65,581	$49,219	$42,096	$62,108	$49,411
Fire ... value	$298,423	$375,023	$510,166	$620,116	$739,385
Stove lining ... do	(*a*)	(*b*)	(*b*)	$9,520	(*b*)
Draintile ... do	$85,748	$53,575	$57,900	$45,114	$35,887
Sewer pipe ... do	$403,075	$436,624	$624,932	$788,513	$903,279
Ornamental terra cotta ... do	$168,000	$184,495	$158,051	$223,554	(*b*)
Fireproofing ... do	$92,272	$26,257	$19,529	$59,043	$99,690
Tile, not drain ... do	$30,673	(*b*)	(*b*)	$60,202	$103,356
Pottery:					
Earthenware and stoneware ... value	$53,258	$70,169	$69,374	$62,647	$48,913
Miscellaneous[c] ... do	$323,629	$654,878	$716,169	$425,300	$802,036
Total value	$3,112,716	$3,666,616	$3,736,567	$4,474,553	$5,166,414
Number of operating firms reporting	233	289	267	259	235
Rank of State	7	7	7	6	7

[a] Stove lining not separately classified prior to 1899.
[b] Included in miscellaneous.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

NEW JERSEY.

Clay products of New Jersey, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	291,734,000	394,764,000	331,579,000	351,886,000	300,583,000
Value	$1,422,612	$1,809,906	$1,449,694	$1,675,746	$1,506,224
Average per M	$4.88	$4.58	$4.37	$4.76	$5.01
Pressed—					
Quantity	30,876,000	37,825,000	25,229,000	29,239,000	42,926,000
Value	$568,106	$609,819	$426,692	$473,138	$552,000
Average per M	$18.40	$16.12	$16.91	$16.18	$12.86
Vitrified—					
Quantity	(a)	(a)	(a)	2,251,000	1,014,000
Value	(a)	(a)	(a)	$22,024	$10,437
Average per M	$14.00	$12.80	$12.43	$9.78	$10.29
Fancy or ornamental, value	$15,852	$43,368	$4,112	$11,514	$11,407
Fire value	$519,688	$633,158	$1,072,535	$780,327	$819,580
Stove lining do	(b)	(a)	(a)	(a)	$8,477
Drain tile do	$13,762	(a)	$55,655	$22,612	$33,020
Sewer pipe do	$34,808	$99,000	$154,481	(a)	(a)
Ornamental terra cotta do	$635,007	$660,304	$647,884	$920,664	$861,730
Fireproofing do	$762,370	$653,144	$873,706	$610,864	$965,047
Tile, not drain do	$292,644	$37,123	$508,392	$436,122	$795,153
Pottery:					
Earthenware and stoneware value	$23,100	$59,500	$75,250	$82,009	$59,820
Yellow and rockingham ware value	(a)	(a)	(a)	(a)	(a)
C. C. ware do	$733,958	$751,444	$544,249	$443,455	$581,267
White granite ware do	$483,917	$442,354	$1,139,620	$1,486,263	$1,431,270
Semivitreous porcelain ware value	$439,356	$372,350	$375,926	$225,962	
China do	(a)	$494,870	$577,593	$665,948	$680,368
Bone china, delft, and belleek ware value	$52,500	$42,000	$65,800	$270,696	$90,840
Sanitary ware do	$1,477,192	$1,850,225	$1,843,358	$2,244,904	$2,807,322
Porcelain electrical supplies value	$182,000	$154,807	$285,466	$342,479	$358,496
Miscellaneous [c] do	$1,049,485	$2,073,901	[d] $828,010	[e] $917,151	[f] $1,040,805
Total value	$8,706,357	$10,787,273	$10,928,423	$11,681,878	$12,613,263
Number of operating firms reporting	139	159	149	160	154
Rank of State	3	3	3	3	3

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
[d] Includes pottery for New Hampshire.
[e] Also includes enameled brick valued at $177,128.
[f] Also includes enameled brick valued at $202,740.

NEW YORK.

Clay products of New York, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	926,711,000	1,246,756,000	1,009,041,000	1,016,237,000	1,061,712,000
Value	$4,486,175	$5,275,194	$4,266,715	$4,947,599	$5,021,132
Average per M	$4.84	$4.23	$4.23	$4.87	$4.73
Pressed—					
Quantity	19,017,000	24,796,000	19,204,000	18,721,000	18,963,000
Value	$260,135	$324,645	$249,078	$254,696	$249,573
Average per M	$13.68	$13.09	$12.97	$13.60	$13.16
Vitrified—					
Quantity	29,988,000	32,350,000	29,943,000	29,950,000	27,009,000
Value	$322,310	$342,845	$347,671	$343,343	$322,250
Average per M	$10.75	$10.60	$11.61	$11.46	$11.93
Fancy or ornamental, value	$8,665	(a)	(a)	(a)	....
Fire .... value	$386,624	$227,814	$360,933	$293,944	$402,006
Stove lining .... do	(b)	$74,507	$93,188	$115,054	$132,832
Draintile .... do	$74,072	$41,921	$89,019	$73,554	$110,301
Sewer pipe .... do	$89,224	$51,293	$94,293	$96,770	$209,105
Ornamental terra cotta .. do	$367,854	$417,350	$676,408	$754,911	(a)
Fireproofing .... do	$87,152	$108,961	$93,994	$98,947	$123,497
Tile, not drain .... do	$95,910	$91,645	$105,519	$140,890	$125,680
Pottery:					
Earthenware and stoneware .... value	$106,343	$67,899	$62,215	$76,068	$86,708
Yellow and rockingham ware .... value	(a)	....	....	....	....
C. C. and white granite ware .... value	(a)	....	(a)	(a)	(a)
China .... do	....	$336,680	$371,564	$441,667	(a)
Sanitary ware .... do	$38,213	....	(a)	(a)	(a)
Porcelain electrical supplies .... value	(a)	$125,234	$257,832	$310,214	$391,319
Miscellaneous [c] .... do	$394,656	$590,424	[d] $592,177	$344,061	$1,239,710
Total value	$6,717,333	$8,076,412	$7,660,606	$8,291,718	$8,414,113
Number of operating firms reporting	271	276	269	276	262
Rank of State	5	4	5	5	5

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
[d] Includes porcelain electrical supplies for Indiana and undecorated china for Ohio.

OHIO.

Clay products of Ohio, 1898–1902

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	356,780,000	467,888,000	411,532,000	489,275,000	538,552,000
Value	$1,786,549	$2,427,684	$2,232,090	$2,725,512	$3,091,847
Average per M	$5.01	$5.19	$5.42	$5.57	$5.74
Pressed—					
Quantity	29,809,000	48,829,000	40,923,000	69,405,000	63,815,000
Value	$308,019	$466,555	$433,086	$612,718	$674,822
Average per M	$10.33	$9.55	$10.58	$8.83	$10.57
Vitrified—					
Quantity	118,854,000	145,657,000	146,693,000	175,757,000	186,786,000
Value	$826,935	$1,133,509	$1,118,106	$1,443,537	$1,643,532
Average per M	$6.96	$7.78	$7.62	$8.21	$8.80
Fancy or ornamental, value	$23,070	$42,037	[a]$47,155	[a]$60,908	[a]$47,376
Fire value..	$568,278	$976,693	$1,340,775	$1,287,059	$1,327,982
Stove lining do....	([b])	([c])	([c])	([c])	$192,460
Draintile do....	$831,713	$977,773	$715,874	$707,409	$894,713
Sewer pipe do....	$1,304,756	$1,680,724	$2,243,386	$2,735,703	$2,646,134
Ornamental terra cotta..do....	$7,384	....	$2,857	([c])	$18,289
Fireproofing do....	$353,320	$346,090	$351,884	$357,284	$757,613
Tile, not drain do....	$661,921	$565,094	$690,257	$996,005	$1,156,371
Pottery:					
Earthenware and stoneware value..	$649,717	$748,170	$949,451	$952,329	$1,311,686
Yellow and rockingham ware value..	$187,649	$159,553	$175,176	$206,843	$129,591
C. C. ware do....	$663,530	$789,044	$1,056,226	$726,321	$729,526
White granite ware..do....	$2,224,264	$1,143,990	$2,767,837	$2,710,726	$6,757,661
Semivitreous porcelain ware value..	$1,337,495	$2,676,412	$2,251,213	$3,520,008	
China do....	$218,000	$424,428	([c])	([c])	([c])
Sanitary ware do....	([c])	([c])	([c])	([c])	([c])
Porcelain electrical supplies value..	$178,919	$190,314	$247,135	$325,664	$415,874
Miscellaneous[d] do....	$1,036,108	$1,752,555	$1,682,120	$2,206,959	$2,454,271
Total value	$13,167,627	$16,500,625	$18,304,628	$21,574,985	$24,249,748
Number of operating firms reporting	901	980	871	813	801
Rank of State	1	1	1	1	1

[a] Including enameled brick.
[b] Stove lining not separately classified prior to 1899.
[c] Included in miscellaneous.
[d] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

PENNSYLVANIA.

Clay products of Pennsylvania, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	621,464,000	782,944,000	744,663,000	875,631,000	949,718,000
Value	$3,466,619	$4,537,305	$4,484,590	$5,357,079	$6,074,352
Average per M	$5.58	$5.80	$6.02	$6.12	$6.40
Pressed—					
Quantity	56,130,000	88,784,000	54,068,000	70,207,000	77,746,000
Value	$671,791	$959,000	$596,559	$844,087	$966,530
Average per M	$11.97	$10.80	$11.03	$12.02	$12.43
Vitrified—					
Quantity	59,014,000	89,017,000	57,827,000	73,498,000	76,024,000
Value	$513,391	$702,782	$481,670	$670,081	$716,887
Average per M	$8.70	$7.89	$8.33	$9.12	$9.43
Fancy or ornamental, value	$76,043	$57,299	$57,279	$74,726	$20,972
Fire ... value	$2,876,331	$4,921,339	$4,587,991	$4,791,083	$6,080,213
Stove lining ... do	(c)	$106,851	$90,348	$86,190	$116,653
Draintile ... do	$11,461	$26,719	$8,420	$7,409	$9,317
Sewer pipe ... do	$224,385	$204,400	$522,650	$438,998	$550,481
Ornamental terra cotta ... do	$147,000	$139,100	$180,100	$314,900	$243,800
Fireproofing ... do	$98,717	$110,210	$95,957	$101,652	$138,839
Tile, not drain ... do	$136,706	(a)	$191,878	$188,525	$232,431
Pottery:					
Earthenware and stoneware ... value	$378,210	$277,156	$341,139	$431,433	$499,227
Yellow and rockingham ware ... value	(a)	(a)	(a)	(a)	(a)
C. C. ware ... do	(a)	(a)	(a)	...	(a)
White granite ware ... do		$201,057	$830,000	$839,903	$1,099,011
Sanitary ware ... do	(a)	(a)	...	(a)	$146,000
Miscellaneous [b] ... do	$1,114,029	$1,860,027	$920,167	$1,175,676	[d] $938,712
Total value	$9,714,683	$14,103,245	$13,391,748	$15,321,742	$17,833,425
Number of operating firms reporting	484	550	508	507	511
Rank of State	2	2	2	2	2

[a] Included in miscellaneous.
[b] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
[c] Stove lining not separately classified prior to 1899.
[d] Also includes enameled brick valued at $57,183.

TEXAS.

Clay products of Texas, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	112,564,000	174,472,000	170,124,000	222,459,000	217,461,000
Value	$638,702	$947,980	$964,743	$1,396,889	$1,353,489
Average per M	$5.67	$5.43	$5.67	$6.28	$6.22
Pressed—					
Quantity	1,635,000	7,316,000	3,827,000	10,138,000	6,844,000
Value	$16,974	$60,061	$35,605	$95,492	$73,619
Average per M	$10.38	$8.21	$9.30	$9.42	$10.76
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$9.33	$9.83	$8.96	$8.70	$9.23
Fancy or ornamental, value	$1,463	$3,147	$1,109	$1,339	$4,557
Fire .... value	$5,435	$23,234	$14,144	$23,337	$17,781
Draintile .... do	$2,600	$2,325	$2,164	$904	$2,766
Sewer pipe .... do	$26,150	$58,753	(a)	(a)	(a)
Fireproofing .... do	(a)	(a)	....	....	....
Tile, not drain .... do	(a)	....	(a)	$2,950	(a)
Pottery:					
Earthenware and stoneware .... value	$55,342	$74,052	$87,464	$90,876	$96,402
Miscellaneous[b] .... do	$71,131	$51,567	$65,788	$111,588	$145,200
Total value	$817,797	$1,221,119	$1,171,017	$1,723,375	$1,693,814
Number of operating firms reporting	148	125	193	201	172
Rank of State	20	17	19	12	17

[a] Included in miscellaneous.
[b] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

VIRGINIA.

Clay products of Virginia, 1898-1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	99,349,000	128,847,000	153,409,000	171,624,000	192,337,000
Value	$590,670	$765,598	$934,185	$1,139,894	$1,185,362
Average per M	$5.95	$5.94	$6.09	$6.64	$6.16
Pressed—					
Quantity	14,700,000	18,712,000	15,617,000	17,650,000	20,433,000
Value	$225,652	$242,137	$275,847	$267,028	$344,139
Average per M	$15.35	$12.94	$17.66	$15.13	$16.84
Vitrified—					
Quantity	(a)	5,000,000	3,692,000		
Value	(a)	$50,000	$44,067		
Average per M	$10.00	$10.00	$11.94		
Fancy or ornamental, value	$21,591	$16,117	$17,921	$20,429	(a)
Fire ... value	$4,476	(a)	$26,573	$3,971	$13,847
Draintile ... do	$7,830	$5,160	$3,285	$3,978	$4,240
Sewer pipe ... do	(a)		(a)		
Pottery:					
Earthenware and stoneware ... value	$6,400	$1,480	$925	(a)	(a)
Miscellaneous[b] ... do	$37,764	$13,292	$2,392	$4,047	$30,245
Total value	$894,383	$1,093,784	$1,305,195	$1,439,347	$1,577,833
Number of operating firms reporting	94	96	112	109	98
Rank of State	17	19	15	19	18

[a] Included in miscellaneous.
[b] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

WEST VIRGINIA.

Clay products of West Virginia, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	30,016,000	49,903,000	103,760,000	60,004,000	81,166,000
Value	$166,425	$269,656	$708,861	$348,452	$527,661
Average per M	$5.54	$5.40	$6.83	$5.81	$6.50
Pressed—					
Quantity	1,690,000	2,196,000	1,610,000	(a)	(a)
Value	$12,690	$16,218	$16,797	(a)	(a)
Average per M	$7.51	$7.39	$10.43	$7.12	$14.33
Vitrified—					
Quantity	38,166,000	53,451,000	53,492,000	62,805,000	60,549,000
Value	$328,266	$415,089	$474,880	$555,389	$578,777
Average per M	$8.60	$7.77	$8.88	$8.84	$9.56
Fancy or ornamental, value	(a)	(a)	....	(a)	....
Fire value	$29,155	$54,400	$149,257	$102,300	$23,633
Stove lining	(b)	....	(a)	....	....
Draintile value	$1,310	$3,656	$1,346	$1,485	$1,226
Sewer pipe do	(a)	(a)	(a)	(a)	(a)
Fireproofing do	(a)	(a)	....	....	....
Tile, not drain do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware value	(a)	$16,464	$9,827	$13,069	$15,018
C. C. and white granite ware value	(a)	(a)	(a)	$419,873	$1,026,446
Semivitreous porcelain ware value	(a)	(a)	....	(a)	(d)
Sanitary ware do	(a)	(a)	(a)	(a)	(a)
Miscellaneous [c] do	$560,729	$676,056	$655,797	$505,912	$345,783
Total value	$1,098,575	$1,451,539	$2,016,765	$1,946,480	$2,518,544
Number of operating firms reporting	47	55	53	53	53
Rank of State	13	13	9	9	9

[a] Included in miscellaneous.
[b] Stove lining not separately classified prior to 1899.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.
[d] Included in white granite ware.

WISCONSIN.

Clay products of Wisconsin, 1898–1902.

Product.	1898.	1899.	1900.	1901.	1902.
Brick:					
Common—					
Quantity	142,767,000	178,722,000	156,586,000	187,173,000	152,127,000
Value	$780,059	$1,073,101	$963,461	$1,151,838	$919,883
Average per M	$5.46	$6.00	$6.15	$6.15	$6.05
Pressed—					
Quantity	9,275,000	6,881,000	10,832,000	6,527,000	7,724,000
Value	$69,896	$60,213	$84,601	$54,379	$70,303
Average per M	$7.54	$8.75	$7.81	$8.33	$9.10
Vitrified—					
Quantity	(a)	(a)	....	(a)	....
Value	(a)	(a)	....	(a)	....
Average per M	$10.00	$15.00	....	$7.50	....
Fancy or ornamental, value	(a)	$1,975	$2,272	$2,105	(a)
Fire value	....	....	(a)	(a)	(a)
Draintile do	$22,007	$23,334	$14,995	$22,727	$17,763
Tile, not drain do	(a)	....	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware value	(b)	$13,145	(b)	$12,400	$12,285
Miscellaneous[c] do	$5,344	$639,944	$6,850	$4,095	$6,424
Total value	$877,306	$1,811,712	$1,072,179	$1,247,544	$1,026,658
Number of operating firms reporting	150	173	168	170	150
Rank of State	18	10	21	20	22

[a] Included in miscellaneous.
[b] Included with Minnesota.
[c] Includes all products not otherwise classified, and those made by less than three producers, in order that the operations of individual establishments may not be disclosed.

EFFECT OF TANNIN ON CLAYS.

By Heinrich Ries.

It is well known that the physical characters of a clay are important factors in determining its uses, and that many clays which might otherwise be of high value are often rendered useless because they are deficient in some one or two physical properties. This deficiency is sometimes overcome by mixing in a second clay which contains the desired physical quality developed in a large degree, and with this mixture it is then possible to obtain a material of the proper character. Many clays are used on account of their plasticity and tensile strength, the high development of these two qualities making them especially valuable as a bonding material for holding together nonplastic particles. An example of this is the use of a very plastic clay with the graphite in manufacturing graphite crucibles, the clay being used to bind together the particles of graphite.

During the year 1902 some interesting experiments were made, the object of which was to find some method by which the plastic and bonding qualities of a refractory clay could be increased to adapt it to crucible making. The experiments originated in the laboratory of Mr. E. G. Acheson, who was desirous of finding some highly plastic material to serve as a bond for siloxycon in the manufacture of refractory crucibles. With this end in view, he tried mixing a number of organic substances with clay, among them tannin, which yielded excellent results. He found that a clay mixed with water in which there was dissolved a small quantity of gallo-tannic acid became more plastic, tougher, and stronger, and required much less water to bring it to a given degree of softness or plasticity. Encouraged by the results he obtained, he tested quite a number of substances, among them spruce, sumac, catechu, tea leaves, and oak, by making infusions and wetting the clay therewith. The behavior of all these substances was like that of the gallo-tannic acid, though in different degrees. After Mr. Acheson had carried on these experiments for a series of months, the writer was asked to make independently a similar series of experiments, which he did, with the results given below.

The material used for treating the clay will be spoken of as a modifying agent, and of the tannins two kinds were employed, namely, gallo-tannic acid and catechu. It was also found, on Mr. Acheson's suggestion, that an emulsion of straw, although containing no tannic acid, produced similar effects.

The clays employed for the tests were the following:

1. Kaolin from the Harris mines, near Dillsboro, N. C. A whitish burning china clay of low plasticity, and one which burns to a rather porous body at moderate temperatures.
2. Kaolin from the Burgess Kaolin Company, at Hockessin, Del. Burns white with a slightly yellowish tinge, lacks in plasticity, and has moderately high air shrinkage.
3. Kaolin from southeastern Pennsylvania (probably South Mountain district). This is a whitish clay of poor plasticity, very low tensile strength, and cracks very badly in drying and burning, no matter what precautions are taken.
4. Ball clay from Florida. Plasticity fair, color white when burned, but tends to crack if too much is used in a pottery mixture.
5. A No. 1 fire clay from New Jersey. A clay of low tensile strength, but quite sticky and refractory. Cracks badly in drying and burning.
6. A white-burning clay from Georgia. A material of low plasticity and tensile strength, but very refractory.
7. Washed ball clay from Edgar's pits at South Amboy, N. J. This, again, is a clay of low tensile strength, and one which when used alone cracks badly in drying and burning.
8. A retort clay from Berry's pits, at Woodbridge, N. J. Clay of dense burning quality but not high tensile strength.

In all cases a decided improvement was noticeable.

CEMENT.[a]

INTRODUCTION.

The total production of hydraulic cement in the United States for 1902 was 25,753,504 barrels, an increase of 5,684,767 barrels over the quantity produced during the preceding year. The value of this production was $25,366,380.

Of the entire quantity, 17,230,644 barrels were Portland, valued at $20,864,078; 8,044,305 barrels were natural-rock, valued at $4,076,630, and 478,555 barrels were Pozzuolana or slag cement, valued at $425,672.

The growth of the cement industry is indicated by the fact that, although the increase in production for 1901 over 1900 reached the large number of 2,837,587 barrels, the increase in production for 1902 over 1901 was 5,684,767 barrels. It is of interest here to note that in 1892, just ten years ago, the entire production of cement in the United States was but 8,758,621 barrels, of which 8,211,181 barrels were natural-rock and 547,440 barrels were Portland.

PORTLAND CEMENT.

PRODUCTION.

There was an increase in the production of Portland cement in 1902 of 4,519,419 barrels. During the summer and autumn of the year there was a marked decline in the price of Portland cement in the Eastern States owing to a variety of reasons. This fact did not greatly affect the western production, however, nor was it a very lasting depression. The building of new factories, the enlargement and remodeling of old ones, and the steady and increasing demand for domestic Portland cement indicate a bright outlook for the future of the industry in this country.

[a] The entire statistical canvass and compilation of this report has been conducted by L. L. Kimball, of the United States Geological Survey.—D. T. D.

Following is a table showing the quantity and value of Portland cement produced in each State in 1900, 1901, and 1902:

Production of Portland cement in the United States in 1900, 1901, and 1902.

State.	1900.			1901.			1902.[a]		
	Number of works.	Quantity.	Value, not including packages.	Number of works.	Quantity.	Value, not including packages.	Number of works.	Quantity.	Value, not including packages.
		Barrels.			*Barrels.*			*Barrels.*	
Alabama							1		
Arkansas	1	40,000	$70,000	1			1		
California	1	44,565	89,130	[b] 1	146,848	$513,968	2	294,156	$431,910
Colorado	1	35,708	71,416	[c] 1	585,000	643,500	2	82,044	105,016
Georgia							1		
Illinois	3	240,442	300,552	4	528,925	581,818	4	767,781	977,541
Indiana	1	30,000	37,500	2	218,402	240,242	3	536,706	628,244
Kansas	1	80,000	100,000	1			1	830,050	1,017,824
Michigan	6	664,750	830,940	10	1,025,718	1,128,290	10	1,577,006	2,134,396
Missouri							1		
New Jersey	2	1,169,212	1,169,212	3	1,612,000	1,450,800	2	2,152,158	2,563,355
New York	8	465,832	582,290	7	617,228	617,228	10	1,156,807	1,521,553
North Dakota	1	400	1,200	1					
Ohio	6	534,215	667,769	[d] 7	689,852	758,837	7	563,113	685,571
Pennsylvania	14	4,984,417	4,984,417	13	7,091,500	6,382,350	15	8,770,454	10,130,432
South Dakota	1	38,000	76,000	1			1		
Texas	2	26,000	52,000	[e] 2	195,752	215,327	2	165,500	234,950
Utah	1	70,000	175,000	1			1		
Virginia	1	58,479	73,099	1			1	334,869	433,286
Total	50	8,482,020	9,280,525	56	12,711,225	12,532,360	65	17,230,644	20,864,078

[a] The States combined for 1902 are mentioned in the text.
[b] Includes product of the single plant in Utah.
[c] Includes product of the only Portland-cement plant in Kansas.
[d] Includes product of the only Portland-cement plant in Virginia.
[e] Includes product of the single plant in South Dakota.

In this table the output in 1902 of the single Portland-cement plant in Alabama is combined with the production of Georgia and Virginia to avoid disclosing individual figures; for like reasons the output of the only Portland-cement plant in Missouri (which in 1902 made simply an experimental run) is included with Kansas and South Dakota, and the output of the single plant in Utah is combined with California. In each case the total figures are placed against the name of that State contributing the largest proportion of the entire amount. The three new States to enter this table for 1902 as producers of Portland cement are Alabama, Georgia, and Missouri. New Mexico is dropped, owing to the fact that the plant in this Territory is definitely abandoned, so far as the cement industry is concerned.

Following is a table which shows the growth of the Portland-cement industry since 1890:

Development of the Portland-cement industry in the United States since 1890.

Section.	1890.			1899.			1900.		
	Number of works.	Quantity.	Per cent.	Number of works.	Quantity.	Per cent.	Number of works.	Quantity.	Per cent.
		Barrels.			*Barrels.*			*Barrels.*	
New York	4	65,000	19.4	7	472,386	8.4	8	465,832	5.5
Lehigh and Northampton counties, Pa., and Warren County, N. J	5	201,000	60.0	11	4,110,132	72.7	15	6,153,629	72.6
Ohio	2	22,000	6.5	6	480,982	8.5	6	534,215	6.3
Michigan	......	....	......	4	342,566	6.1	6	664,750	7.8
All other sections	5	47,500	14.1	8	246,200	4.3	15	663,594	7.8
Total	16	335,500	100.0	36	5,652,266	100.0	50	8,482,020	100.0

Section.	1901.			1902.		
	Number of works.	Quantity.	Per cent.	Number of works.	Quantity.	Per cent.
		Barrels.			*Barrels.*	
New York	7	617,228	4.8	10	1,156,807	6.8
Lehigh and Northampton counties, Pa., and Warren County, N. J	16	8,595,340	67.7	17	10,829,922	62.8
Ohio	7	689,852	5.4	7	563,113	3.3
Michigan	10	1,025,718	8.0	10	1,577,006	9.1
All other sections	16	1,783,087	14.1	21	3,103,796	18.0
Total	56	12,711,225	100.0	65	17,230,644	100.0

Pennsylvania continues to hold leading place as a producer of Portland cement, while New Jersey follows in second place. The counties of Lehigh and Northampton, Pa., formerly included all the factories producing Portland cement in the State; now, although they are still the center of that industry, there are 5 plants in other counties, none of them, however, ranking at present among the very large producers. Under all other sections is included the production of Alabama, California, Colorado, Georgia, Illinois, Indiana, Kansas, Missouri, South Dakota, Texas, Utah, and Virginia.

RELATION OF DOMESTIC PRODUCTION AND CONSUMPTION TO IMPORTS.

The increase, both in the use and in the production of Portland cement in the United States within the last thirteen years, as compared with natural-rock cement and with imported cement, is shown in the following table:

Comparative production of Portland and of natural-rock cement in the United States and of imports of hydraulic cement, 1890–1902.

Year.	Natural cement.	Portland cement.	Total of natural and Portland cement.	Imports.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*
1890	7,082,204	335,500	7,417,704	1,940,186
1893	7,411,815	590,652	8,002,467	2,674,149
1895	7,741,077	990,324	8,731,401	2,997,395
1897	8,311,688	2,677,775	10,989,463	2,090,924
1899	9,868,179	5,652,266	15,520,445	2,108,388
1900	8,383,519	8,482,020	16,865,539	2,386,683
1901	7,084,823	12,711,225	19,796,048	939,330
1902	8,044,305	17,230,644	25,274,949	1,961,013

This table does not include the production of Pozzuolana or slag cement reported by this Bureau for the last three years, which is as follows: 1900, 365,611 barrels; 1901, 272,689 barrels; 1902, 478,555 barrels.

Following is a diagram showing the growth of the domestic production of Portland cement, the increase of total consumption of Portland cement, and the decline of the imports of foreign hydraulic cements during the last thirteen years:

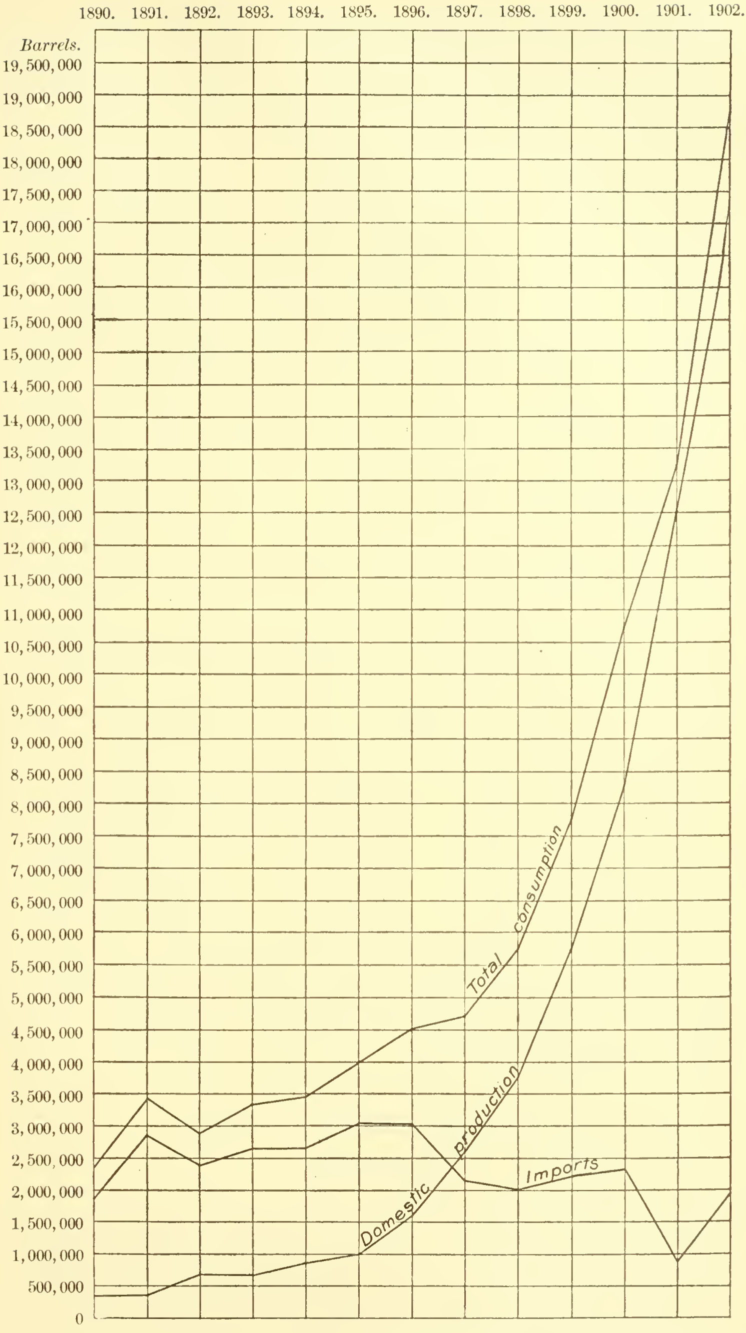

FIG. 1.—Diagram showing relation of domestic production of Portland cement to imports and to total consumption of Portland cement in the United States, by years and by barrels, from 1890 to 1902, inclusive.

The following table shows a comparison of the production of Portland cement in the United States with the entire amount of hydraulic cement imported in 1891, 1899, 1900, 1901, and 1902. The increase in the percentage of total consumption of the home product continues, 1902 marking the highest point yet reached.

Comparison of domestic production of Portland cement with consumption of all hydraulic cements, 1891–1902.

	1891.	1899.	1900.	1901.	1902.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Production in the United States	454, 813	5, 652, 266	8, 482, 020	12, 711, 225	17, 230, 644
Imports	2, 988, 313	2, 108, 388	2, 386, 683	922, 426	1, 961, 013
Total	3, 443, 126	7, 760, 654	10, 868, 703	13, 633, 651	19, 191, 657
Exports (domestic and foreign)		110, 272	139, 939	417, 625	373, 414
Total consumption	3, 443, 126	7, 760, 382	10, 728, 764	13, 216, 026	18, 818, 243
Percentage of domestic production to total consumption in the United States.	13. 2	73. 9	79. 1	96. 2	91. 6

The production and the annual percentage of increase in the last twelve years have been as follows:

Production of Portland cement, with increases each year, 1891–1902.

Year.	Quantity.	Increase.	Percentage of increase.	Year.	Quantity.	Increase.	Percentage of increase.
	Barrels.	*Barrels.*			*Barrels.*	*Barrels.*	
1891	454, 813	119, 313	35. 6	1897	2, 677, 775	1, 134, 752	73. 5
1892	547, 440	92, 627	20. 4	1898	3, 692, 284	1, 014, 509	37. 9
1893	590, 652	43, 212	7. 9	1899	5, 652, 266	1, 959, 982	53. 1
1894	798, 757	208, 105	35. 2	1900	8, 482, 020	2, 829, 754	50. 1
1895	990, 324	191, 567	24. 0	1901	12, 711, 225	4, 229, 205	50. 0
1896	1, 543, 023	552, 699	55. 8	1902	17, 230, 644	4, 519, 419	35. 6

The total consumption of all kinds of cement in the United States in 1902 was 28,627,429 barrels, an increase of 8,053,891 barrels over the total consumption of 1901.

NATURAL-ROCK CEMENT.

PRODUCTION.

The production of natural-rock cement in the United States during the calendar year 1902 amounted to 8,044,305 barrels, an increase of 959,482 barrels over 1901. The demand for the leading brands of this product was steady, and the prices a trifle higher than usual during the greater part of the year.

The following table shows the quantity and value of the natural-rock cement produced in the United States in 1900, 1901, and 1902:

Production of natural-rock cement in 1900, 1901, and 1902.

State.	1900.			1901.			1902.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
		Barrels.			*Barrels.*			*Barrels.*	
Georgia	1	28,000	$21,000	2	50,577	$40,967	2	55,535	$31,444
Illinois	3	369,276	129,446	2	469,842	187,936	3	607,820	156,855
Indiana and Kentucky	19	2,750,000	687,500	15	2,150,000	752,500	15	1,727,146	869,163
Kansas	2	146,000	58,400	[a] 2	175,560	97,002	2	160,000	80,000
Maryland	4	335,070	134,028	4	351,329	175,665	4	409,200	150,680
Minnesota	2	109,403	54,701	[b] 2	126,000	63,000	2	150,000	67,500
Nebraska	1	500	400	1					
New York	17	3,409,085	2,045,451	[c] 18	2,234,131	1,117,066	19	3,577,340	2,135,036
North Dakota				1			1		
Ohio	3	35,029	17,514	[d] 1	104,000	62,400	2		
Pennsylvania	5	687,838	343,919	7	942,364	376,954	6	796,876	340,669
Tennessee	1	10,000	8,000						
Texas	1	17,000	28,900	1			1		
Virginia	3	25,313	15,187	1			2	34,000	20,000
West Virginia	1			1			1	88,475	62,655
Wisconsin	1	461,005	184,402	2	481,020	182,788	2	437,913	162,628
Total	64	8,383,519	3,728,848	[e] 60	7,084,823	3,056,278	[f] 62	8,044,305	4,076,630

[a] Includes product of Nebraska and Texas.

[b] Includes product of North Dakota.

[c] The number of companies producing natural cement only, is given, and the number given for 1899 and 1900 has been changed accordingly, as in those years the *total* number of companies in the State was given.

[d] Includes product of Virginia and West Virginia.

[e] This total includes one plant in North Dakota, which for this year is reported as having a natural cement product.

[f] The States combined for 1902 are noted in the text.

The product of the single plant in North Dakota for 1902 has been combined with that of the only plants producing natural-rock cement in the States of Ohio, Texas, and West Virginia for the purpose of avoiding the publication of individual figures; otherwise the table shows the State totals and values in their exact relation. The product of the cement plant in North Dakota is still designated by its owners as a natural-rock cement. Although it tests beyond the usual standard and is stronger than the general run of natural-rock cement, it does not reach a condition which permits the company to class it as high-grade Portland cement.

As stated in another report, the number of plants given in the above tables includes only the active producers of cement. Such plants as throughout the year were idle, or were closed for remodeling or repairs, or were destroyed by fire and in process of rebuilding, are not taken into account here, but are noted in the report by States.

It should also be said that where one company has several different plants in the same State the product of all of them is classed as one product and the works as one plant; that is to say, the companies rather than the plants are counted. Of course, plants owned by one company but located in different States are credited, with their products, to the States in which they are built.

New York still ranks all other States as a producer of natural-rock cement, and the combined output of Kentucky and Indiana—known as the Louisville cement—holds second place.

POZZUOLANA OR SLAG CEMENT.

PRODUCTION.

The States reporting production of Pozzuolana or slag cement in 1902 were Alabama, which has two plants, Illinois, Maryland, New Jersey, and Ohio, each of which has but one slag cement plant. The total production amounted to 478,555 barrels, valued at $425,672, an increase of 205,866 barrels in quantity and of $227,521 in value over the production in 1901. The two plants in Alabama were run under the same management in 1902, one company having leased the plant owned by the other company in that State. The production of the Illinois Company was many thousands of barrels in excess of their 1901 production, and the mills of the Maryland company nearly doubled their production in 1902, though they were idle for about two months. The New Jersey plant ran slightly ahead of its 1901 production, and the Ohio plant was within a few thousand barrels of twice its production for 1901.

A large plant for the manufacture of slag cement, which will have a capacity of 500 barrels per day, is in process of erection by the Stewart Iron Company, of Sharon, Pa.

The best slag cement now ranks with American Portland cement and is used for the same purposes, except in sidewalk work. This is a matter of deep interest to iron-furnace men, to whom hitherto the slag has been a troublesome and expensive waste product.

SLAG CEMENT IN EUROPE.

A recent paper quoted in Le Génie Civil states that the manufacture of cement from blast-furnace slag has made great progress. In France there are now ten factories making this cement, one of which produces 80 tons a day. Belgium has five slag-cement factories; Luxembourg two, and Switzerland one. In Germany there are twelve plants, turning out about 150,000 tons per year, and in Austria two plants make 100,000 annually. This paper recommends the granulation of slag by running it into cold water as it is drawn from the furnace.

PRODUCTION OF CEMENT IN CANADA.

For the calendar year 1902 the production of cement in Canada was as follows: Portland, 594,594 barrels, valued at $1,028,618; natural rock, 124,400 barrels, valued at $91,870—an increase in Portland cement of 297,528 barrels, or over 100 per cent, and a decrease in natural-rock cement of 8,928 barrels, or about 6.5 per cent, as compared with 1901.

IMPORTS.

The table showing the imports of cement into the United States by countries is as follows:

Imports of hydraulic cement into the United States in 1898, 1899, 1900, 1901, and 1902, by countries.[a]

Country.	1898.	1899.	1900.	1901.	1902.
	Barrels	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
United Kingdom	241,198	199,633	267,921	37,390	79,087
Belgium	651,204	624,149	826,289	303,180	615,793
France	17,294	15,649	32,710	11,771	14,922
Germany	1,032,429	1,193,822	1,155,550	555,038	1,259,265
Other European countries	51,582	68,348	75,827	19,077	17,956
British North America	4,635	4,398	4,517	6,066	3,611
Other countries	15,476	2,389	23,869	6,808	4,153
Total	2,013,818	2,108,388	2,386,683	939,330	1,994,787

KILN REPORT IN 1902.

The approximate number of kilns of each kind that were reported to this office as in existence during the year is shown in the following table, although the number of kilns in idle plants was not always reported. It should perhaps be said that although Portland cement is burned in both the rotary and the dome or vertical kilns, natural cement is burned only in the latter kind, and never in the rotaries.

Number, kind, and condition of cement kilns in 1902.

Kind.	Active.	Idle.	Building.
Vertical	611	76	6
Rotary	456	9	46
Total	1,067	85	52

Of these kilns, many that were building have already been completed and put into operation, although others will not be ready for use for a year or more. The several companies producing only Port-

[a] This table shows total imports as contrasted with imports withdrawn for consumption used elsewhere in this report.

land cement and using nothing but vertical kilns for that production reported a combined output of nearly 400,000 barrels. This does not include any of the product of companies producing both kinds of cement. A rough estimate of all the Portland cement made in vertical kilns would place that output at something below 1,500,000 barrels, leaving the great bulk of the Portland cement manufactured in the United States to be credited to the rotary kilns.

PROCESSES OF MANUFACTURE.

Natural-rock, Portland, and slag cement are all hydraulic cements; that is, they possess the power of hardening under water.

Natural-rock cement is produced by burning an impure limestone at a comparatively low temperature. The stone best suited to the production of this cement is an argillaceous or clayey limestone, containing a certain percentage of lime, silica, and alumina. After the burning is accomplished the resulting clinker is ground to powder and packed in barrels or bags, and it is then ready to be put on the market. Of the natural-rock cements, the principal brands are Rosendale, from the region of the lower Hudson River; Louisville, from the Ohio valley, and Utica, Akron, and Milwaukee, from the localities indicated by those names.

Portland or artificial cement is made by grinding some form of carbonate of lime and clay to a coarse grit, mixing the required ingredients in exact proportions, and then burning the mixture at a high temperature to a point just short of vitrifaction. The clinker which results is ground to a fine powder and stored in bins, whence it is packed ready for shipment. In the dry process the ingredients are crushed, mixed, and then ground to a powder, which is fed directly into the rotary kiln, traversing it lengthwise, and passing out through a flame as clinker. In the wet or semiwet process the materials are mixed in exact proportions and made into a slurry, which is fed directly into a rotary kiln. Where Portland cement is burned in vertical or dome kilns, this slurry has to be dried and cut into blocks or bricks, which are packed in the kilns between layers of fuel. In all cases the burning for Portland must be under high temperature and the resulting clinker ground to powder. Of the Portland cements the Lehigh brands are from southeastern Pennsylvania, and those from New Jersey, Ohio, Michigan, and Texas are usually known by local or State names.

Pozzuolana, or slag cement, is made in this country of the slag from blast furnaces. Limestone is used as a flux for iron and other ores; its action is to flux the impurities, which pass off as slag. Upon issuing from the furnace this slag is granulated by a jet of cold water, as, if allowed to cool slowly from a state of fusion it loses some of its hydraulic property. It is then dried, mixed with crushed slacked lime, and ground to a fine powder, when it is ready for use. Like many of the Portlands, the slag cements are frequently named from the States or from the immediate localities in which they are made. It should perhaps be said that when slag is used in the production of a true Portland cement it must be dried, analyzed, and ground before it can be mixed with the crushed limestone in such a manner as to give proper proportions for the manufacture of Portland cement. The mixture of slag and limestone is then ground and fed into the rotary kilns for burning. The clinker that results is reduced to powder, which is the finished product, and is in every way equal to Portland cement made of other ingredients, provided the slag has been of the right quality and properly proportioned.

The materials suitable for the production of artificial cements cover a wide range.

In France, marls, chalks, and clays are used for the manufacture of Portland cements. In England, the Portland cement is made of white and gray chalks, mixed wet with the blue clay or mud from English rivers. In Germany, where the Portland cement industry is developed in the northern part of the country chiefly, marls and limestones are both used in combination with clays. In Belgium, lime or clay is added to the natural cement rock; chalk and clay are also used.

REVIEW OF THE CEMENT INDUSTRY IN THE UNITED STATES BY STATES.

By L. L. Kimball.

ALABAMA.

The manufacture of cement in Alabama is of very recent date, though an attempt to utilize the slag in the State was made in 1889. In 1899 the Birmingham Cement Company first succeeded in making slag cement from the waste material at the iron furnaces in Ensley, near Birmingham. In 1900 their plant was destroyed by fire; but it was at once rebuilt, as the production of cement had proved to be successful, and during the year a second plant for the manufacture of slag cement was projected by the Southern Cement Company. In 1901 the new company produced cement satisfactorily, and the Alabama Portland Cement Company began to make a first-class Portland cement at Demopolis, in Marengo County, using for the purpose clay and the limestone which is plentifully deposited in this State. At the present time these three are the only Alabama companies.

CALIFORNIA.

In 1860 a bed of hydraulic limestone was opened about a mile south of Vallejo, in Solano County, Cal., and a small cement mill was erected near Benicia, having a capacity of 100 barrels of natural-rock cement daily. This mill was operated, though not always to its full capacity, for about twenty-five years, its largest output being in 1872, when the plant turned out 25,500 barrels of excellent cement. About 1875 limestone suitable for use in producing natural-rock cement was exploited at Santa Cruz, in Santa Cruz County, and a plant for its production was erected there. Business complications and litigation prevented the factory from running, however, for more than a very short time.[a] In 1886 no cement was made in California, though the imports at San Francisco for that year amounted to 159,000 barrels, which were used largely in San Francisco and vicinity. A deposit of cement rock was opened at Niles, in Alameda County, about 1884, and

[a] The production of cement: Mineral Resources U. S. for 1883-84; U. S. Geol. Survey, 1885, p. 675.

the cement made there was reputed to equal the best brands of natural-rock cement. Its manufacture was, however, discontinued.[a] In 1890 an important discovery was made of large deposits of cement rock in the Coast Range of mountains near Sierra Peak, nearly 4 miles southwest of South Riverside, in southern California, and in 1891 this rock was analyzed and tested for use in producing Portland cement. It was found that a first-class quality of Portland could be produced from it without the admixture of any extraneous material. It was of the following composition:

Analysis of cement rock near South Riverside, Cal.[b]

Constituent.	Per cent.
Silica	24.34
Alumina	8.56
Lime	63.62
Magnesia	.40
Oxide of iron	2.08
Alkalies	1.00
Total	100.00

Reference to the ideal composition of a perfect Portland cement, given elsewhere in this report, will show how nearly the analysis of this rock approaches perfection. A plant was projected in this locality, but did not develop, though there has been talk of it at intervals since the discovery of this deposit.

In 1891 an unsuccessful attempt was made to reestablish works at Santa Cruz, and a small output of Portland cement was made by a new plant at Jamul, in San Diego County. The cheap price of foreign cements in 1891 had, however, a bad effect on this plant, and work there was discontinued for a time.[c] In 1894 a cement plant began operations at Colton, and this company has had a steadily increasing output since that time. They use the white coralline limestone, which is nearly a pure carbonate of lime and clay.[d] In 1897 a company was formed for the purpose of establishing a plant at Arroyo Grande, but the venture did not materialize, and in 1900 a plant was attempted at Benicia. This also was discontinued. In August, 1902, the Pacific Portland Cement Company began operations at Cement, in Solano County, and made a good record for the half year. It is quite possible that the plant projected in Riverside County may yet materialize, as the rock there offers exceptional advantages in its exposure, extent, and quality. It is nearly a hundred feet thick and has about 350 acres

[a] The production of cement: Mineral Resources U. S. for 1885, U. S. Geol. Survey, 1886, p. 409.
[b] The production of cement: Mineral Resources U. S. for 1889-90, U. S. Geol. Survey, 1891, p. 463.
[c] The production of cement: Mineral Resources U. S. for 1892, U. S. Geol. Survey, 1893, p. 743.
[d] The production of cement: Mineral Resources U. S. for 1894, U. S. Geol. Survey, 1895, p. 584.

surface area; it runs into the adjoining counties of San Bernardino and Orange and is underlain by a good bed of bituminous coal, which is mined on both sides of the mountain range adjacent to the cement-rock deposits. The fact that this location is directly within the great orange belt of southern California, where cement is largely used in constructing dams for irrigation and canals and also in building pipe lines, and the further fact that the railroad is near by are both greatly in favor of the undertaking.[a]

COLORADO.

In 1882 this Bureau reported the accidental discovery during the year 1881 of the hydraulic quality of the lime burned from one of the limestone beds near Canyon, Colo. Experiments made by Mr. Megrue were at first but slightly successful in producing a good cement. Later, however, a satisfactory result was attained. In 1882 a plant was erected at Denver and about 100 barrels of excellent cement were made, which, when tested, proved entirely equal to the tests. In 1883 the first entire kiln of cement was turned out, and for the first six months of that year the output of the Denver Cement Company was 385 barrels, which retailed at $4 per barrel. This company, with the Canyon City Iron, Paint and Cement Company, produced cement from the limestone of the Upper Silurian in the Hogback near Canyon.[b] The small demand during the winter months led to the closing down of these plants at the close of 1884. In 1885 the works of the Denver Cement Company were run part of the year, but the production was not large. In 1886 the plant was enlarged and an attempt was made to extend the sale of its product. In the report for 1886 made by this Bureau it is noted that a small production of cement was made at Canyon.[c] No further mention is made of this company until 1891, when the fact is noted that their capacity had been largely increased.[d] In 1894 the plant was destroyed by fire and not rebuilt. In June, 1900, the Colorado Portland Cement Company started their factory for the production of Portland cement at Portland, in Fremont County. The mills ran throughout the rest of 1900 and through 1901. In 1902 this company was consolidated with the Portland Cement Company, which had just located at Portland, and in 1903 these plants will be under one management. A company has been incorporated at Canyon, and, if it is successful, will produce both Portland and natural-rock cement. There is a large supply of material in Colorado from which an excellent cement, either natural or artificial, may be made. Limestones, calcareous marls, chalks, slags, and clays are all plentiful and can be had in favorable locations.

[a] The production of cement: Mineral Resources U. S. for 1890, U. S. Geol. Survey, 1891, p. 463.
[b] The production of cement: Mineral Resources U. S. for 1881, U. S. Geol. Survey, 1882, p. 462.
[c] The production of cement: Mineral Resources U. S. for 1886, U. S. Geol. Survey, 1887, p. 564.
[d] The production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 536.

ILLINOIS.

The construction of the Illinois and Michigan Canal led to the discovery of a very fine quality of magnesian limestone at Utica, Ill., in 1838. Experiments showed that the cement made from this rock was of unusual excellence, and in the same year Messrs. Norton and Steele erected a factory for the production of natural-rock cement, after having secured a contract to furnish this product for use in the construction of the canal. By the time this work was finished the Utica cement had an established reputation, and its annual production was continuous and uninterrupted. In 1845 the plant was purchased by Mr. James Clark, who operated it with great success for over thirty years. Improvements were made from time to time in the methods of manufacture and in the machinery used. When the kilns were first built they were located on the edge of the bluff near the river and the raw rock was brought to them by a horse-car railway, but later, as the business increased, patent processes for grinding and burning were used, and the rock was burned at the beds whence it came. In 1888 the plant was incorporated as the Utica Hydraulic Cement Company, and its capacity was largely increased. It is still successfully operated under this name.[a] The same formation of cement rock used at Utica is also available at Lasalle, and in 1869 the manufacture of natural rock cement was begun there, since which time it has been continuously carried on.[b] The production of Portland cement was begun in Illinois at Oglesby in 1894,[c] and a year later slag and limestone were utilized by the Illinois Steel Company at Chicago to make Portland as well as slag cement. At Oglesby limestone and shaley clays are used; this factory was burned in 1898 and rebuilt on a larger scale. Meantime, two plants had been built at Lasalle for the production of Portland cement, and another plant had become a successful producer of natural-rock cement at Utica. In 1886 the State production was 226,000 barrels of natural-rock cement; in 1890 it was 400,000 barrels. Five years later the Portland cement output amounted to 750 barrels, and the natural-rock cement output was 491,012. In 1900 there were 240,442 barrels of Portland produced and 369,276 barrels of natural-rock cement. The figures for 1902 are given elsewhere.

KANSAS.

Natural-rock cement has been made in Kansas since 1868, when mills for that purpose were erected at Fort Scott. During the previous year it was discovered that rock suitable for this manufacture existed in large quantities in the locality, and a specimen was analyzed by

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[a] Cummings, U., American Cements, 1898, p. 20.

[b] Ibid., p. 22.

[c] The production of cement: Mineral Resources U. S. for 1894, U. S. Geol. Survey, 1895, p. 581.

Prof. Louis Agassiz, who pronounced it to be "of superior value if properly calcined." The plant erected was a small one, and its first output was only 10 barrels per day. But the demand at that time was rather limited, and as it grew larger the company increased their production, making their first large shipment in 1870.[a] The mills have been running continuously since that time and in 1888 reported a production of 40,000 barrels of cement as their output for the season. The plant has been remodeled, having had new machinery and improvements added, and is now a large producer annually.

In 1889 a second plant for the production of natural-rock cement was started at Fort Scott, and these two are still the only ones in the State. The plant at Iola produces only Portland cement. The company owns a large area of land which is underlain by limestone having 95 per cent of carbonate of lime and shale having 75 per cent of silica and alumina. They have been in successful operation since 1900.

A description of the geological formation of eastern Kansas bearing upon the manufacture of cement may be found in the reports of the University Geological Survey of Kansas.

KENTUCKY AND INDIANA.

The discovery of a natural cement rock in Kentucky and Indiana was due, as in so many other cases, to the construction of a canal. In 1829, while the Louisville and Portland Canal was being built, in order to facilitate navigation around the falls of the Ohio, an excellent natural cement rock was discovered,[b] and Jno. Hulme & Co. began the manufacture of the now well-known Louisville cement in that year, at a small suburb of Louisville called Shippingport. This product, which was the first cement made in the West, was used in constructing the canal locks, and proved so satisfactory that the State of Kentucky continued to use it in making improvements on the Green, the Barren, and the Kentucky rivers. The value of this first Louisville natural-rock cement was shown by the fact that when in 1860, the enlargement of the Louisville and Portland Canal was begun the cement binding the stones together was found to be more firm and substantial than the stone itself. In 1832, at Clarksville, Mr. Vesey built a flour mill, which was shortly utilized to manufacture cement, and, after passing through many hands, was finally sold to Mr. W. F. Beach, who in 1873 had in operation four vertical kilns, with a total capacity of 400 barrels per diem.

For some years following the discovery of cement rock at Louisville the industry showed little growth, the census of 1850 recording for Kentucky but one cement factory, with four employees and a product

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[a] Hazelrigg, C. H., A New History of Kansas, p. 156.

[b] Lesley, R. W., Jour. Assoc. Eng. Socs., vol. 15, 1895, p. 198.

valued at $10,000. The census of 1860 reported one cement establishment, but gave $52,000 as the value of its product, and stated that 50 men were employed, showing a growth in the business of the plant if not in the number of factories. The census records for 1870 are not exact, but it is stated that 320,150 barrels of Louisville cement were sold during the year. The census of 1880 recorded no production of cement for Indiana, and gave Kentucky only two plants with a production said to be valued at $145,000. In 1883 this Bureau reported[a] 10 factories in the Louisville district, and in 1886[b] gave the output as 925,210 barrels. In 1890[c] the production amounted to 1,533,579 barrels, with a value of $1,150,184, and in 1899 there were 19 factories, with an output of 2,922,000 barrels, valued at $1,022,858.[d] The records showing the detail of growth in the production of cement in the Louisville district are meager and incomplete, but the product has long been known as a most trustworthy cement. In 1848 it was said by Colonel Long, of the Corps of Topographical Engineers, to be—

> a cement which, when used in the formation of subterraneous and submarine foundations, and other structures in similar situations, is unsurpassed by any material of the kind hitherto employed for such purposes in this or any other country.[e]

Among the natural-rock cements it ranks second to Rosendale only.

The production of Portland cement in Indiana is confined to the northern portion of the State, where the vast deposits of marl in the lakes and marshes furnish a material suited to this industry. In 1877 the first factory for the manufacture of Portland cement was erected by Mr. Millen, at South Bend. The materials used were marl and clay, and although the slurry had to be dried in bricks in order to admit of burning in the old-style dome or vertical kilns used at that time, the process was eventually successful, and the firm produced a well-known brand of Portland cement for a decade or more.[f] In 1886 Mr. Millen commenced the manufacture of Portland cement in New York State, leaving the original factory in other hands, and within a few years thereafter the plant at South Bend began to deteriorate. In 1893 it was shut down, and has not been a successful producer since that time.[g] That fact, however, is in no wise due to the lack of good materials in this locality, as is shown by the production during 1902 of over half a million barrels of cement by the three companies now operating there. In 1900 the Wabash Portland Cement Company commenced to make Portland cement at Stroh, in Lagrange County, and has been an

[a] The production of cement: Mineral Resources U. S. for 1883, U. S. Geol. Survey, 1884, p. 672.
[b] The production of cement: Mineral Resources U. S. for 1886, U. S. Geol. Survey, 1887, p. 556.
[c] The production of cement: Mineral Resources U. S. for 1890, U. S. Geol. Survey, 1891, p. 461.
[d] The production of cement: Mineral Resources U. S. for 1899, U. S. Geol. Survey, 1900, p. 407.
[e] Gillmore, Q. A., Practical treatise on limes, hydraulic cements, and mortars, 11th edition, 1896, New York, pp. 59–60.
[f] Twenty-fifth Ann. Rept. Geol. and Nat. Resources of Indiana, 1900, p. 24.
[g] Ibid., p. 27.

increasingly successful producer since that time.[a] In 1901 the plant erected at Syracuse, Kosciusko County, by the Sandusky Portland Cement Company, of Ohio, reported a large production,[b] and in 1902 the plant of the Lehigh Portland Cement Company, of Pennsylvania, erected at Mitchell, Lawrence County, contributed a fair part of the entire output.

The success which has been so marked in the State of Michigan, where similar materials for the manufacture of Portland cement are in use, should be repeated in northern Indiana as the demand for and uses of Portland cement increase.

MARYLAND.

Up to the present writing there has been no attempt to manufacture Portland cement in Maryland, notwithstanding the fact that limestones, clays, shales, and marls, well situated relatively and suitable for the purpose, are distributed liberally through the State. The manufacture of natural-rock cement is, however, an industry of long standing. Rock suitable for use in this capacity was first discovered in Maryland in 1836, during the building of the Chesapeake and Ohio Canal, at a place called Round Top, which is about three miles southwest of Hancock. A cement plant was established here, which is still in existence. It was operated by Mr. George Shafer until 1862, when it was sold to Messrs. Bridges and Henderson, who now own and manage it. The plant averages more than 60,000 barrels per annum.[c] The Cumberland Hydraulic Cement and Manufacturing Company, whose plant was started in the same year, has been a successful producer of an excellent brand of natural-rock cement ever since that time. Their quarries are on the south bank of Wills Creek, where the Helderberg rocks are finely exposed and where a series of natural folds in the beds admit of the convenient working of them. The product of this plant is more than 100,000 barrels yearly. The Antietam Cement Company, near Sharpsburg, formerly produced a good grade of cement from the Trenton limestone of the same formation that farther north is used in Pennsylvania and farther west is worked near Shepherdstown, W. Va. The works were started in 1888; they are now successfully operated by another company. There were also works at Lansdowne a number of years ago, but they have been idle since 1892. Besides the companies already noted are the Potomac Hydraulic Cement Company and the Cumberland and Potomac Cement Company, each of which has been under successful management for a number of years.[d] In addition to these plants there is

[a] Twenty-fifth Ann. Rept. Geol. and Nat. Resources of Indiana, 1900, p. 27.
[b] Ibid., p. 28.
[c] Maryland, its resources, industries, and institutions, 1893, Baltimore, p. 139.
[d] Ibid., p. 139.

at Sparrows Point a plant where slag cement of good quality is produced. This plant has been in successful operation for more than five years. The production of natural-rock cement in Maryland in 1890 was 223,209 barrels,[a] in 1900 it was 335,070 barrels, and in 1902 it was 409,200 barrels.

The slag used for the manufacture of cement in Maryland is produced by the blast furnaces at Sparrows Point, where limestone and marble are used as a flux. Much of this stone comes from Texas, in Baltimore County, where there is a large quarry whence an average of 400 tons daily is shipped to Sparrows Point. There are also extensive limestone quarries at Cavetown, in Washington County. Besides the use of this limestone as a flux for blast furnaces, large quantities of the stone from the numerous quarries at Texas are used for burning lime; the limestone from Lochraven is also used for this purpose, as is that from Westminster and New Windsor.[b]

The slate belt in Maryland forms a narrow zone, which begins a short distance east of the Susquehanna River and passes in a southwest direction through the southeastern corner of York County, Pa., terminating near Pylesville, on the Baltimore and Lehigh Railroad, Maryland. At the present time nearly all the active quarries are in Harford County.[c]

MINNESOTA.

Minnesota has produced natural-rock cement for many years, the older of the two plants in that State having been active for nearly twenty-five years. It is situated just south of Mankato, and fronts on the Blue Earth River, where the rock formation yields a very superior quality of cement. This rock is a compact, finely grained, siliceous limestone, actively hydraulic, and the cement produced from it sets quickly and is very durable. The superficial area of the quarry is about 90 acres, and clay deposits are found abundantly in the neighborhood. This plant has been steady in its output and yields a successful annual production.[d] Until 1895 it was the only plant in Minnesota, but during that year a factory in Austin, Mower County, was opened,[e] and since then the two have produced all the cement made in the State. No production of Portland cement has as yet been attempted here.

NEW JERSEY.

The cement industry in New Jersey is an old one, though the earlier product was a natural-rock cement, and the present output is entirely Portland cement. The State Geological Survey made a very complete

[a] Production of cement: Mineral Resources U. S. for 1890, U. S. Geol. Survey, 1891, p. 532.
[b] Maryland, its resources, industries, and institutions, 1893, Baltimore, p. 138.
[c] Ibid., p. 133.
[d] The State of Minnesota, by State Board of Immigration, 1885, St. Paul, p. 146.
[e] Production of cement: Mineral Resources U. S. for 1895, U. S. Geol. Survey, 1896, p. 891.

and valuable report on the geology of New Jersey in 1868, and on page 525 of that volume the statement is made that limestones had been used at a few places in the State for cement manufacture, though none was then being made; that when wood was used as a fuel in lime burning the magnesian limestones yielded a product having hydraulic properties, but that since coal had been introduced the additional heat, or burning at higher temperature, caused the product to lose its hydraulic property, and that the so-called cement layers of rock were no longer used for the manufacture of cement. This report further states that at Johnsons Ferry, in Hunterdon County, opposite Durham, Pa., there is an old quarry, near the Presbyterian Church, which was worked for rock to make the cement used in building the "locks on the feeder," but that the quarry was not worked at that time (1868). It mentions that along the Delaware River the Corniferous limestone had been used at Dingmans Ferry as a source of cement. In 1890 the erection of a plant for the manufacture of Portland cement was begun at Alpha by Mr. T. D. Whitaker, who turned out his first product in 1891. In 1895 this plant, which had been in constant operation since its establishment, was sold to the present owners, the Alpha Portland Cement Company, and is one of the largest producers in the country. In 1894 the Vulcanite Portland Cement Company, which also produces annually a very large output, built a plant at Vulcanite, near Alpha. The raw material used by these plants is closely similar; in each case the land is underlain by the cement rock, which has a depth of more than 160 feet.[a]

Following these plants, mills were erected at Clinton and at Stewartsville. The Alpha Company also have an additional mill at Phillipsburg. At Perth Amboy the plant making cement produces a slag or Pozzuolona cement. Two companies have been incorporated in this locality which have not materialized. The Edison plant, which is located at Stewartsville, will probably have an output in 1903. The company owns about 600 acres of land a few miles northeast of the Alpha and the Vulcanite properties, and if the process used proves to be successful it is designed to so enlarge the plant as to have an output of 10,000 barrels per day. The present capacity is about 2,500 barrels per day.

For an extended description of the deposits in New Jersey of materials suitable for the manufacture of cement, reference may be made to the annual reports of the geological survey of New Jersey for 1899–1900.

NEW YORK.

History begins, in so far as the cement industry in New York State is concerned, with the discovery of a natural cement rock about 1818 by Mr. Canvass White at or near Chittenango, Madison County.

[a] Production of cement: Mineral Resources U. S. for 1894, U. S. Geol. Survey, 1895, p. 584.

After some experimenting, a process for producing good cement from this rock was found by Mr. White, who then applied to the State for an exclusive right to manufacture the product for twenty years. Such a right was refused, but instead he was presented by the State with $20,000 in recognition of his valuable discovery.[a] His cement was first used in building the Erie Canal, as shown by the following extract from a letter written June 24, 1820, by Mr. Benjamin Wright, chief engineer of the canal, touching the subject of the lime used in the subaqueous construction of the canal:[b]

The specimen of argillo-ferruginous limestone herewith presented is found in great abundance in the counties of Madison, Onondaga, and Cayuga, State of New York. When found in place, it is always under the blue lime, which is uniformly overlain by gray lime. * * * The whole is 6 or 8 feet in thickness. Under the blue lies the first described, which is found to be a superior water cement and is used very successfully in the stonework of the Erie Canal and believed to be equal to any of the kind found in any other country. * * * I do not know that it is found in the counties west of Cayuga, but presume from the geological character in that county it may be found in all the country west to Niagara, and probably farther west. It is pulverized (as it will not slack) and then used by mixing two parts lime and one part sand. It hardens best under water. * * * Mr. Canvass White, a friend of mine, has obtained a patent for it when used for hydraulic purposes. * * * For cisterns it will be much used, no doubt, and for all the principal erections of stonework for canals it is indispensable.

The price of this lime—pulverized, burnt, and delivered at Utica—was 20 cents per bushel, and the analysis of it, made in 1821 by Doctor Hadley, is as follows:

Analysis of Madison County (N. Y.) hydraulic lime, 1821.

Constituent.	Per cent.
Carbonic acid	35.05
Lime	25
Silex	15.05
Alumine	16.05
Water	5.03
Oxide of iron	2.02
Total	98.20

Mr. Myron Holley, one of the Erie Canal commissioners, wrote from Albany, in January, 1821, as follows:

Mr. White, one of our engineers on the Erie Canal, and a man of good character and useful attainments, discovered in the course of the season before last material for making an excellent waterproof cement, existing in great abundance in the western district of this State, and we have made extensive and profitable use of this discovery in the locks and other mason work of the Erie Canal. It is probably superior to Parker's Roman cement in quality, and may be afforded at less than half the expense of that. It will therefore probably soon come into general use throughout our country wherever such a cement is required.

[a] Sylvester, N. B., History of Ulster County, N. Y., 1880, p. 240.
[b] Am. Jour. Sci., vol. 3, 1821, p. 230.

A few years after this, when the Delaware and Hudson Canal was being constructed, it was assumed that the cement used would, of necessity, be brought from Madison County, but during the summer of 1825 a cement rock similar to that at Chittenango was found at High Falls, in Ulster County, which, under test, proved to be of excellent quality, and for that reason the purchases from Chittenango ceased.[a] The first specimen of the rock at High Falls was burned in a blacksmith's forge and reduced to powder by pounding. In 1826 the first cement mill was built below High Falls, and, this proving insufficient for the necessary grinding, others were soon erected. In 1828 a mill was erected at Rosendale, in Ulster County. This locality quickly became a leading center for the production of natural-rock cement, and it has remained so ever since. Extensive works were also erected by Mr. Hugh White at Whiteport, and others soon appeared in the vicinity. The kilns for these pioneer mills were built small, and wood was the fuel used for burning. At the bottom of the kiln an arch was formed to contain the wood; the kiln was filled with cement rock; a fire was lighted and kept burning for six days and nights, and at the end of this time the stone was supposed to be sufficiently well cooked. Frequently unfavorable weather or inexperienced burning caused the whole kilnful to come out either worthless cinders or raw stones. At best the entire product of a kiln for the week was not more than 25 barrels. After the Delaware and Hudson Canal had been in operation for a short time kilns were so constructed as to admit of daily drawing. These were called "draw kilns," and coal was used in them instead of wood. So great was the improvement that an output of 550 or 600 barrels was the result of a burning that under the old method would have yielded but 25 barrels. At this time water power was used for grinding, and a production of 4,000 or 5,000 barrels of cement was regarded as a good season's business.[b]

With the completion of the Delaware and Hudson Canal the manufacture of cement ceased to a great extent, but it began to revive when Louis Elmendorf reopened the old Snyder mill and commenced the manufacture of natural-rock cement for the general market. Cement rock had been discovered at Williamsburg, Erie County, and a mill was erected there. In 1839 cement rock of an exceptionally high grade was found at Akron, also in Erie County, and since then the output of cement from there has been continuous.[c]

In 1840 beds of limestone yielding hydraulic cement were extensively worked in the vicinity of Kingston, Rosendale, Lawrenceville, and High Falls, and there were 60 kilns burning natural-rock cement,

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[a] Sylvester, N. B., History of Ulster County, N. Y., 1880, p. 240.
[b] Ibid., p. 244.
[c] Cummings, U., American Cements, 1898, p. 20.

the season's output being about 600,000 barrels. Mr. Mather states[a] that—

White's quarries and kilns are the most numerous, and turn off about 600 barrels of cement per diem. Mr. White contracts with the quarrymen to quarry and burn the stone for 25 cents per barrel, while he furnishes the fuel (dust anthracite from screened coal), delivered at the kilns, removes the cement to the mills, grinds, and barrels it.

In 1847 Mr. White's property passed into the hands of the present Newark and Rosendale Lime and Cement Company. The growth of the cement industry from this time on was gradual, but steady. A letter from Messrs. Newman & Bro., written in March, 1859, says:[b] "We are now burning 100 barrels on account of the dullness of the market; we can burn 130 barrels every twenty-four hours with three cords of wood." Mr. Newman further speaks of the great improvement made in the cement from his factory by the introduction of the newly patented "flame" kiln, made to replace the "draw" kiln. This new patent had a vertical division wall, extending a little above the level of the furnaces, which prevented a horizontal draft through the kiln. It was so constructed that either coal or wood could be used for fuel. In order to test the advantages claimed for this new kiln, the Newark and Rosendale Company erected one in the fall of 1859 with very satisfactory results. Since that time the plants and methods for burning natural-rock cement have undergone no radical changes, the business having been carried on along the lines which experience proved to be trustworthy with entire success.

From time to time, as new outcrops of the stone, which is now known to be abundant in the State, were found, new plants for the making of natural-rock cement were established. In 1870 a plant was erected at Howe Cave, Schoharie County. In 1874 the Buffalo Cement Company began manufacturing cement at Buffalo, Erie County. In 1877 they rebuilt their factory on a larger scale to increase its capacity. Both these localities continue to yield a uniformly good quality of cement.[c]

It was about this time that efforts were made to produce a good Portland cement in this State. Experiments were tried in Ulster County, but the cost of production was found to be prohibitive, and the supply of Portland continued to come from abroad, chiefly from England, whence it had been imported since 1865, being first used but sparingly for the more difficult kinds of engineering work. In those years the imports were small and the prices large, but as work could be done with it which could not be done with natural-rock cement, the imports increased, and the manufacture of a good American Portland cement became a demand which, at last, created the supply. Mr. Lesley

[a] Mather, W. W., N. Y. Nat. Hist. Survey, Geology 1st Dist., 1843, p. 329.
[b] Gillmore, Q. A., Limes and hydraulic cements and mortars, 1896, p. 133.
[c] Cummings, U., American Cements, 1898, p. 22.

states[a] that the Buffalo Portland cement, of which small quantities were manufactured from 1878 to 1885, was due to the discoveries and patents of Uriah Cummings and L. J. Bennett, who found out that by selecting overburned material from the natural-rock-cement kilns of the Buffalo Cement Company and using it for the manufacture of Portland cement a material closely resembling the imported Portland could be made. In 1881 Portland cement of good quality was made by the Wallkill Portland Cement Company, and in 1884 prices of American Portland were quoted as far west as California.

In 1885 nothing new developed, the product of New York consisting chiefly of natural-rock cement. In 1886 the Empire Portland cement plant was erected at Warners, Onondaga County, by Messrs. Thomas and Duane Millen, for the production of Portland cement from the marl and clay found in abundant quantities in that vicinity. These gentlemen had been successful in producing a first-class Portland cement from similar material in northern Indiana for a number of years, and were no less successful in New York, though the entire amount of Portland cement made in the State in 1886 was considerably less than 50,000 barrels, while the natural-rock production amounted to 2,620,856 barrels, or more than half the entire production of natural-rock cement in the United States. The growth of the Portland cement industry was steady, however, and the demand for American Portland continued to increase. In 1890 the supply had increased to meet this demand, and the output of the single plant at Warners was over 60,000 barrels.

Other plants in the State producing Portland cement had met with varying success. In 1889 the one at South Rondout was burned down and not immediately rebuilt. Within the next five years, however, the progress of the industry in this State was rapid. In 1893 a large plant for the manufacture of Portland cement was erected at Glens Falls, Warren County, which has since been a successful and continuous producer. In the same year a factory, which had been erected at Montezuma on an old site, was burned. It had produced Portland cement successfully for a year, but was not rebuilt. In 1892 Millen & Son began making Portland cement at Wayland, Steuben County, and they, too, had a disastrous fire in 1893. Their plant was rebuilt, however, and has been prosperous since that time.

In 1890 the production of natural-rock cement was about 3,500,000 barrels in New York State, and the progress of this industry during the next few years was steady, though not so rapid as that of the Portland-cement industry. Prices for natural-rock cement were slightly depressed in 1893, but the enormous production made it possible to obtain a profitable percentage on the capital invested, and within a

[a] Lesley, R. W., Journal Assoc. Eng. Socs., vol. 15, 1895, p. 200.

short time prices again advanced. There was also a falling off in the prices of American Portland cement in 1893, but in spite of this fact the total production of the State increased to 159,320 barrels, the production of natural-rock cement for that year being 3,939,727 barrels. From this time until 1901 the growth of the Portland-cement production was as marked as it had been during the years immediately preceding. New York has never been so prominent in the production of Portland as of natural-rock cement, possibly because the latter industry so greatly antedates the former. But in 1901 the number of factories in the State making Portland cement had increased from four (in 1895) to seven, of which five were devoted exclusively to its production, the other two making both kinds of cement. The output of natural-rock cement, always increasing until 1900, decreased in that year and in 1901. In 1902 it again increased.

The total State production for 1897 was 394,398 barrels of Portland and 4,259,186 barrels of natural-rock cement; for 1899 it was 472,386 barrels of Portland and 4,689,167 barrels of natural-rock; for 1901 it was 617,228 barrels of Portland and 2,234,131 barrels of natural-rock cement, and for 1902 it was 1,156,807 barrels of Portland and 3,577,340 barrels of natural-rock cement.

NORTH AND SOUTH DAKOTA.

The cement industry in South Dakota is of earlier date than that in North Dakota. The plant at Yankton, S. Dak., was built in 1889, and had its first production of Portland cement in 1890.[a] It has been in successful operation since that time and is now in process of enlargement. The materials used are chalkstone of the Colorado Cretaceous and a dark, fat clay overlying it, commonly known as the clay of the Pierre epoch. The clay is also found below, and in the chalk. This formation covers many hundred square miles northward from the southern boundary of the State, and at Yankton has a thickness of 150 feet.[b] The plant is built on the north side of the Missouri River, about four miles west of Yankton, with which it is connected by rail.

In North Dakota the only cement factory is that at Pembina, on the Tongue River. It was erected about five years ago, and was originally planned to produce a high grade of Portland cement. The tests did not reach a sufficiently high standard to admit of this, however, and the company now puts out its product as a natural-rock cement, though it is far stronger than the usual requirements of such a product.[c] A soft, chalky clay is the material used for making the cement; it outcrops from a hillside, and is more than 50 feet in thickness. The factory was built with great regard to economy of labor and material,

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[a] Production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 536.

[b] South Dakota Geol. Survey Bull. No. 3, 1902, p. 100.

[c] Production of cement: Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, p. 722.

and has been a successful though not a very large producer since it started. The scarcity and high cost of fuel in this section of the country is a factor which enters largely into the success or failure of cement making here.

OHIO.

Numerous cement plants are scattered throughout the entire State of Ohio. Among the first to be established was a small plant at Sandusky, which was abandoned after a short time. The next venture in cement manufacturing was made by Mr. Gleason, at Defiance. He succeeded in producing an excellent article, which he called the Auglaize cement, and which was made from the lowest and most calcareous layers of the Huron shale.[a] This plant was established in 1846, and has been operated, though not continuously, ever since. It is now managed by Messrs. Wilhelm and Gorman. In 1858 the firm of Messrs. Parker & Sons began to manufacture cement at Barnesville, in Belmont County, from the limestone there. At the outbreak of the war their establishment was closed, as the demand for cement ceased. In 1868 it was reopened, and in 1869 their product was tested by the Atlantic and Great Western Railway Company, in competition with eleven other brands, the result being that Parker's cement was adopted. Eleven thousand barrels were used in the construction of the railroad bridge at Bellaire. These works are not operated at the present time, but until quite recently there were cement works just below Bellaire where cement was made from this same stone.[b]

In 1884 a small plant was erected at Columbus, which ran successfully for a number of years, but is now closed down. In 1889 the Buckeye Portland Cement Company established a plant at Harper, in Logan County, which has been successfully operated since that time. The materials used here are marl and clay, and the plant has been twice enlarged to meet the demand for its output. In 1891 cement was being manufactured at Bellaire, and at New Lisbon, Columbiana County, but none was produced in Sandusky.[c] In 1892 a plant was erected at Middle Branch to produce Portland cement from limestone and clay, and it is still a successful producer. In 1893 the Sandusky Portland Cement Company began operations at Bay Ridge, near Sandusky.[d] In 1898 works were built at Castalia, and have been running continuously since that time. In the same year a plant was established at Ransomes for the production of a fine, white cement for use in art work and other special purposes.[e] This venture was not entirely successful, and the works were later closed, so far as producing cement was concerned. The Alma Portland Cement Company

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[a] Rept. Geological Survey of Ohio, vol. 2, 1875, p. 438.

[b] Rept. Geological Survey of Ohio, vol. 3, 1878, p. 269.

[c] Production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 532.

[d] Production of cement: Mineral Resources U. S. for 1893, U. S. Geol. Survey, 1894, pp. 621–622.

[e] Production of cement: Mineral Resources U. S. for 1895, U. S. Geol. Survey, 1896, p. 886.

was established at Wellston in 1898, and has been producing cement for the last five years.[a] Another plant erected at Wellston three years later was sold in 1902 to a large cement company in Pennsylvania. There are other companies, all of more or less recent date, in the State, and they are successful in their operations. The Sandusky Portland Cement Company, whose plant at Bay Ridge has a large annual output of cement, in 1901 built a factory in Syracuse, Ind.

The growth of the cement industry in Ohio has been steady, though it has not been so marked as in some other States. In 1890 the entire production amounted to only 57,000 barrels of Portland cement, which was manufactured by two plants. In 1902 twelve plants reported, and the seven factories engaged in producing Portland cement had an output of 563,113 barrels.

PENNSYLVANIA.

In 1831 excavations were made in the process of constructing a canal to connect Muncy, Lycoming County, with Lock Haven, Clinton County, which exposed a large mass of cement rock of first-class quality near Williamsport. On being tested it yielded such satisfactory results that a cement plant was at once erected for the production of such cement as should be necessary in the construction of the locks and dams of the new canal. For more than three years these kilns, built by Mr. Crane, continued to manufacture and to supply all the local trade as well as the canal with an excellent quality of cement. When the canal was finished, however, the local demand was not great enough to justify a large supply. The industry was kept up, but in a very small way, the production fluctuating as there was or was not a market.[b] In the year 1850, when the Lehigh Canal, running from Easton, Northampton County, to Mauchchunk, Carbon County, was under construction, the cement rock, which has since been used in such enormous quantities in this valley, was uncovered.

This discovery of hydraulic limestone or cement rock was of great economic importance to the entire State, as it obviated the necessity of importing cement from New York State or from abroad, besides proving a great source of wealth in itself. The manufacture of cement for the canal was begun at Siegfried, Northampton County, and the product proved to be of excellent quality. The methods of burning were somewhat primitive as compared with the present appliances to be seen at Siegfried, but the rock yielded a fine cement, and has been used more or less continuously since that time.[c] In 1865 Mr. David Saylor established a large natural-rock cement plant at Coplay, in Lehigh County. The product of this plant was good, but the competition with Rosendale and other long-established brands of natural-

[a] Production of cement: Mineral Resources U. S. for 1899, U. S. Geol. Survey, 1900, p. 402.
[b] Cummings, U., American Cements, 1898, pp. 19-20.
[c] Ibid., p. 21.

rock cement led to experiments in the manufacture of an artificial or Portland cement, and in 1870 Mr. Saylor began to produce a small output of this important product. His was the first plant in the United States where Portland cement was sucessfully made, and the history of the experiments tried before a good result was obtained is most interesting.

In 1876 the plant, which is still a successful producer of Portland cement, was established, the materials used being limestone and clay. At the Centennial Exposition held at Philadelphia in that year, both the Wampum and the Saylor Portland cements were exhibited, and held their own with the foreign brands sent here for that occasion.[a] In 1878 there were four cement plants on the Lehigh River, two on the west side worked by the Coplay Cement Company and the Lehigh Cement Company, and two on the east side, the Allen Cement Company and the old Lehigh Cement Works. The Coplay plant had at that time 11 kilns, 7 of which were burning Portland cement. Their success led to the growth of the industry, and this locality, which was the first in the United States where Portland cement was extensively manufactured, became the leading center of production for Portland, which position it still holds, producing more than one-half the entire output of the country. The Coplay Cement Company have had continued success, and have now 34 kilns, producing a large annual output of both natural-rock and Portland cement. In 1882 the production of Portland cement was well established in the Lehigh Valley, and the United States Geological Survey reported for that year that "both natural and artificial cements were manufactured to a considerable extent at Allentown, Pa."[b] In 1883 the Pennsylvania State Geological Survey reported as follows:

> Two companies have tried to utilize the hydraulic properties of the limestone in Northampton County, but neither of them has done a great deal for the last four or five years, and the quarries have been practically unworked. These companies are the Old Lehigh Cement Works and the Allen Cement Company. But it must not be supposed that because these companies have been apparently unsuccessful there is no future for this business in this part of the State; on the contrary, the success of the Coplay Cement Company shows what perseverance under difficulties can and does do. Of course, the composition of some of the cement beds is far more favorable to the manufacture of cement than that of others, but all may be more or less profitably utilized by careful intermixture.[c]

It was during this same year that a plant for the manufacture of Portland cement was inaugurated at Egypt. For a time its output was rather small, but it increased slowly, and at the present time the outcome of this small beginning is the American Cement Company, one of the largest producers of both natural-rock and Portland cement in this country.

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[a] Lesley, R. W., Jour. Assoc. Eng. Socs., vol. 15, 1895, p. 200.

[b] Production of cement: Mineral Resources U. S. 1882, U. S. Geol. Survey, 1883, p. 461.

[c] Second Geol. Survey Pennsylvania, vol. 1, D. 3, 1883, p. 164.

In 1885 the small output of artificial cement was mostly from Pennsylvania, though a certain percentage of it was produced in New York. The imports increased, and the slow growth of the home production left them apparently unchecked. There were, however, three reasons for this in 1885 other than the natural demand. They were, a strong competition among the importers, very low ocean transportation, and the removal of duty on packages.[a] In 1886 there were a number of improvements made in the machinery devised to save labor and reduce the cost of producing Portland cement, which gave an impetus to this industry. Referring to these improvements, Mr. R. W. Lesley, president of the American Cement Company, said, in a paper read before the Engineer's Club at Philadelphia:[b]

The raw rock is crushed and ground dry. The powder thus formed is run into a mixer, when a small proportion of pitch and water is added. The moistened powder is then passed through a pair of heavy rolls having matched, egg-shaped cavities, which mold it into small eggs and deliver these latter in front of the kilns, avoiding all handling. These eggs can be used the same day in the kilns, if necessary, whereas under the old process the same stage of manufacture required weeks—a manifest advantage, to say nothing of the immense saving in labor, land, and interest. The form of the material, its uniformity in density, porosity, and size, make it more easily burned, handled, crushed, and ground, and cause a saving at every stage of the process, while the addition of the pitch aids the uniform burning, and, moreover, by forming pores through which the moisture in the egg escapes prevents them from falling away in the kiln, which they would otherwise do, owing to the generation of steam within them and the formation of a crust on their outer surfaces. This is the point which in the old process prevented placing the wet paste in the kilns promptly, and which is here overcome by the use of a combustible. By this process the foreign brands are fairly met in point of price, and repeated tests by leading authorities here and in Europe show that the quality of the cement made is equal to the foreign Portland.

It was about this time that Ransome's improved revolving cylinder for the manufacture of Portland cement was introduced in England. It was first used in this country by a plant in Oregon,[c] which has since been abandoned. After a number of failures and many experiments with a view to improvements on Mr. Ransome's invention, the rotary kiln was adopted here. The modifications and changes made in this country were very advantageous, and the first rotary kiln successfully established in the Lehigh district proved to be a great saver of time and labor. The expense of fuel was much increased, but the output of the plant was so much greater that this disadvantage was obviated in a degree. The recent use of powdered coal, which has superseded the use of oil as a fuel, has somewhat reduced the expense of rotary kilns. In 1891 the output of Portland cement in Lehigh County had reached 268,500 barrels, this being the production of six

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[a] Production of cement: Mineral Resources U. S. for 1885, U. S. Geol. Survey, 1886, p. 407.
[b] Production of cement: Mineral Resources U. S. for 1886, U. S. Geol. Survey, 1887, p. 560.
[c] Production of cement: Mineral Resources U. S. for 1887, U. S. Geol. Survey, 1888, p. 530.

plants.[a] The production of natural-rock cement was 695,000 barrels. In 1895 two of the leading plants at Coplay enlarged their factories so as to nearly double their capacity for producing Portland cement. There were now seven plants in Pennsylvania producing Portland and five producing natural-rock cement.[b]

In 1897 the State production of Portland cement was very much in excess of that of any previous year, while the production of natural-rock cement increased but slightly; and in 1898 the output of Portland again increased remarkably in this district, reaching upward of 2,000,000 barrels, while that of natural-rock cement decreased, the figures reported showing only about a quarter of a million barrels.[c] In 1900 Pennsylvania had a record of fourteen plants for the production of Portland and five for the production of natural-rock cement. Of these several plants had an output of both kinds of cement. In 1901 there were seven plants devoted to the exclusive production of Portland cement, six that made both Portland and natural-rock, and one where only the natural-rock cement was manufactured; three plants were idle, two of them being closed for reconstruction, and four new ones were in process of building. The quantity of Portland cement produced in the State during the year was 7,091,500 barrels or more than half of the entire output of the United States. The figures for the production of natural-rock cement were 942,364 barrels. The materials used in this locality are argillaceous limestone or cement rock for the natural cement, and the same stone mixed with pure limestone for the Portland cement. The Lehigh Valley cement rock, which carries silica and alumina mixed with almost the requisite amount of lime, analyzes as follows:

Analysis of Lehigh Valley cement rock.

Constituent.	Per cent.
Silica	14.44
Iron oxide and alumina	5.91
Lime	42.10
Magnesia	.37
Carbon dioxide	33.48
Total	96.30

UTAH.

A discovery of cement rock, which proved on analysis to be of good quality, was made in 1888 in Utah, and noted in the report of this Bureau on cement for that year as being "at some point between

[a] Production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 537.
[b] Production of cement: Mineral Resources U. S. for 1895, U. S. Geol. Survey, 1896, p. 884.
[c] Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6 [cont.], 1899, p. 540.

Ogden and Provo City."[a] In 1890 a company formed to exploit this discovery erected a plant for the production of Portland cement at Salt Lake City, and in 1891 the first production of cement from Utah was reported by this Bureau.[b] In the fall of 1896 the present company began to manufacture Portland cement, and they have been very successful, in spite of the fact that in the spring of 1898 the plant was entirely destroyed by fire. During the summer following the factory was rebuilt, rotary kilns were installed, and steel buildings erected. The capacity was also enlarged. The original plant had a capacity of but 50 barrels per day. The present one produces 600 per day. The stone used is a hard, argillaceous limestone, very similar to the rock so extensively quarried for the manufacture of Portland cement in the Lehigh Valley of Pennsylvania. It is found in Parleys Canyon, about 10 miles east of the plant, where it is quarried from a ledge of rock 50 feet high and lying in strata which stand at an angle of about 75°. The rock is taken out by tunnel blasting in an open face, ordinary drills being used. The present plant is equipped with electric power, and powdered coal is the material used for fuel. As this is the only factory in the State of Utah and as the nearest plants are those in Colorado, it will be easily understood that there is generally a ready market for the entire production of cement manufactured in the State.

VIRGINIA AND WEST VIRGINIA.

An excellent quality of cement was made in Virginia as early as 1835 from natural rock obtained in Rockbridge County. The report of the State Geological Reconnaissance for that year alludes to it as a rock "that has been quarried and found highly valuable in the formation of water cement."[c] Works were established at Balcony Falls, Rockbridge County, in 1848, which were known as the James River Cement Works.[d] In 1898 the cement report issued by this Bureau stated that the plant of the James River Cement Works at Balcony Falls had been destroyed by flood, but was rebuilt in a most substantial manner at Locker, a short distance away.[e] This is the present location of these works, which are the oldest in Virginia. Subsequently a mill was erected at Blue Ridge Springs, which was sold a few years ago, and is henceforth to be used for other purposes. The Ridgemont cement plant is of recent establishment, and it has been remodeled within a short time. In 1900 a plant for the manufacture of Portland cement was started up at Craigsville, and it has had marked success in producing a fine quality of cement.

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[a] Production of cement: Mineral Resources U. S. for 1888, U. S. Geol. Survey, 1889, p. 553.
[b] Production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 532.
[c] Rogers, Wm. B., Rept. Geol. Reconnaissance State of Virginia, 1835, p. 91.
[d] Cummings, Uriah, American Cements, 1898, p. 21.
[e] Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6 [cont.], 1899, p. 550.

In West Virginia natural-rock cement was made near Shepherdstown, Jefferson County, at a very early date. In the State report of 1835 mention is made of the fact that this cement was of the very best quality. An analysis given is as follows:[a]

Analysis of cement, Shepherdstown, W. Va.

Constituent.	Per cent.
Carbonate of lime	32.17
Carbonate of magnesia	18.36
Silica	38.93
Oxide of iron and alumina	4.17
Total	93.63

A great diversity in the chemical constituents of the rock in this neighborhood occurs. The rock used for preparing cement to be used for the locks of the James River Canal had the following analysis:[a]

Analysis of rock used for cement for James River Canal locks.

Constituent.	Per cent.
Carbonate of lime	38.33
Carbonate of magnesia	16.30
Silica	36.60
Oxide of iron and alumina	6.33
Total	97.56

The industry was not kept up continuously in this locality, but about 1870 the Shepherdstown Hydraulic Cement Works were established by Mr. H. W. Blunt, who owned the vast deposits of limestone which outcrop about a mile south of Shepherdstown, along the Potomac River. For more than thirty years this plant produced a superior brand of natural-rock cement, but since the death of the proprietor the mill has been shut down. The situation at Shepherdstown is an exceptionally favorable one from an economic point of view, as the good water power, the adjacent canal, and the near-by railroads are all available. The deposit of limestone shows about 100 feet high above the river, and contains, besides the strata of natural cement rock, a great deal of stone which has all the elements necessary to a good Portland cement. This limestone shows through its thin covering of soil for hundreds of acres.

OTHER STATES.

Besides the more detailed account of various well-known sections in the United States where suitable materials exist from which cement can be profitably manufactured, mention should be made of other

[a] Rogers, W. B., Geology of the Virginias., 1835, p. 138.

localities containing similar deposits, some of which have never been developed.

Arkansas.—The cement industry in Arkansas is confined to a single plant, which is located at White Cliffs, and which, under the new management that took possession in 1901, began a production of cement in 1903. This plant is about seven years old and has been idle for the last two years. The factory and buildings have been thoroughly remodeled, and as the raw material owned by the company is practically unlimited, their future outlook is good. The materials used are chalk and clay. The company owns the chalk cliffs on the banks of Little River and 3,000 acres of woodland, including 600 acres of fine-grained clay.[a]

Florida.—Of the material in Florida, Mr. Cummings reported in 1898 that what was perhaps the most remarkable natural hydraulic cement rock known occurs near River Junction. This deposit extends for several miles along the left bank of the Appalachicola River southerly to Aspalaga. It comprises over 2,000 acres and has a thickness of 80 feet above the river, containing sufficient raw material to produce over 2,000,000,000 barrels of cement. The material is usually soft enough to cut with a spade and shows a remarkable uniformity of proportions of the ingredients essential to the production of a good cement. The raw material is white, and the manufactured product is as white as marble. This rock has been successfully used, a mill having been operated at River Junction a number of years ago. Within the last four years it has been idle, waiting for capital to develop this field.[b]

Georgia.—The hydraulic-cement rock in Bartow County has been used for the manufacture of cement since 1889, and has always yielded a satisfactory product. The plant is located at Cement. In 1900 a company was formed to develop the deposits at Clifford, but the plan was abandoned for lack of capital. In 1901 a plant was established at Rossville to produce natural-rock cement, and in 1902 this plant had also a small output of first-class Portland. The plant which is being erected at Rockmart will produce Portland cement in 1903. In the report on cement made by this Bureau in 1899, the deposit of cement rock at Rossville (near Chattanooga, Tenn.) is described as being a bed of natural Portland similar to that at Boulogne, France, but superior to the latter, in that the proper proportion of ingredients is more uniform.[c]

Iowa.—The natural-rock deposits, the St. Louis marls and limestones, and the deposits of chalk in the northwestern portion of Iowa are all available for the manufacture of good cement, and are described in the Annual Report of the Iowa Geological Survey for 1899.[d]

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[a] Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 5 [cont.], 1897, p. 1174.
[b] Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6 [cont.], 1899, p. 549.
[c] Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 6 [cont.], 1900, p. 410.
[d] Rept. Iowa Geol. Survey, vol. 10, 1899, p. 622.

Missouri.—Notwithstanding an abundance of good material, the cement industry had not been attempted in Missouri until the year 1902, when the St. Louis Portland Cement Company completed its plant at Prospect Hill Station.

Nebraska.—In 1880 the manufacture of hydraulic cement had been conducted for some time at Beatrice, but owing to inadequate appliances it was at first insufficiently pulverized. Later it was properly manufactured, and is said to have stood the test of time.[a] In 1880 the business of producing cement was temporarily suspended, and was carried on only at times for the next fifteen years. The plant then became a fairly successful producer, though with only a small output. Since late in 1901 no cement has been manufactured in Nebraska.

New Mexico.—In 1899 this Bureau reported a small production of Portland cement from Springer, N. Mex. Since that time, however, the plant has been idle, and is now dismantled.

Oregon.—The report on cement made by this Bureau in 1882 states that in Oregon and also in Washington Territory a good quality of hydraulic limestone had been found, and that in Oregon works had been erected for making cement.[b] The report for 1884 mentions that a deposit was opened in Oregon some years ago, but it was not of an extensive character.[c] In 1887 this Bureau reported that the first attempt in the United States to use the Ransome process of burning and grinding cement—that is to say, the first use of the rotary kiln—had just been made by the Portland Cement Company, of Portland, Oreg.; that those works had just commenced operations, and were located at Oregon City, Clackamas County, and that the material used was a natural Portland cement rock, found in Douglas County. Gas was the fuel, and the abundant water power of the Willamette River was utilized. The works had a 30,000 barrel per annum capacity.[d] In 1888 a new discovery of cement rock at Llewellyn, Lane County, Oreg., was noted by this Bureau, and it was stated that the material when burned gave satisfactory results and would probably be developed.[e] The report for 1891 stated that the works at Portland had not been operated for some time, owing to litigation among the stockholders of the company, and that the cement had formerly been made of natural rock and burned in a rotary furnace.[f] Since that time no cement production from Oregon has been reported.

Tennessee.—In Tennessee there are many deposits of hydraulic limestone, and cement of a fine quality was produced therefrom before 1860.

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[a] Aughey, S., Physical Geography and Geology of Nebraska; pt. 2, Geology, p. 314.

[b] Production of cement: Mineral Resources U. S. for 1882, U. S. Geol. Survey, 1883, p. 463.

[c] Production of cement: Mineral Resources U. S. for 1884, U. S. Geol. Survey, 1885, p. 675.

[d] Production of cement: Mineral Resources U. S. for 1887, U. S. Geol. Survey, 1888, p. 530.

[e] Production of cement: Mineral Resources U. S. for 1888, U. S. Geol. Survey, 1889, p. 553.

[f] Production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 536.

In 1886 cement rock of first-class quality was examined at Erin, in Houston County, and there was talk of a plant at that place. It did not develop, however.[a] In 1887 the fact that the cement works at Erie, in Loudon County, were enlarged to give a capacity of 2,000 barrels per month, looked very encouraging. But in the report for 1891, made by this Bureau, it is stated that "no cement is now made in this State,"[b] and since then no production is reported.

Texas.—Cement has been made in Texas for more than twenty years. The plant which first produced it had an output of natural rock cement, which, though small, was of good quality. About 1892 a plant for the manufacture of Portland cement was erected near Dallas, and has been in active operation since that time.[c] The plant at San Antonio, Bexar County, makes both varieties of cement, and the one at Austin, Travis County, has been shut down for the last two years.

Washington.—Two companies have been formed in this State within the last few years for the purpose of manufacturing cement, but as yet no plant has been erected.

Wisconsin.—About 1874 a remarkably good quality of natural cement rock was discovered in this State by Dr. I. A. Lapham, who directed general attention to it in an article mentioning the geological relation existing between this rock and the water limestone of Louisville, Ky., and suggesting its possessing the same useful qualities. In 1875 a cement mill was established near White Fish Bay, and with scarcely a break it has been producing an excellent quality of cement since that time.[d] In 1890 a second company was formed, and shortly thereafter a second plant was erected not a great distance from the first. These two plants produce all the cement made at the present time in the State. They use the same kind of rock, which is described in the second volume of the report of the State Geological Survey of Wisconsin, published in 1877.

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[a] Production of cement: Mineral Resources U. S. for 1886, U. S. Geol. Survey, 1887, p. 564.
[b] Production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 532.
[c] Production of cement: Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, p. 530.
[d] Geology of Wisconsin, vol. 2, 1873–1877, p. 400.

PRECIOUS STONES.

By George F. Kunz.

INTRODUCTION.

Since 1894, when the business of the country was at its lowest ebb, there has been a great advance in the lapidary industry in the United States. The fact that larger establishments have been formed which are able to purchase the rough diamonds in greater quantities, has placed our American diamond cutters in a position quite equal to that held by those of Amsterdam, Antwerp, and Paris. The cutting of our native gems has also proved to be something of an industry, notably in the case of the beryl and the amethyst, found in North Carolina and Connecticut; the turquoise, from New Mexico, Arizona, Nevada, and California; the fine-colored and deep-blue sapphires found in Montana; the colored tourmalines, of San Diego County, Cal.; the chrysoprase, mined at Visalia, Tulare County, Cal.; the garnets of Arizona and New Mexico; and also, notably, the pale-purple garnets from North Carolina.

In addition to the usual work on gems, there has been the greatest demand known in years for fine cutting. Stones already cut abroad have been recut here with sharper angles and a higher polish. The lentil-shaped stones, the marquise, the double marquise, the heart-shaped, and the rose-brilliant stones are shapes that generally indicate the recutting of the gems. This form of lapidary work requires very great skill. The cutting must usually be of such a character as to suit the fancy of the buyer. This fact has led to the establishment in this country of a number of lapidarian works in which all the employees are much more skillful than were those of a decade ago, and their work is of a much higher class than the commercial work of Oldenburg and of other foreign gem-cutting centers.

The total of precious stones imported into the United States for the year 1902 reached the high valuation of $24,753,586, being $1,938,234 more than for the previous year, and nearly nineteen times as great as in the year 1867—showing the enormous advance in wealth and taste that has taken place in this country in the course of a generation.

The production of precious stones in the United States in 1902 was valued at $338,300, as compared with $289,050 in 1901.

DIAMOND.

INDIANA.

In the report of this Bureau for 1900, mention was made of the finding of a diamond of $3\frac{3}{4}$ carats on a branch of Gold Creek, some 9 miles north of Martinsville, Morgan County, Ind. Reference was also made to the rumor that other smaller diamonds had been found in the same region. Recent information received from Mr. R. L. Royse, of Martinsville, gives a full account of the facts in this matter. The stone above noted was found by an employee of his, from whom he purchased it. A considerable amount of panning for gold has been done in the streams of Brown and Morgan counties for some years by certain old residents, well known as farmers and prospectors. Two of these have found occasional diamonds. Mr. Royse himself possesses six besides the one mentioned, which he sold. Of these, four are from Brown County, purchased from one of the old prospectors who obtained them; three are very small, weighing hardly a carat together; the fourth weighs about 1 carat. In color, the last is a blue-white, the others are tinted—a brown, a yellow, and a bluish one. Another local gold-seeker has a diamond of 2 carats, which he found also in Brown County, making five positively known from that county, to say nothing of others reported, but not actually seen by Mr. Royse. From Morgan County he knows of three, viz., the large stone first announced, found 3 miles west of the village of Centerton; a little one, of $\frac{1}{8}$ carat, found by himself in gold-panning; and a third, of $\frac{3}{4}$ carat, purchased from one of the old prospectors. Most of the stones are clear and flawless. This makes eight in all positively known from these two counties of central Indiana.

As regards the minerals associated with the gold and diamonds of the creeks of this region, the writer received samples from Professor Blatchley, the State geologist of Indiana, which comprised the following species and varieties: Quartz, vein in ironstone; white chalcedonic; rolled pebbles, colorless and clear, also milky; red jasper; iron ores—magnetite, showing some cleavage, with quartz and decomposed muscovite; red hematite, resembling the ore of Marquette; limonite, a rolled pebble; menaccanite; pyrite, small cubes in quartz; marcasite, stalactitic; zinc blende (sphalerite), cleavable, yellow with black spots, in quartz; metallic inclusions, evidently rutile, in corundum, of a pinkish to bluish tint; zircon, broken prisms, yellow and transparent, 4 by 2 mm.; garnet grains (almandite), purplish red; cyanite, blue reflections in green, prism fairly perfect; amphibole, brown, with chatoyant reflections; rocks, gray shale, and putty-like clay. Only the magnetite and menaccanite are at all abundant, and next to these the garnet.

WISCONSIN AND CANADA.

In regard to the source of the diamonds carried south by the Glacial ice sheet and found scattered along the line of the terminal moraine from Wisconsin to Ohio, Mr. Archibald Blue, the Canadian geologist, is disposed to differ from Professor Hobbs as to the distance through which they have been transported.[a] The latter, estimating from the direction of the striæ and the width of what he terms "the fan of distribution," locates the source in the unexplored region of Ungava, east of Hudson Bay. It has already been suggested in the report of this Bureau for 1899[b] that this determination depends on the theory of there being but a single source, or at least on the theory of the sources lying within a very limited area; whereas if there were localities, as in Brazil, extending through or along a considerable region, they need not lie so far to the north. This is essentially the position taken by Mr. Blue. He emphasizes the fact that the bulk of the material forming the terminal moraine and the moraines of recession has been carried only a moderate distance from its source, and although he admits the possibility of Professor Hobbs's view, he is disposed to question it.

In this article he reviews the general facts of the occurrences in the United States, especially those in the glacial drift, and describes also briefly the theories as to the source of the diamonds in Africa. He goes on to say that there has been no search made for diamonds in Ontario, "although Dr. Lawson and Dr. Coleman some time ago suggested[c] that they might be found in the Rainy Lake region." These authors, and Mr. Blue himself, show an evident leaning toward the theory that diamonds are formed by the action of igneous rocks upon strata containing carbonaceous matter, and hence a number of references are made to points in Ontario where rocks of these kinds have been observed in some proximity, as possible sources for the diamonds of the drift. Logan, Macfarlane, Coleman, and Lawson[d] are cited as to ancient volcanoes, numerous dikes and intrusions, and graphitic and carbonaceous slates at various points north of the Great Lakes. Mr. Blue himself emphasizes the vicinity of Thunder Cape, Lake Superior, and of Balfour, near Sudbury, as presenting conditions favoring, or at least suggesting, the production of diamonds in this manner, and he advocates careful investigation at these points.

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[a] Blue, Archibald: Are there Diamonds in Ontario?: Bureau of Mines Report (Ontario), 1899, pp. 119-124.

[b] Extract from Mineral Resources U. S. for 1899, U. S. Geol. Survey, 1901, p. 8.

[c] Can. Nat., vol. 4, new series, pp. 461-463.

[d] Geol. Surv. Canada, 1887; Geol. Rainy Lake region, p. 180 F.

BRAZIL.

An exploration company has been formed in London for the purpose of searching for diamonds in the Serra de Frio Mountains in the State of Minas Geraes, the object being to explore the mines, to work them, and to sell diamonds. The report[a] is very elaborate, but no great amount of development is recorded as having been carried on.

Diamonds and carbons in Bahia.—An extended account has lately been given by Mr. H. W. Furniss, United States consul at Bahia, of the occurrence of diamonds and carbons in the State of that name in Brazil.[b] This account is valuable not only in itself, but for comparison with the similar account reviewed in the report of this Bureau for 1899 of the diamond mines of the State of Minas Geraes, by Mr. T. C. Dawson, of the American legation at Rio de Janeiro.

Mr. Furniss outlines briefly the history of the Bahia diamond workings from their reported discovery in 1821 and their first development in 1844, when a rush began for the district. Since that time they have been more or less actively worked. Fourteen mining districts are officially recognized, but Mr. Furniss groups these into two well-marked geographical sections, one in the central part of the state, in the basin of the Paraguaçu River and its tributaries, and the other in the southern part, along the valley of the Pardo River. His experience is almost wholly with the first of these two regions. The latter, which he calls the Cannavieras district, is reached from the port of that name by ascending the Pardo River, and has been known as a diamond region only since 1881. An account of it from other sources will be found in this report further on. Very recently other descriptive articles have appeared—some of them already referred to in reports of this Bureau—which point out the richness of these Bahia districts along the almost unexplored valleys of the numerous affluents of both the Paraguaçu and the Pardo.

The enormous production of diamonds from the African mines, together with the facts that the methods employed in Brazil are crude and unsystematic and that the most accessible places at all profitable under such methods have been much worked over and worked out, have caused a great decline in the Brazil production for some time past. But there is a very wide extent of diamantiferous country awaiting only the introduction of improved processes.

The chief center of production in the first or Paraguaçu River district lies 250 miles or more inland from the city of Bahia; but diamonds begin to be found in the bed of the Paraguaçu about 150 miles from the coast, and from that point up the river to the town of Andarahy, which is one of the mining centers. Their occurrence in the

[a] The Diamond Fields of Brazil, 1902, London, pp. viii, 75.

[b] U. S. Consular Reports, No. 1423, August 20, 1902.

river bed, however, renders them difficult to obtain. The diamantiferous region extends for about 172 miles, with a breadth varying from a maximum of 16 miles to a minimum of 3 or 4. It includes several mountain ranges, the Serra do Sincora, with the headwaters of the Paraguaçu and the Una, the Serra dos Remedios, the Serra das Lavras Diamantinas, the Chapada Velha, and a portion of the Serra do Espinhaço. The most productive region is apparently that of the foothills east of the Serra das Lavras Diamantinas, along the small tributaries of the Paraguaçu.

The geology of the region is described by Mr. Furniss as consisting of granitic hills, with much sandstone and conglomerate. The granite shows a slightly inclined stratification, and hence is probably in strictness a gneiss. This rock is frequently broken by gullies, fissures, or crevasses, which are in many cases filled with the sandstone and conglomerate, and these latter also occupy small basins in the crystalline rock. All are much weathered and in some places disintegrated. The diamonds and carbonados occur in the fragmental rocks, and according to Mr. Furniss, in the granitic also, a fact of much interest, if it shall be clearly established; but they can only be obtained from those portions of either that have been pretty well disintegrated. Much of the work is done in the gullies, fissures, and cavities, which are occupied by soft sandstone and conglomerate; but sometimes these are rendered inaccessible, at least in their lower portions, by hard ledges or by water; and hence promising spots, rich in diamonds, have to be abandoned as unworkable by the rude and simple methods employed.

The river and stream beds are largely occupied by bowlders and gravel, the latter apparently the equivalent of the diamond-bearing formação of Minas Geraes, described in Mr. Dawson's report. The small basins in the gneissic rocks of the hillsides would seem to correspond to his gupiaras. Mr. Furniss describes the digging out of the cascalho, or diamond gravel, and piling it up until the rainy season, and also the conducting of water in some cases through native-made sluices, etc., to wash the cascalho, in ways that correspond closely to those noted by Mr. Dawson. The washing process, first in troughs or ditches, and then in wooden basins (bateas), and the skill acquired in picking over the residue and recognizing diamonds therein, all resemble methods described by Mr. Dawson, and are identical also with those of the South Borneo diamond miners, depicted by M. Gascuel in his recent article.[a]

The method of obtaining the river-bed stones, however, presents a marked difference from that in Minas Geraes. Nothing is said of diverting the stream and excavating its bed during the dry season, as in the valley of the Jequitinhonha, but Mr. Furniss tells of diving as

[a] Production of Precious Stones, extract from Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, pp. 17–18.

employed along the Paraguaçu. This is conducted in two ways, the principal one involving the use of what he calls "diving machines," i. e., apparently movable caissons, beneath which two men can work alternately for three hours each, gathering the cascalho into sacks lowered from above. This method is in use along the Paraguaçu from João Amaro, the point where diamonds first appear in the bed, as before noted, nearly up to Andarahy; and there are at least six of these machines engaged during the available season. The other method is pursued by individuals, who dive naked into the shallow parts of the river, especially in the dry season, and bring up what they can gather of the cascalho during a brief submergence.

Mr. Furniss states that the field is not one to attract the fortune seeker, although occasional wealth may be obtained; but the uncertainty is great, hardships are many, food is poor, and climatic conditions are trying and unhealthy.

Some five thousand people are engaged in diamond mining, but irregularly and with no system. The tools are the commonest—a hoe, a crowbar, a stout iron hook on the end of a pole, sometimes a hammer and a hand drill, and two basins for washing—a larger and a smaller. Rarely a little powder is used to blast away some obstructing piece of rock. Through years of such crude exploitation, sand and gravel have been washed down from the small streams to the larger ones, covering up rich river beds with quantities of débris, which will require considerable expenditure of capital to remove. In a tour through the entire district, Mr. Furniss failed to find a single attempt at modern methods. "In the home of the carbon there was not even a hand-power rotary drill, much less a carbon set drill, which would frequently save days of work and much expense." Instead, men with hand drills and hammers make about three holes a day. In many places water comes in faster than it can be bailed out; and such openings have to be abandoned until some methods of pumping can be introduced. The native pumps, described with so much interest by Mr. Dawson, in Minas Geraes, do not seem to be known or used here.

All diamond and carbon lands belong to the State, which maintains a director at the town of Lemçoes. The laws are specific, though liberal, and persons of any nationality may lease claims. The property must be described and applied for in writing; and then, after a prescribed time of announcement, it is offered at auction, the highest bidder obtaining a lease for a period varying from one year to ten, with certain rights of renewal. There is usually but little competition at the sale. Individuals who do not care to lease claims may take out licenses for a fee of \$1.50 a year, and must also, each one, pay a local village tax of 10 milreis, about \$2.40. Mining without lease or license is subject to confiscation of tools used and stones found, one-half going to the informer. About 350 leased claims are being worked, and "it is estimated that there are 450 other productive claims without lease."

Besides these leases and licenses, some large concessions have been granted to individuals and companies, almost all Brazilian, save a French company at Cannavieras. These and the ordinary lease-holders generally work their mines on shares rather than by fixed wages, the miners paying the lessees one-fourth or one-fifth of the diamonds and carbons obtained.

This method is found more profitable, as the miners work better on their own account than for a fixed wage. There is little chance for cheating, as the buyers know all the parties concerned and reserve the proper share for the owner when purchasing.

Mr. Furniss refers to the recent high price of carbons and to the statement frequently made that it is maintained by a syndicate or combination. He finds no ground, after full inquiry, for the idea of any such combination among the miners, the buyers in the field, or the exporters at Bahia. He gives a full account of the manner of purchasing by field buyers representing five principal firms in Bahia, all being kept systematically informed as to market rates, which are determined by values in Europe constantly cabled to Brazil. The field buyers work independently, and there is even more or less competition for any particularly good material. The miners obtain prices that are a fair equivalent according to the rates abroad and the fluctuations of the Brazilian currency.

The great increase in prices for carbons is illustrated by some figures given in the report. To cite only in part: In 1894 carbons were bought in the field from the miners at from $4 to $4.40 per carat; in 1898 the rate paid was $11 to $11.20. The cause of the higher prices lies principally in the vastly increased demand for carbons in mining and drilling machinery, with the fact that while the supply in existence is immense, it is practically limited by the defective methods of working. The present output averages 2,500 carats a month; but, without more capital and improved methods, Mr. Furniss thinks it can not maintain even this rate; and the demand is steadily growing. Water power is abundant, "and with electrically run drills, pumps, and other machinery, there is fabulous wealth awaiting development."

Two grades of carbons are recognized—good, and porous or crystalline. Present prices for the best grade range from $24 a carat for stones over three-fourths of a carat in weight down to $7.20 for those between three-fourths and one-half a carat, and to about $2.75 for smaller ones, which last are mixed with imperfect and refuse diamonds. The porous and crystalline grade of carbons sell for about half of the above-noted rates. The average size of the stones found is about 6 carats in weight. Stones between 1 and 2 carats are the most desirable, as they do not require to be broken up for commercial use. Very large specimens command a relatively lower price, on account of the labor and cost of breaking them up. Two enormous pieces have been found within a few years past, upon claims belonging to the same lessee, who received in both cases one-fourth of the first selling price. The first was the unique and celebrated mass, weighing 3,150 carats, found in 1895, and briefly mentioned in the report of this Bureau for that year;[a] the other was discovered in 1901, and weighed 750 carats. The prices paid for these two remarkable stones furnish a striking illustration of the advance in values during the interval of six years. The amount paid the finder was, for the second, $17,380, although the first (five and a half times as large) had brought but $16,000. The first mass went through several hands, and was purchased in Bahia for 121,000 milreis, about $25,400; it was then sent abroad and finally broken up, not in Paris, as stated in Mr. Furniss's article, but in London, as described in the paragraphs following this abstract. The other mass is also described in this report farther on. Another immense carbon, of 975 carats, was mentioned by Mr. Furniss in his former article, as found in 1894,[b] but he does not refer to it here. It is said to have brought $19,300 in Paris, where it was finally broken up, but it failed to realize anything like that sum when sold in pieces.

The diamonds of the Paraguaçu country are stated to be more brilliant than those of the Cannavieras region but less perfect and clear; they occur with the carbons, and are often impaired by black inclusions. The field buyers divide them into five grades: Bons, those of good shape and color; fazenda fina, small and tinted stones, but otherwise fine; mellé, off-colored and imperfect; vitriar, very small, bright stones of various colors; and fundos, defective and broken stones, unfit for jewelry, and mixed as above noted, with second quality carbons. The prices paid in the field vary somewhat, but average for first grade $11.50 per carat; for the second, $10.50; for the third, $5, and for the fifth, $2.50. The fourth class, the brilliant little vitriars, are sold by the quarter carat, which contains from six to eight stones, for 12 milreis ($2.88), about the same rate as the bons. The other grades are usually bought by the oitava, 17½ carats. To these prices must be added transportation to Bahia by special carriers and the Bahia dealers' profit for the prices in that city; and for stones reaching Europe, the export duty (13 per cent), the steamer charge, and insurance must also be added.

The stones are mostly small, averaging about 1 carat. In a lot of nearly a thousand carats' weight of stones examined by Mr. Furniss the largest weighed 3½ carats. About 30 per cent were of the poor

[a] Seventeenth Ann. Rept. U. S. Geol. Survey, pt. 3 (cont.), p. 903.
[b] Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6 (cont.), 1899, p. 567.

LARGEST PIECE OF CARBON EVER FOUND. ACTUAL SIZE.

grade, fundos; the rest were good to fair. Other lots gave like results, and these are probably average examples.

The actual output is hard to estimate. The only data are the export figures, and these are far below the reality, as the amount thus indicated for both diamonds and carbons is less than the value of the latter alone. This shows that large quantities must leave the country without paying duty. All the shipments are to Paris and London.

The diamonds are exported uncut, though there are several cutting establishments in the diamond region and one in Bahia. But there is at present little demand for cut stones in the country, a condition different from that reported in Minas Geraes by Mr. Dawson in 1899, but perhaps due to financial depression, as Mr. Furniss believes.

The carbons are sold in mixed lots, and all sorting is done in Europe. So long as this method is maintained, American dealers will continue to purchase abroad, at higher cost, rather than in Brazil, where they can not obtain selected material, and must take all sorts and sizes of carbons together.

A recent article in Le Diamant, of Paris, refers to this same subject of the difference between miscellaneous and selected carbons, and states that in London, which is the principal market, the dealers sell unsorted lots, which are of little use to the engineer or the factory superintendent, who needs certain sizes and qualities; that Germany has lately recognized this fact, and that consequently the Berlin dealers are developing a profitable business in assorted carbons.

With regard to the great carbon masses, although only two are usually spoken of, there seem really to be three on record: (1) The one of 975 carats found in 1894, which was broken up in Paris and sold at less than its cost, $19,300, as stated by Mr. Furniss in his former article[a] referred to above. (2) The greatest piece, found in 1895, shown in Pl. II, natural size. As to this carbon, a recent letter to the Journal of the Society of Arts[b] and a subsequent one to the writer from J. K. Gulland, esq., of London, furnish precise details. He says: "It was not broken up in Paris; I broke it up here myself. The exact weight was 3,078 carats. I bought the stone on September 19, 1895, for £6,464 (about $32,000), broke it up into pieces suitable for use in diamond drills, and resold the whole at 10 per cent profit. * * * Now, it would be worth £26,163 (about $130,815). The present price of carbon at the mines (November 17, 1902) * * * is £8 10s. to £9 per carat," for good quality. (3) The third, though usually spoken of as the second, is the mass found in 1901. This was taken abroad and exhibited at the Düsseldorf Exposition of the same year. It is here shown in the accompanying illustrations, Pls. III and IV. These and the following notes are from the Organ des

[a] Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6 (cont.), 1899, p. 567.
[b] Journal of the Society of Arts, 1902.

Vereins der Bohrtechniker,[a] Vienna, of April 15, 1902, to which the data were furnished by Messrs Joh. Urbanek & Cie., of Frankfurt-am-Main. The stone as a whole weighed 750½ carats; the single pieces into which it was divided weighed from 3 to 4 carats each. Besides its extraordinary size, its quality was remarkably fine, and hence the division was very successful, especially with regard to the beautiful surfaces of the separated pieces. The division itself of such a stone is a very peculiar task, and requires long experience to achieve a successful result. Moreover, the artisan, in order to complete the work properly, must needs forget that he is handling a stone worth 100,000 marks ($23,600). Carbons vary much in hardness, and they can not stand a heavy blow or exposure to great heat; a hard blow will often crush the stone to fragments, and a great heat may destroy its quality. Of great interest is the statement that some samples of carbon used in a boring drill were changed, in consequence of the stopping of the water current, to a black mass resembling glass (perhaps a graphitic material), and so soft as to be easily affected by a file, while the soft iron of the borer was hardened to steel. Ilmenite, nigrine, and other black minerals are often mistaken for carbon, but they naturally fall to pieces the moment the pressure of the drill is applied to them.

BRITISH GUIANA.

Further data have appeared as to the diamond discoveries in the Upper Mazaruni Valley in British Guiana,[b] in the Thirteenth Annual Report of the Institute of Mines and Forests of British Guiana on the gold, diamond, and forest interests of the colony for 1901–2.[c] About one page is given to the diamond industry, and the facts may be summed up as follows: In the year ending June 30, 1902, the number of diamonds "declared" was 132,077, nearly all from the Mazaruni district, though 1,414 stones came from the Potaro, and a very few from other districts. These occurrences are noted as indicating a somewhat wide distribution of the diamond-bearing deposits. Of late, stones of somewhat larger size have been found, though most of the Guiana stones are quite small. They are spoken of as closely similar to those from Diamantina, Brazil, and the suggestion is made that careful and extensive search may develop the presence of deep deposits, such as some of those in Minas Geraes.

Machinery is being introduced, and good results are looked for, although, as in previous years, the remoteness of the Upper Mazaruni Valley and the difficulties of transportation are still great obstacles to successful progress. On the other hand, these conditions prevent a

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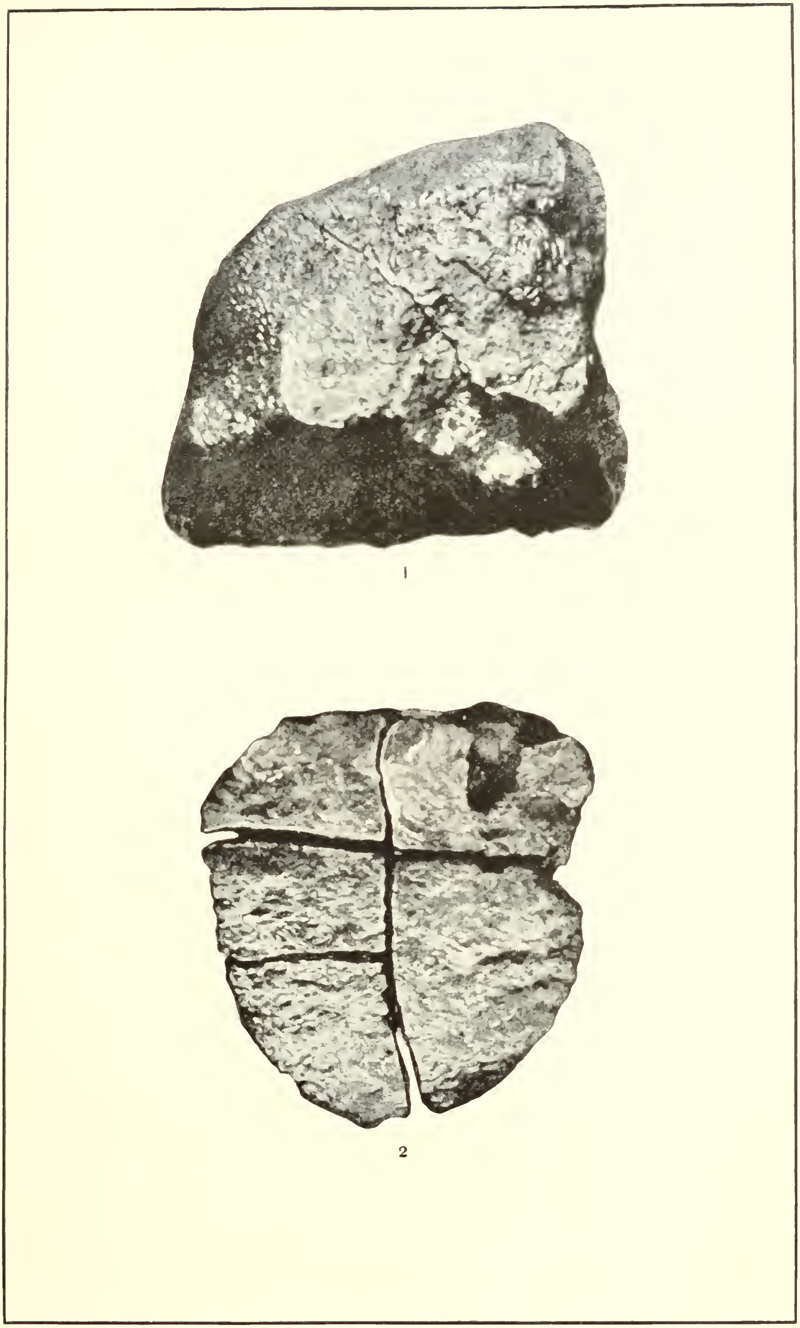
[a] Organ des Vereins der Bohrtechniker, 1902, Wien, April 15.

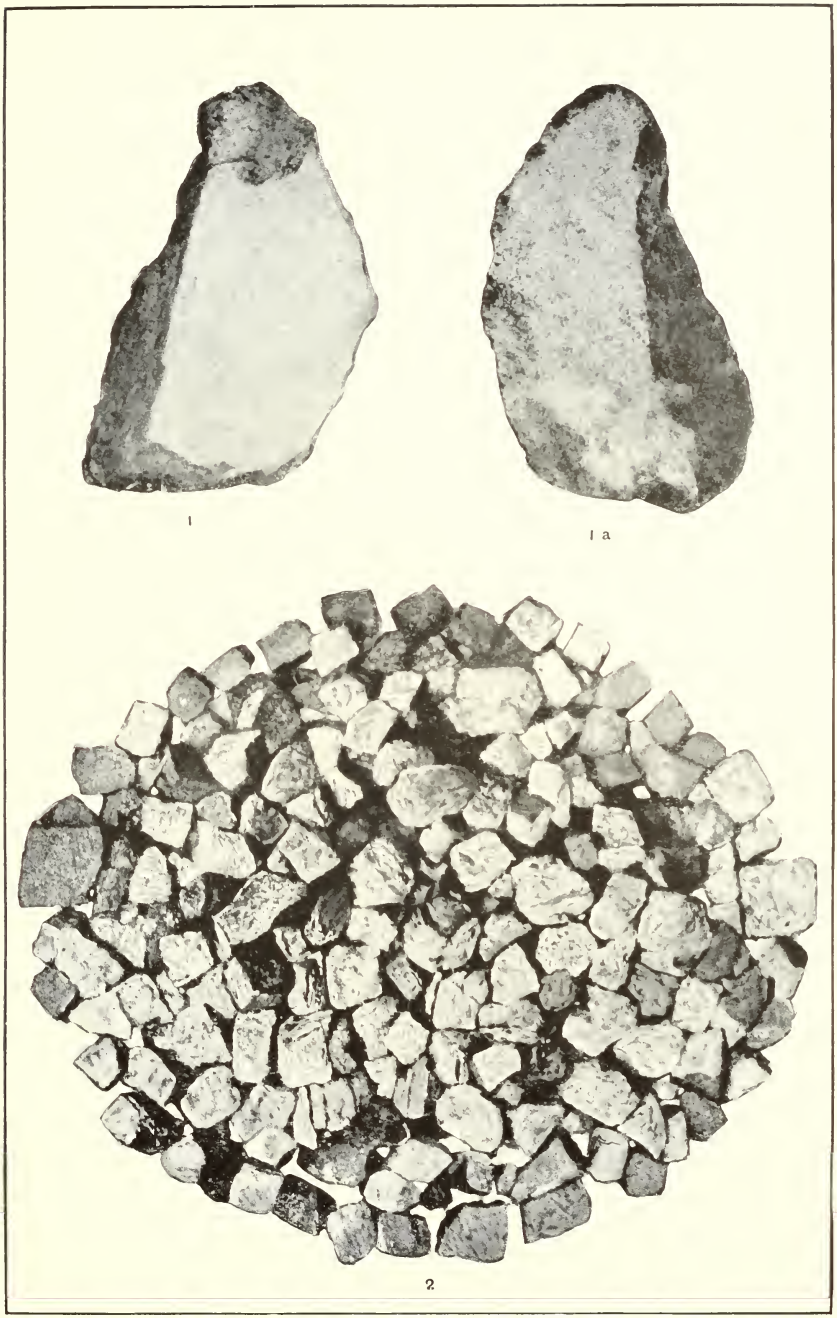
[b] Mineral Resources U. S., 1901, U. S. Geol. Survey, 1902, p. 735.

[c] Thirteenth Ann. Rept. Institute Mines and Forests of British Guiana, Georgetown, 1902, p. 15.



PROCESS OF BREAKING THE THIRD LARGEST PIECE OF CARBON EVER FOUND.
WEIGHT, 750½ CARATS; VALUE, $23,600.

1, Outer half of the piece, showing a break diagonally across it; 2, reverse (inner) side of 1, showing three breaks, making five pieces of the half of the carbon.



THE CARBON SHOWN IN PLATE III, AS FINALLY BROKEN INTO PIECES FOR DRILLS.

1, 1 a, Inner sides of upper part of the carbon shown on Plate III, fig. 2; 2, the entire third largest piece of carbon broken into pieces that weigh from three to four carats each, the sizes generally used for diamond drills.

rush of the undesirable element that has greatly impeded operations at some of the gold mines, and thus there is a compensation.

Plans are under consideration by the Colonial Government for opening a road from the terminus of steam navigation at Potaro to the still water above the Mazaruni falls, which is already traversed by a steam launch. Another proposal is for a light steam or electric railroad extending the Caburi road, which has been built for some distance above Bartica. This is in the line of United States Consul Moulton's suggestion referred to in the last report of this Bureau.

No less than twenty-seven companies are engaged in mining, and have "declared" diamonds during the year; but only fourteen of these have reported over 100 stones. The greater part of the production has been by Messrs. Armeny & Fogel, 55,608 stones; the British Guiana Company, Limited, 27,557; the Mazaruni Company, Limited, 26,280, and the Marshall Syndicate, 14,045. The customs returns show an export for the year covered, of 9,822½ carats; if the bulk of the stones obtained have been exported, their size would appear to average only about one-third of a carat. No data are given as to this point.

The following are the returns supplied by the British Guiana[a] Department of Mines as to diamonds and other precious stones (evidently nearly all diamonds) produced during the past year, showing the monthly output:

Production of diamonds and precious stones in British Guiana in 1902, by months.

Month.	Number.	Weight.
		Carats.
January	11,253	1,098½
February	12,403	1,176½
March	14,020	1,261½
April	22,914	1,516 15/16
May	10,474	753
June	21,042	1,047
July	5,562	381
August	24,876	1,358 5/16
September	10,337	517⅝
October	15,680	754 1/16
November	13,870	901¾
December	10,413	951 15/16
Total	172,844	11,718⅛

It thus appears that the 172,844 diamonds give an average of nearly 15 stones to the carat.

INDIA.

The Mining Journal (London) for February 28, 1903, has accounts from its correspondents as to gem mining in India. Although that

[a] The Mining Journal (London), February 7, 1903.

country has been so long renowned in history and tradition as the source of gems, little is now being done, save the ruby mining in Burma. The diamond industry is practically dead. Work is still carried on by the Madras Diamond Company, at Vajrakarur, but no output is reported for 1902. In the alluvial mines of the Bundelkund, in central India, the last returns were of 169 carats, in 1900.

BORNEO.

Diamonds have long been known to exist in southwestern Borneo, in the region of the Landak River near the mouth of the Seran River. A piece of so-called serpentine has been there obtained which incloses a diamond apparently in its true matrix. The Rajahs of Panembohan and Pongerans possess an immense belt studded with diamonds, said to be from this district, one stone weighing 67 carats. It is a peculiar belief of the natives that the gold and diamonds in the earth are a sort of bank, and should be worked only when they themselves need money, since they believe that gold and diamonds are always there when they desire them. The great Borneo diamond of Mattam, said to weigh 367 carats, is believed to be from this same region. During the last year the entire district has been examined by competent engineers, and an effort is now being made to exploit it systematically.

In the last report[a] of this Bureau an abstract was given of the account by M. Gascuel of the diamond region of southeastern Borneo. [In this abstract the word "northern" occurs in two places for "southern" by an error noticed too late for correction.] The account dealt principally with the Bandjoe-Irang district and the valley of the Martapoera, an affluent of the Barito, but mentions other less-known districts in the same portion of the island. A recent article, referred to in the Geologisches Centralblatt,[b] and taken from the Dutch of H. E. D. Engelhardt,[c] on the Doessonlaender district of southeastern Borneo, mentions the occurrence of diamonds and gold along the tributaries of the Barito, especially on the Mewien and the Djoeloei, left and right branches, respectively, of that stream.

NEW SOUTH WALES.

Mr. George W. Card, F. G. S., curator and mineralogist of the Geological Survey of New South Wales, has recently described very fully the eclogite-bearing breccia from the Bingera diamond field,[d] which is of so much interest in its relation to the occurrence of the same rare rock in the "blue ground" of the African diamond mines. This

[a] Production of Precious Stones, extract from Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, pp. 13-19.

[b] Geol. Centralblatt, vol. 2, No. 23, p. 793, December 1, 1902, Leipzig.

[c] Bijdragen tot d. Taal-, Land-, en Volkenkunde v. Ned. Indie, 6 Volgreeks, 8, d. (D. LII.), 1901, pp. 179-222, s'Gravenhage Mart Nijhoff.

[d] Records of the Geological Survey of New South Wales, vol. 7, pt. 2, 1902, pp. 29-39, Pls. IX-XI.

peculiar breccia has a close resemblance to the diamond-bearing rock at Kimberley, and like it, occupies a vertical "pipe" or chimney, piercing through sedimentary beds, and is itself traversed by basaltic dikes. The locality is at Ruby Hill, 12 miles south of Bingera, and has been described by the Government geologist, Mr. E. F. Pittman, in the Mineral Resources of New South Wales.[a] The occurrence of diamonds in this eclogite breccia, or at least in very close association with it, and the recent recognition of the same fact in South Africa, give it extreme interest. The eclogite occurs in bowlders and fragments in the intruded basalt and largely in the breccia, from which Mr. Card thinks that it may have been taken up by the basalt. The breccia consists of pieces, large and small, of melaphyre, claystone, and eclogite, embedded in a granular mass composed largely of minerals liberated by the decomposition of the latter. The masses of eclogite are seen to be altering from without into the greenish earthy mass of the decomposing breccia. Of the liberated minerals, pyrope garnet is the most abundant, then a green pyroxene, a little feldspar, occasional quartz, pleonaste, zircon, and perhaps cyanite. There is much secondary calcite and some magnetite. The whole is singularly like the African mixture.

Mr. Card goes into a detailed discussion of the modes of occurrence of all the components both of the eclogite itself and of the basalt and the breccia containing it, and also of their processes and products of alteration, illustrated with plates of microscopic sections. The paper is one of great interest both as a study of alterations in a rare rock and in connection with the recent views of Professors Bonney and Crookes on an eclogite source for the Kimberley diamonds.

Within the last few years quite extended discoveries of diamonds have been made in New South Wales, and considerable work has been done by individuals and by companies. But the diamonds, though brilliant and remarkably hard, are all small, and the Australian yield can not therefore become of great importance. The modes of occurrence, however, are interesting. The mining region is somewhat extensive, and there are half a dozen principal centers or "fields" located in the northern central part of New South Wales, chiefly in the counties of Hardinge and Murchison, a little north of south latitude 30, and in about longitude 151 east.

In most of these fields the occurrence is much like that familiar in California, in old river gravels which have been covered and protected from erosion by flows of Tertiary basalt. The diamonds are scattered more or less abundantly through these old gravel beds, with gold, stream tin, and various minerals often found in such associations; and occasionally the gravel is cemented by iron oxide into a sort of conglomerate, recalling the Brazilian cascalho; but there is no indication

[a] Mineral Resources of New South Wales for 1901, pp. 292–295.

of the original source. At one or two points, however, they have recently been traced to outcrops of a volcanic breccia, closely resembling the African. This is the case at the Ruby Hill mine, about 12 miles south of Bingera, and is also reported at the Mittagong mine, though the latter has not been much investigated.[a] As in Africa, dikes of basalt are found traversing the breccia. The point of especial interest, however, is the fact that in the breccia, and also in the dikes, occur pieces and irregular masses of the same rare and hard rock, eclogite, above referred to in connection with the latest phases of the discussion as to the source of the African diamonds. It does not appear that any diamonds have yet been detected in this material itself; but its presence under similar circumstances is of great interest, and gives hope of light being shed on the whole question by fuller and further investigation.

QUEENSLAND.

The diamond discoveries in New South Wales have been repeatedly noted in former reports of this Bureau, but no diamonds have been found in the adjoining province of Queensland until quite recently, when a single crystal has been obtained and a few others are reported.[b] The stone was found in the "sapphire wash" of the Anakie sapphire district, elsewhere described in this report (p. 35), at a point in its eastern portion a little south of Policeman Creek. The sapphire miners have been in the habit of mixing a few pale and off-colored stones in the lots that they sold, and an investigation as to this was undertaken by the Queensland Geological Survey. The diamond, unrecognized and taken for a white sapphire, was found among a group of such off-colored stones shown to Mr. Dunstan of the survey, by Mr. McCrystal, who operates the claim where it was found. He thinks that other similar stones have been sent away by the miners as of little value. The diamond is a crystal of 1¼ carats, flawless and colorless, and in form is an octahedron, with faces of the trisoctahedron and hexoctahedron. It was found at the bottom of the layer of sapphire wash, which was clayey and full of bowlders, and which contained also blue and green sapphires, corundum, pleonaste, zircon, and quartz pebbles. The sapphires are believed to have come from a basalt, which spread over much of the region in Tertiary time, but is now largely decomposed, save as it forms the capping of some scattered high hills. The country rock beneath consists of very ancient schists and granites. Nothing can be judged as to the source of the diamond as yet, and it seems pretty clear that there is no frequent or important diamond occurrence in this region.

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[a] Pittman, Mineral Resources New South Wales, 1901, pp. 392–395.

[b] Dunstan, B., Report on the Sapphire Fields of Anakie: Queensland Geol. Survey, Brisbane, 1902, p. 19, and Pl. II, fig. 10.

SIBERIA.

Two small diamonds have lately been obtained from new localities in Siberia, in the alluvial gold mines of northern Taiga, department of Yenisei. The first was discovered in 1897 in the gold mine of Baladin, on the Melnitschnaia, a tributary of the Pit River, itself a right-hand affluent of the Yenisei.[a] The second has been described in two or three articles by P. Jeremejev[b] and L. Jascewski,[c] with some dispute as to the precise locality, but it is from one of the gold mines of the same neighborhood. This is a colorless, transparent crystal, flattened in form and twinned in structure, weighing but 0.13 gram. Its crystallography is given in detail by Jascewski in his article.

An "Index of Minerals which occur in the Mining Districts of the Ural Mountains" has been published by W. P. Yarkov.[d] In this paper diamonds are mentioned as found in the mine of the Chariton Mining Company on the river Dankowka (a tributary of the Serebrianaja), about 3 miles from the Serebrjanovski factory, and at the Nikolai-Swjatitelski mine on the river Issa (district of Goro-Blagodad). Their occurrence is not described, but it is presumable that they are found in connection with gold placers; and as nothing is said of their size or frequency, they are doubtless small and rare. Microscopic diamonds were also recognized as long ago as 1871 by Prof. P. W. Jeremejev, from the Schischim Mountain, near the Kusinski works (district of Zlatoust), but their interest is purely scientific and in no wise practical.

As to the finding of diamonds in the Ural region, moreover, a recent article by N. Wyssotzky on the gold mines of the Kotschkar district,[e] mentions them as sometimes occurring with gold in the sands, together with topaz, beryl, chrysoberyl, euclase, chrysolite, garnet, tourmaline, cyanite, rutile, corundum, and smoky and amethystine quartz.

The occurrence of the diamond in the Ural country was for a long time questioned, but at various times for seventy years past small diamonds have been found in or in close proximity to the platinum and gold washings of the Ural Mountains. Some two hundred stones have been obtained hereabouts, but all of small size. A description of these occurrences has been given by the writer in the Journal of the Franklin Institute.[f]

In a collection at Nijni-Tagilsk the writer saw a small white crystal weighing one-third of a carat, a twinned hexoctahedron, which was pronounced phenacite by a local mineralogist, who had taken its spe-

[a] Glinka, Verh. Russ. min. Ges. St. Petersburg, (2), vol. 35, 1897, Prot., p. 75.

[b] Bull. Acad. Sci. St.-Pétersbourg, (5), vol. 9, 1898, Prot., pp. xiv, xv; Russ. Auszug in: Verh. Russ. min. Ges. (2), vol. 36, 1899, Prot., p. 34.

[c] Verh. Russ. min. Ges., (2), vol. 36, 1899, Prot., pp. 42, 43.

[d] Bull. Ural Soc. Nat. Sci., Ekaterinbourg, vol. 22, 1901, pp. 26–36.

[e] Centralblatt für Mineralogie, Geologie und Paleontologie, No. 11, 1902, Stuttgart, pp. 345–346.

[f] Jour. Franklin Inst., 1898, p. 23.

cific gravity, but which the writer identified as a small opalescent white diamond, similar to those from the Bagagem mines in Brazil. It was found in a small brook near the village of Kalstchi.[a] The existence of pyrope garnets here and their frequent finding seem to favor the theory of the presence of diamonds, although some of the Russians believe that the man who found the diamonds for Humboldt had really deceived him. The pyropes, however, are frequently associated with diamonds, and to a certain extent would suggest their occurrence.

The California diamond district in Trinity and Del Norte counties—the Del Norte-Smith River occurrence—presents a resemblance to this Ural region in the great frequency of platiniferous and chromiferous gold sands in upper California, Oregon, and northward, which would suggest the advisability of further search for diamonds. Very minute diamonds have been found in these sands, but it is possible that larger ones may be encountered. In this connection it is well to recall Prof. J. F. Kemp's statement that "minerals associated with the platinum nuggets are the familiar ones which have been so frequently studied in connection with the much more abundant gold-bearing placers. The commonest ones are gold, silver, copper, iridosmine, and other members of the platinum group—chromite, magnetite, menaccanite, garnet, zircon, rutile, small diamonds, topaz, quartz, cassiterite, pyrite, and epidote. Almost any mineral of high specific gravity which is commonly met in rocks may be expected to appear in the pannings."[b] Hence it is advisable to look for the heavier gem minerals, including the diamond, in the tailings of platinum washings.

NOTE.—With regard to the discovery of a single diamond in Bohemia, in connection with the pyrope garnets at Dlaschowitz, see under Pyrope, Bohemia and Saxony, p. 838.

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[a] Jour. Franklin Inst., September, 1898, pp. 23–24.
[b] Bull. U. S. Geol. Survey No. 193, 1902, p. 26.

CORUNDUM GEMS.

SAPPHIRE.

MONTANA.

The sapphire locality on Cottonwood Creek, Montana, noticed in the report of this Bureau for 1896,[a] has recently been investigated by Mr. J. M. Jamieson, and in June, 1902, he discovered, at the head of the main fork of Dry Cottonwood Creek, the source from which the sapphires of that locality were derived. He does not state the character of the rock, which is doubtless an igneous dike, but says that it is a ledge some 200 feet wide, traceable for 3,000 feet, and contains sapphires and garnets. Little development has yet been made, the deepest cut being about 8 feet, but Mr. Jamieson proposes to exploit the locality further very soon. He states that sapphires were found in the bed of the creek about thirteen years ago (1889), but that the ground along the creek was too flat for placer mining. Interest was revived, however, and some little work done, when the other Montana localities, at Yogo Gulch and Rock Creek, began to attract notice. Nothing important has thus far been done on Dry Cottonwood Creek.

QUEENSLAND.

The occurrence of sapphire-bearing deposits in Queensland has been known for over twenty years, but only lately have they begun to attract attention. A report was published concerning them in 1892, by Dr. R. L. Jack,[b] and an extended account has recently appeared, by Mr. B. Dunstan, assistant Government geologist of Queensland.[c]

The location of these deposits, which are best reached from Anakie station on the Central Railway, is between south latitude 23° and 23° 30′, west of longitude 148° east, and east of the Drummond Range of mountains, which runs a little west of north, leaving the great dividing range of central Australia, that trends north toward Cape York Peninsula, at about latitude 26° and longitude 147°.

The deposits are in an ancient alluvium, and occur chiefly in lines or bands parallel to the present water courses but somewhat above them. These slightly elevated ridges are old stream gravels which present a curious likeness and unlikeness to the ancient gold gravels of California. Like them, they represent former valleys filled by basaltic flows, but, in contrast to them, the gravel consists largely of the decomposed basalt, the matrix of the sapphires, which has been almost completely removed by disintegration and does not form a pro-

[a] Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 5, 1897, p. 22.

[b] Jack, R. L., Report on Sapphire Deposits and Gold and Silver Mines near Withersfield; Brisbane, 1892.

[c] Dunstan, B., The Sapphire Fields of Anakie, 26 pp., with maps and plates; Geol. Survey Queensland, 1902.

tecting cap. The protecting element has been supplied by bowlders and masses of an extremely hard siliceous rock of Cretaceous age that partly filled these valleys prior to the basaltic flow, and this covering, though broken up and strewn along the valleys, has even then so resisted wear as to preserve, between and beneath its broken masses, the sapphire alluvium of the decomposed basalt from entire removal. The miners look upon these bowlders of "billy," as they call it, as a sure sign of sapphires, and even as the source whence they are derived.

The sapphires themselves occur in a variety of crystalline forms, which are illustrated in the plates, and in many shades and hues of color, but not in the deep reds and blues most prized for jewelry. Greens, yellows, and light blues, with much dichroism, are frequent, and many of them are very beautiful. In this variety of delicate and peculiar colors they resemble the sapphires of Rock Creek, Montana.[a] Mr. Dunstan believes if they were more freely announced as Australian stones, and their peculiar features were emphasized as such, that they would soon command interest and acceptance, instead of the doubtful and partial favor that they have thus far had when brought into competition with gems of more conventional color from old and standard localities.

An interesting account is given, illustrated by a peculiar colored plate, as to the influence of strongly marked dichroism on the colors of gems, according to the direction in which the "table" or face is cut. The plate shows the widely different hues obtainable from the same crystal in this manner—a point of extreme importance to the lapidary and gem dealer. He suggests the advantage of a more general use of the dichroscope by those engaged in such business, and figures and describes a simple form of the instrument. This pleochroism is marked in the blue Anakie sapphires, is less so in the green ones, and is not observable in the yellow.

The colors found are carefully described, and Mr. Dunstan proposes the name Oriental peridot, instead of Oriental emerald, for the deeper green stones, and Oriental chrysoberyl for the light yellowish greens. The blues vary much in depth of color, but the real cornflower tint is not found. Red is very rare, and the purple (Oriental amethyst) also, but sometimes very fine.

The sapphire wash is usually a more or less clayey material, with bowlders of basalt and "billy," and is sometimes overlain by more recent alluvium. Many minerals occur with the sapphires, notably pleonaste and zircons, the latter sometimes of gem quality. One diamond was found, elsewhere described in this report. The sapphires are obtained in much the same way as gold, only that sieves are used instead of the pan. The coarser gravel and the fine material are thus removed, either by washing or jigging, according as water is accessible

[a] Mineral Resources U. S. for 1900, U. S. Geol. Survey, 1901.

or not, and the smaller gravel picked over for sapphires by hand. Dr. Jack, in his former report, stated that he obtained from a ton and a half of wash dirt "254 stones of from 3 to 179 carats each, and weighing in all 3,289 carats." This would give nearly 13 carats as the average weight. Mr. Dunstan, however, thinks this much overestimated, and has hardly found even one-half of such results.

Values and statistics are difficult to obtain. From one hundred to two hundred men are working throughout the region, with the fluctuating success of prospectors and pioneers. The gems, too, are variable in value, from not having yet been "standardized," and hence are not like gold, the amount of which obtained by a day's work is at once easily estimated at fixed rates. Mr. Dunstan judges that the amount realized thus far by the miners for stones sent from the Anakie fields may be about £10,000. He regards the prospects for permanent production as being very good. Much of the country is yet unexplored, and new discoveries are constantly being made.

CORUNDUM.

CONNECTICUT.

Corundum with carbon.—A singular occurrence of corundum associated with carbonaceous matter is reported at Barkhamsted, Conn., by Prof. B. K. Emerson, of Amherst College, in the American Journal of Science for September, 1902.[a] The corundum forms a bed between 2 and 3 inches thick, very pure, dark blue or blue-black in color, with occasional patches of pistachio green. It is granular, glistening, and resembles the emery of Ceylon. The specific gravity is 3.64. When magnified it is seen to consist of elongated grains. Through it are scattered small, stout prisms of cyanite, and it is densely penetrated with a coaly substance intimately mingled with the corundum in trains and rounded balls. "This carbonaceous matter," says Professor Emerson, "has been evidently introduced in an oily or tarry condition, and has been inspissated in place; and the abundant graphitic matter in the garnet" (see under Essonite, p. 42) "gives indication of the same origin." This corundum occurs in association with cyanitic mica-schist and fibrolite gneiss at Barkhamsted, Conn., where the latter rock carries the singular graphite-coated garnets described on page 42.

RUBY.

BURMA.

A recent article on Burman ruby mines, by G. Eisfelder,[b] develops little beyond what had already been given by English writers. He

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[a] Am. Jour. Sci., 4th ser., vol. 14, No. 81, pp. 235–236.

[b] Burma ruby mining: Berg- und hüttenm. Zeit., No. 1, 1902, pp. 1–8.

regards the old Mogok region of Upper Burma as still the most important, more so than the ruby mines of the Nanyadeik precinct in the Myit Kyina district, or those near the Sagiu-mount in the Mandole precinct. The rubies are found in a mass called by the natives "byon" (clay), considered by C. Barrington Brown and Professor Judd[a] to be a residual product of decomposed crystalline marble, which contains also sapphires, spinels, and tourmalines. The marble, mostly coarse granular, is supposed to be developed by contact metamorphism from a dolomitic limestone, which belongs, as Professor Noetling has stated, to the Upper Carboniferous. Limestone of this kind is found in many places unaltered, while at other points it appears changed into marble from penetration by eruptive rocks. The clay containing precious stones mixed with sand is found lying on the sides of the valley, and also occupies large depressions sometimes to the extent of a kilometer, which frequently penetrate the limestone itself as cavities. The same name (byon) is also applied to the ruby-bearing gravel bed underlying the alluvial deposits throughout a large extent of the Mogok Valley.

Rubies are the only important gem product of India at present, and these are confined to Upper Burma. In the Mogok Valley the Burma Ruby Mining Company, Limited, is at work actively, and has produced 210,784 carats of rubies, 9,786 of sapphires, and 10,241 of spinels, as the output of 1902. The workings are open excavations to and into the ruby-bearing gravel to a depth of 50 feet, and present a resemblance to the early stages of the Kimberley diamond mines, though of course the conditions of occurrence are widely different. The "byon" or gem gravel is raised to the surface by endless-rope haulage, crushed in rotary pans, and the gems finally separated by pulsators and hand picking. It seems remarkable that the company has not introduced the grease separator, which has proved so effective in place of hand picking at the African mines. Besides these large workings of the company, a number of small ones are let to natives, who pay a royalty on the product. In view of the ease with which valuable gems are secreted, this can hardly be a profitable arrangement for the company, but it is probably maintained chiefly as a conciliation to the native interests, as prior to the British occupation the natives had worked the alluvial deposits for generations and regarded it as a right.

A writer in the Allahabad Pioneer Mail points out that fuel in the vicinity of the Burma ruby mines has now become exceedingly scarce, and has to be brought from a considerable distance. In the near future it is probable that an electric plant will be introduced, as extensive water power exists to furnish an abundance of electricity should

[a] The rubies of Burma and associated minerals: Trans. Royal Soc. of London, vol. 187, A, pp. 151-228; Seventeenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1895, pp. 905-907; and Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 5, 1896, pp. 19, 20.

it be desired. The Mogok ruby district is by no means exhausted, but new regions have also been discovered, notably in the Chin country some miles to the southwest, and it is believed that this district will prove as important a factor in ruby production as that of Mogok itself.

Ruby trade in Burma.—A recent article in Le Diamant, Paris, 1902, gives accounts of the Burman ruby trade and of the native cutting. The estimated value of rubies sold annually in Mandalay amounts to $1,000,000 (30 lakhs of rupees). The leading gem dealers of Amsterdam and of Paris have agents who deal directly with the Shans, and the finest rubies are destined for the French capital. The traffic is conducted in peculiar ways, very interesting to the foreign observer. Certain conditions are rigorously maintained, as to the time of day for examination and purchase, and a system of signs for bargaining and agreement.

In examining rubies, the Shans never use artificial light, holding that full sunlight alone can bring out perfectly the color and brilliancy of the gems. Sales must therefore take place between the hours of 9 and 3, and the sky must be clear.

The purchaser, placed near a window, has before him a large copper plate. The sellers come to him one by one, and each empties upon the plate his little bag of rubies. The purchaser proceeds to arrange them for valuation in a number of small heaps. The first division is into three grades, according to size: (1) Those of 3 grains or less; (2) 3 to 6 grains; (3) 6 to 10 grains; any larger stones are set aside to be valued separately.

Each of these groups is again divided into three, according to color, the first quality being called extra red, the second pale, the third dark, or poorly colored. A further division is made, again into three grades, according to shape: (1) Those which will cut well; (2) those that will lose more than half their weight; (3) those that can not be cut, but only polished (rounded). There are thus 27 grades in all, besides the larger rubies that are estimated singly.

The bright copper plate has a curious use; the sunlight reflected from it through the stones brings out a color effect with true rubies different from that with red spinels and tourmalines, which are thus easily separated.

The buyer and seller then go through a very peculiar method of bargaining by signs, or rather grips, in perfect silence. After agreeing on the fairness of the classifications, they join their right hands, covered with a handkerchief or a flap of a garment, and by grasps and pressures, mutually understood among all these dealers, they make, modify, and accept proposals. The hands are then brought out, and the prices are recorded.

The larger single stones are valued according to color and shape for cutting, the very fine ones bringing high prices. A ruby of $36\frac{1}{2}$ carats from the Mogok mine some years ago brought 90,000 rupees ($30,000) at Calcutta.

Cutting is an important industry at Mandalay, and the Burmese workmen have remarkable skill, especially in avoiding loss in weight. European cutting they consider very wasteful, and at Mandalay a man would not be employed who sacrificed more than one-fourth of a ruby, while at Antwerp a loss of two-thirds is not uncommon. The tools are extremely simple. The stone is first shaped with a small steel chisel and wooden mallet, as far as possible according to its cleavage. The facets are then ground and polished on a copper wheel with ruby dust, the stone being held with wax or lac on a curved piece of ox-horn. A month or six weeks may be occupied in cutting and polishing a ruby of 1 carat.

The pale stones, cut rounded (cabochon) with a concave base, are much used for ornamental work, especially upon gold vessels. The luster of the gold beneath appears to enrich and darken the ruby and give it the true pigeon's-blood color.

BORNEO.

Ruby and sapphire corundum are reported as occurring in Borneo, in an article by Fr. W. Voit from geological and mining notes in the eastern part of that island.[a] They are found in small pieces, associated with gold, in the beds of mountain streams tributary to the Pâsir River in the sultanry of that name. It is notable that the associated gold occurs only in the lower portions of these little rivers, and in wire-like and "toothed" (crystalline) forms, not rolled, a fact indicative of a near source; but no particulars are given as to the corundum.

RUBY UNDER ULTRA VIOLET LIGHT.

In 1902 M. Chaumet read a paper before the Académie des Sciences de l'Institut, Paris, concerning an important result attained with rubies by experimentation with violet light similar to that tried on diamonds, as already mentioned. The Burmese rubies have a higher value than those of Siam, although in outward aspect they differ so slightly that even experts may easily fail to distinguish them, and no precise definition of their difference can be given. The radiograph affords no aid, but M. Chaumet finds a marked distinction under the action of violet light. The Siamese rubies allow the violet rays to traverse them, with little or no fluorescent effect; but the Burmese stones all fluoresce markedly and present a vivid red glow. By this means the gems from the two sources, however mingled, may be easily separated. Dr. Charles Baskerville and the writer are examining all the gems of the Morgan collection with this light, the Roentgen rays, and radium.

[a] Berg- und hüttenm. Zeit., Nos. 38, 39, 1902, pp. 445-459.

BERYL AND EUCLASE.

SIBERIA.

N. Orlow describes a new locality of beryl in eastern Siberia, near the Mongolian frontier, on a tributary of the Yasakin River.[a] The beryl occurs in veins of pegmatite, which, at the point where the beryl is found, pass into a mica schist. The crystallography of the beryl is described, and some optical anomalies noted, which the author attributes to an intermixture of euclase, as indicated by analysis, to an extent of about one-fifth. This euclase admixture appears to increase from the central portion of the crystals, where it forms only one-fifteenth part, toward the exterior, where it seems to constitute an outer zone, which is optically biaxial, while the central portion is normal.

GERMAN EAST AFRICA.

W. Bornhardt and B. Kuhn[b] mention beryl in long light-green crystals, occurring in pegmatite, in the district of Namaputa on the Muiti River, tributary of the Rovuma, in German East Africa.

TOPAZ.

WEST AUSTRALIA.

A remarkable discovery of topaz has been announced by Mr. E. S. Simpson, mineralogist to the Geological Survey of West Australia,[c] and fuller particulars are given in a subsequent letter to the writer. The locality is in the Coolgardie gold field, and near the town of Londonderry; the occurrence is in a dike of very coarse pegmatite, traversing amphibolite rock. The composition of the pegmatite is peculiar in that the mica is mainly lepidolite, and that topaz is present in large amount. The lepidolite is of amethystine tint, and has been found in sheets up to a foot square, or even more. Analysis shows it to be a true lepidolite, but almost anhydrous, and with rather less potash and with more soda and lithia than usual. The topaz is described by Mr. Simpson, in his letter, as in enormous rude crystals, up to 6 feet long and 2½ feet across. The rock has been disturbed and broken by subsequent geological action, so that the minerals are much fractured and crushed, and the topaz crystals have been rendered white and opaque on the exterior and along numerous cracks and fissures. Within they are pale blue and transparent, but so much broken that only small

[a] Verh. Russ. min. Ges. (2), vol. 37, 1899, Prot., pp. 48–49.

[b] Bornhardt, W., Zur Oberflächengestaltung und Geologie Deutsch-Ostafrikas, Berlin, 1900 (cf. Zeitschr. f. Krystall. u. Miner., vol. 36, pt. 4, Leipzig, 1902, pp. 420, 421).

[c] Simpson, Edward L., Bull. Western Australia Geol. Survey No. 6, 8vo., 89 pp., and plates; Perth, 1902.

pieces of gem-material are procurable; these are so light in color as to appear like clear white topazes. Mr. Simpson hopes that perhaps further opening of the rock may reveal material in better condition. An analysis is given, which shows the mineral to have the composition of a normal topaz.

ZIRCON.

QUEENSLAND.

Zircons, usually small, but sometimes of gem quality and good size, are found with the sapphires, elsewhere described (see p. 34), in the ancient alluvium, the sapphire wash, of central Queensland.[a] Some of them are colorless, with brilliant luster and rounded faces, and have quite naturally been mistaken for diamonds, but the majority are of various shades of brown and red. One large, red piece yielded a cut "hyacinth" of 15 carats, but those uniting size, transparency, and rich color are scarce.

Zircon, in regard to its color, has long been known to be sensitive both to heat and to sunlight, and the statements made in the report of Mr. Dunstan are of special interest in this respect, as definite accounts from a new locality. He says that these color changes are very marked in some of the zircons of the Anakie district, so that paling of tint is caused sometimes in stones that have been carried about in the pockets of miners, apparently by the mere warmth of the body, and that gentle heating is actually resorted to in order to render lighter the tint of zircons that are too dark. If the heat is slight, the former color may return as the stone cools; if too strong, the stone is decolorized entirely and permanently. The change may affect only the depth of color, but it usually renders the reds more or less brown. A remarkable fact, however, is that no such effects are produced, according to Mr. Dunstan, by the heat employed by lapidaries in cementing gem zircons to the holder for cutting and polishing, nor by the heat of the friction involved in those processes, though to this last point he does not refer directly.

Insolation also changes the color, but its effect is usually temporary, the original tint returning. One very interesting case is noted, that of a stone decolorized by heat, which partially regained its color after exposure to sunshine.

The whole subject of the effect of heat and sunlight on color is one deserving a careful scientific investigation, which has never been made. It would furnish a most interesting field for study and experiment, both as to zircons and as to other gem stones.

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[a] Dunstan, B., The Sapphire Fields of Anakie: Geol. Survey, Queensland, Brisbane, 1902.

GARNET.

ESSONITE.

CONNECTICUT.

Prof. B. K. Emerson, in the American Journal of Science for September, 1902,[a] describes a very peculiar occurrence of essonite garnet, partly coated and penetrated with graphite, at Barkhamsted, Conn. The garnets form a surface-layer on a bed of fibrolitic gneiss, and appear as large dodecahedral crystals, as much as 2 inches in diameter, much grown together. The faces are dull and cavernous, sometimes inclosing grains of calcite, and Professor Emerson thinks that the crystals developed from the gneiss surface into an overlying bed of calcite, since removed by erosion. In color they are pale yellowish, largely weathered to gray, and more or less covered or blotched with dull black graphite. This graphite stain extends below the surface for about half an inch, and there ceases abruptly, the plane frequently passing through the middle of the crystals of garnet; the graphite also runs farther into streaks and wedges. The real essonite is little more than an exterior zone or shell, however, the mass of the crystals proving under the microscope to be largely composed of a mixture of wollastonite, calcite, quartz grains, and diopside. The whole occurrence is very peculiar.

RHODOLITE.

NORTH CAROLINA.

The beautiful rhodolite garnet of Cowee Valley, in Macon County, N. C., has been extensively worked during the last year, the total output being estimated at $1,500, as against $27,000 in 1901. Mr. William E. Hidden, who has been actively interested in the development of the rhodolite, states that larger single pieces of it have been obtained than at any time before—one of 59 carats, the largest previously reported having been 23, 28, and 43 carats.

PYROPE.

ARIZONA AND NEW MEXICO.

Pyrope garnets of fine quality are found at several localities in New Mexico and Arizona, and have been referred to in previous reports of this Bureau. The principal locality in New Mexico is on the Navajo Reservation, and the finest large specimen from there is the property of Mr. W. T. Kaufman, of Marquette, Mich. It is more than half an inch

[a] Am. Jour. Sci., 4th ser., vol. 14, pp. 234–235.

in diameter, weighs $11\frac{1}{8}$ carats, and has a magnificent red color, equal to any garnet that the writer has seen from any locality. They are also found at some places in northern Arizona, and one of the finest, from near Fort Defiance, was figured by the author several years ago.[a] They occur loose in or near the surface, and are gathered by Indians, soldiers, and cowboys, principally from around ant hills and scorpion holes, where they are brought up and thrown out by the insects. Their source is doubtless in peridotite rocks, weathered out in the decomposition of the outcrops.

BOHEMIA AND SAXONY.

The Bohemian garnet beds and the alluvial gems of the Seufzergründel near Hinterhermsdorf, Saxony, have been described by Dr. I. H. Oehmichen in an article on "Die böhmischen Granatlagerstätten und die Edelsteinseife des Seufzergründels bei Hinterhermsdorf in Sachsen."[b]

The Bohemian garnets occur on the southern slope of the central chain of the Bohemian Mountains, either in genuine alluvial deposits (at Chodolitz, Podseditz, Chrastian, Triblitz), or in a decomposed peridotite (at Meronitz), or in tufa, breccia, and fragmental rocks (at Linhorka Hill, near Starry). At the first two places mentioned, the garnets belong probably to the latest stage of the Tertiary period. The basins containing garnets occupy an area of 70 square kilometers and extend in different directions. In the basins fragments of basalt are the rock chiefly found, but there occur also gneiss, granulite with garnet and cyanite, granite, mica-schist with garnet crystals (110) up to 2 centimeters in diameter, serpentine with pyrope not infrequently, porphyry, Pläner clay, and Tertiary sandstone. The garnet is associated in these basins with the following minerals: Zircon, in reddish-brown to yellow-brown crystals with rounded faces (111); (110) (111); (100) (111); spinel (ceylonite), spherical granules scarcely red in color; corundum (sapphire and ruby), in angular fragments, rounded granules and crystals of pyramidal aspect; cyanite, less frequently; tourmaline, in small black prisms; olivine, in rounded, mostly crisp, granules and small crystals; quartz; opal; calcite; aragonite; barite; magnetite; brown iron ore, partly pseudomorphous after iron pyrites; augite and hornblende in crystals and fragments of typical basaltic character, and moldavite.[c] Former reports on the occurrence of topaz, bronzite, and titanite could not be verified by Herr Oehmichen.

Mention is made of the finding of a diamond at Dlaschkowitz. On the basis of oral communications by Dr. Vrba to Dr. R. Beck, the

[a] Gems and Precious Stones of the United States, 1892, Pl. III, fig. A.
[b] Zeitschr. f. prakt. Geol., 1900, vol. 8, pp. 1-16.
[c] Zeitschr. f. prakt. Geol., 1900, vol. 33, p. 649-650.

features of this diamond must be deemed entirely different from those of the India and Brazil diamonds, and hence it was considered to be the only representative of a special type. The origin and finding of this same diamond were fully described by the author after a visit to the garnet fields of Bohemia, when he saw the stone in the great collection of the University of Prague in 1891. He was then, and is still, fully convinced of the Bohemian source of this diamond.[a]

The conglomerates containing garnet near Meronitz are treated of by Dr. Oehmichen on the foundation of earlier reports on that subject. Of the genesis of the garnet beds he gives a detailed account, indicating that the garnets came from an olivine rock, probably lherzolyte, and that they were brought up by a volcanic eruption which formed the hill called Linhorka, near Starry. In the tufas surrounding the hill occur nearly all the minerals and conglomerates containing garnets. From that tufa the minerals have been transported to the diluvial basins.

The alluvial gems in the Seufzergründel near Hinterhermsdorf ("Sächsische Schweitz") have some likeness to the Bohemian garnets of the alluvial deposits. In the little valley or basin are frequently found sand layers containing unusually large quantities of magnetic iron ore, and also magnetic iron associated with titanite; besides these there are also fragments of hornblende, augite, bronzite, diopside, zircon up to 7 millimeters in size, ceylonite, and corundum. As matrix there occurs in these sand masses some glassy basalt containing olivine and hornblende, and an associated breccia. In the latter occur peculiar inclusions showing a gabbro-like structure, and sometimes products of basalt, which have been cooled and solidified in the depths of the earth. From the basalt and the breccia is probably derived the alluvium, and from the gabbro-like rocks originally came the larger part of the spinels.

For a recent statement as to the falling off in the Bohemian garnet industry for some years past, see page 70.

ALMANDITE.

GERMAN EAST AFRICA.

A brief notice of the discovery of almandite in German East Africa appeared in the last report of this Bureau.[b]

Dr. A. Miethe, professor in the technical high school at Charlottenburg and director of the photochemical department of the same school, sent a highly appreciative letter to Mr. Fred. Marquordt,

[a] Kunz, George F., The garnet fields of Bohemia: Trans. Am. Inst. Min. Eng., 1892, Feb. meeting, Sup., pp. 1-9, with map.

[b] Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, p. 746.

owner of the garnet mines in Luisenfeld, in Linde-Hinterland, German East Africa, expressing his pleasure in being able, after careful examination, to communicate a favorable report, especially as Germany has not many of the precious stones. The letter[a] states that the German East African garnets are next in rank to the so-called rubies of the Cape, which occur, together with diamonds, in the Kimberley mine and in the other African diamond diggings. A careful comparison of these latter shows their close likeness to those of German East Africa. But in Luisenfeld there have not been found stones of white, yellow, or brown color, like the majority of those found at Kimberley. The choice cut stones made by order of Dr. Miethe from the pieces sent to him for examination, show the exceedingly fine quality of the rough material. The luster is very beautiful, exceeding that of the Indian and Bohemian garnets, and even of those from Arizona. The color of the stones is a pure carmine. The garnets from Luisenfeld have also the rare quality of not changing color in the evening; the tint does not darken, but the play of color seems more beautiful in gaslight than in sunlight. The average color of single stones is comparatively light. This is an advantage, because it is consequently possible to cut larger gems having more brilliant effects. The Cape rubies have been found only in small pieces; but in Luisenfeld the rough material is of much larger size, and after cutting it shows no flaws. To Dr. Miethe as an expert was sent for examination a perfectly regular cut stone, absolutely faultless, of admirable color, 15 carats in weight. In view of these facts, it is evident that the finding of these large, light-colored stones of exceedingly rich color in such abundance is indeed an important circumstance.

The Cape rubies and the Arizona garnets, as well as those so long and extensively worked in Bohemia, belong to the species pyrope, which never occurs in masses of any size, but in small rounded pieces from the amygdaloidal cavities of igneous rocks. The Luisenfeld stone is apparently almandite, the precious garnet of jewelers, which occurs in larger pieces and often in well-defined crystals.

A further account of this interesting discovery has been given by W. Bornhardt and B. Kuhn in a series of mineralogical notes published in a work by the former.[b]

The locality is on the Namaputa River, a tributary of the Rovuma. The garnet occurs in a decomposing hornblende gneiss, whence it is liberated in rounded masses up to the size of a man's fist, probably representing large crystals, irregularly distributed through the rock. It is usually transparent, of a columbine-red inclining to brownish-red, and is suitable for good jewelry. But the authors of the work

[a] Schlesische Zeitung, Breslau, October 10, 1902.

[b] Zur Oberflächengestaltung und Geologie Deutsch-Ostafrikas, Berlin, 1900. Cf. Zeitschr. f. Krystall. u. Miner., vol. 36, pt. 4, Leipzig, 1902, pp. 420, 421.

cited question whether continuous mining of it would be profitable, especially as other localities of garnet have been discovered, though not of such good quality. The analysis given of this garnet is interesting, as representing an almandite in which the ferrous oxide has been largely replaced by magnesia, and to some extent by lime, showing its approach in part to a pyrope, and suggesting some molecular combination of the two species, such as has been recognized in the case of the North Carolina rhodolite,[a] though quite different from that instance. The density, too, is very low for almandite, and both in this particular and in the composition the description approaches very nearly the analysis (No. 13) given by Dana, under pyrope, of a Cape ruby.

Analysis of almandite garnet, German East Africa.

Constituent.	Per cent.
SiO_2	38.87
Al_2O_3	23.15
FeO	20.55
CaO	5.58
MgO	11.74
Total	99.89

Specific gravity, 3.875.

TOURMALINE.

CONNECTICUT.

The tourmalines and associated minerals from Haddam Neck, Conn., previously described in these reports,[b] have been very fully investigated and described by Mr. H. L. Bowman, in the Mineralogical Magazine,[c] London, on the basis of a representative collection of some eighty specimens, presented to the Oxford Museum by Mr. Ernest Schernikow, of New York, who was largely engaged in exploiting the albite quarry at the locality in which these minerals occur.

The paper treats of ten species, of which the collection contains examples, and mentions three others not represented—microlite and columbite, which are reported as occurring at Haddam Neck, and the chrysoberyl of Haddam, on the opposite side of the Connecticut River. The ten species are muscovite, lepidolite, cookeite, albite, microcline, quartz, beryl, fluorite, apatite, and, of course, the lithia tourmaline. They occur chiefly in a large vein or rather dike of pegmatite, in which albite, quartz, and muscovite are the conspicuous elements.

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[a] Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6 (cont.), 1898. Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, p. 744.

[b] Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 5 (cont.), 1897, pp. 1183–1204; Nineteenth Ann. Rept., pt. 6 (cont.), 1898, p. 505; Twentieth Ann. Rept., pt. 6 (cont.), 1899, p. 602, Pl. I, fig. E.

[c] Mineralogical Mag. and Jour. Min. Soc., May, 1902; vol. 13, No. 60, pp. 97–121, and Pl. IV.

The other species appear chiefly in cavities or pockets, lined with crystals of more or less smoky quartz and the feldspars.

The paper dwells especially on the remarkable intergrowth of muscovite and lepidolite, which is familiar to all who are acquainted with specimens from this place, and also with specimens from some of the Maine localities. The peculiar association of these two species, their modes of grouping and twinning, etc., are investigated and described in detail. Much interest attaches to the curious fibro-prismatic rose-colored modification of muscovite from this locality, that has lately become somewhat familiar. Chemical and optical examination show it to be a true muscovite, though so different in general aspect from ordinary micas, and to consist of minute and very elongated rhombic crystals attached in either parallel or twin position, "so that the whole mass can be cleaved across like a single crystal." The separate components, looking like fibers, are not however prisms, but excessively long and slender pyramids. The tourmalines are discussed optically and crystallographically, and the peculiar color sections are noted and referred to successive growths. The planes of demarcation, as is well known, are usually parallel to the base, a fact which is remarked upon as rather singular when the basal plane is so rarely developed in the perfect crystals. One specimen is figured, in which the green central and pink terminal portions are separated by the ordinary low trigonal pyramid.

Beryl appears in two forms, one greenish-white, and the other pale pink; the latter is noted as of interest as probably containing cæsium, which has been found in similar specimens by Penfield, though no analysis is given of it here.

The apatite is treated at length crystallographically. It also presents two varieties, a grayish-green, in hexagonal tables, and a more prismatic pink form.

In general, Mr. Bowman refers to the close resemblance between the minerals of Haddam Neck and those of the Maine localities of albite-pegmatite and of some others in New England. The same intimate association of lepidolite, forming borders on crystals of muscovite, appears at Auburn, Me., and even to some extent also the external zone of fibrous muscovite. The intergrowth of muscovite with quartz and of microcline with quartz are also noted, and the determinations of Wells and Penfield and Harper as to the presence of cæsium oxide (1.66 to 3.6 per cent) in beryls from Hebron and Norway, Me., are closely paralleled by the Haddam Neck variety. As to the order of formation little can be affirmed, the minerals being so mingled that they must have been nearly contemporaneous. The quartz and microcline are evidently among the last, from their inclusion and envelopment of tourmaline and of some of the micas. Among the latter the order is always muscovite, lepidolite, and the pink fibro-prismatic muscovite on the outside.

NEW YORK.

An article of great interest from a scientific point of view appeared in the American Geologist[a] for June, 1902, on "Tourmaline contact zones near Alexandria Bay, N. Y.," by C. H. Smyth, jr., of Hamilton College, Clinton, N. Y. The data and conclusions have special interest in regard to the origin of tourmaline, and its relation to igneous dikes and to veins, and to the connection between the two last-named phenomena, as traceable in certain of the islands of the St. Lawrence and the adjacent shores near Alexandria Bay. On Wellesley Island the contact is well shown between igneous and older sedimentary rocks, the former representing the great granitic and gneissic complex of the western Adirondack region, and the latter a body of schists, gneisses, and quartzites of pre-Cambrian age. Both series have undergone extensive alteration, but their general characters are well discernible.

The granitic series cuts the sedimentary at many points, and includes multitudes of fragments from the quartzite and schists. Dikes and veins are abundant. The larger dikes have the prevailing character of the granitic and gneissic mass of the mainland, with which they are undoubtedly identical, while the smaller dikes become coarser in texture and more quartzose in composition—in other words, become pegmatitic—and black tourmaline appears as a marked ingredient. The narrower these dikes become, the farther do they penetrate the older rock, relatively if not absolutely, and the more they take on the aspect and much of the character of aqueous veins. But even more remarkable is the difference seen in the contact phenomena of the larger dikes as compared with the smaller dikes in the schists. These latter, indeed, show more or less local alteration from the intrusion of the masses and the larger dikes, but far more effect is apparent along the smaller dikes and veins. Along these there is a pronounced development of tourmaline in the schists, in exceedingly varied forms, which Professor Smyth in part describes. But the striking fact is, as he expresses it, that "in a general way, the amount of tourmaline seems to vary inversely as the width of the dikes," and that it "becomes relatively greater as the offshoots become more quartzose." These two statements, as he adds, are essentially the same, since the narrow offshoots are the richest in quartz.

Comparing these phenomena with somewhat similar ones reported in Colorado by Prof. H. B. Patton,[b] the author goes on to trace the stages in the development of these dikes and veins and their influence on the penetrated rocks. The granitic magma of the large masses would force its way unchanged into the wider fissures, while through the influence of heated water and gases with which the magma must,

[a] Am. Geologist, June, 1902, vol. 29, No. 6, pp. 377-383.
[b] Bull. Geol. Soc. America, vol. 10, pp. 21-26.

of course, have been charged, the narrow offshoots, with fluid products of hydrothermal fusion, were injected into the narrower fissures and cracks, often to long distances. "Indeed," he says, "starting from the normal granite, we might expect to find a gradation to a pure quartz vein, * * * filled by hot solutions of silica having their origin in the granite. * * * This series is pretty well represented; but the quartz, as a rule, is accompanied by some tourmaline, * * * indicative of the boric vapors so common in granite intrusions." According to this view, the increased development of tourmaline along the smaller veins finds a natural explanation.

A number of additional points are dwelt upon which can scarcely be treated of here. Professor Smyth points out that, as to the tourmaline in the granitic veins themselves, the general position of the prisms at right angles to the vein is evidence both of the fluid condition of the magma and of the absence or the cessation of injecting pressure at the time when the crystals formed. As regards the tourmaline in the schists, it is plainly derived from the biotite of the latter, which is abundant where the rock is unaltered and absent in the contact zones where the tourmaline appears.

In the process before outlined it follows clearly that the narrow, vein-like dikes represent a protracted stage of development, continuing long after the larger masses and wider dikes had measurably solidified; and that thus quartz veins and slender dikes of pegmatite, even cutting the true granitic dikes, may have been produced, subsequently, indeed, but actually as a continuous part of the same general body of igneous activities.

Passing to some other localities on the mainland, in the towns of Omar and Alexandria, where specimens of hematite in feldspar have long been obtained by mineralogists, Professor Smyth finds a similar condition, though with some variations. "Here, too," he says, "it is possible to find every gradation from these mineral veins, through pegmatites to dikes of normal granite; and there seems no question that the veins owe their existence to the granitic intrusion." But they themselves are yet true veins, not dikes, and were filled by heated solutions and not by melted rock.

URAL MOUNTAINS.

In the Bulletin of the Ural Society of Natural Science[a] has appeared an "Index of minerals which occur in the mining districts of the Ural Mountains," by W. P. Yarkov.

Among other interesting references, a remarkable occurrence of green tourmaline is noted near the village of Schabrov (district of Ekaterinbourg). Arzruni, who had received a specimen from this

[a] Bull. Ural Soc. Nat. Sci., 1901, Ekaterinbourg, vol. 22, pp. 26–36.

locality, and also from the works at Berezov, wrote of it from Berlin to the Imperial Mineralogical Society in 1882, saying that it was of exceeding interest from the fact that, like alexandrite, its pure green color changed to a ruby-red in artificial light, and adding that this is only the second mineral showing this remarkable property. A double refraction is also noted in connection with these green tourmalines, but no particulars are given. The two optical anomalies may have some relation to each other, which no doubt will be fully investigated.

Other colored tourmalines are also mentioned—rose-pink, with black, in a talcose rock; and wine-yellow to dark brown, containing some chromium, associated with fuchsite and chrome-iron, on the left bank of the Kamenka River, a mile northwest of the Suisserski works (district of Suissersk). Prof. P. W. Jeremejev, the secretary of the Imperial Mineralogic Society, had stated in 1882 that thin plates of this tourmaline appear to show a double refraction by artificial light, together with a difference of color.

Corundum is merely mentioned, with no particulars as to color or quality, as found in the sands of the Kornilov Valley (district of Mursinsk).

ORIGIN OF TOURMALINE.

Prof. Giovanni d'Achiardi, of the University of Pisa, has published an article on the metamorphism of limestone by contact with granite, at Porto dei Cavoli, on the island of Elba.[a] Having previously described a similar case of local alteration at Berdiauch in the Urals,[b] he was led to pursue the subject further, as developed on the island of Elba, at the famous tourmaline locality, which had been studied by himself, and also to some extent by others, from 1899 to 1902. The limestones at this locality are closely associated with a body of metamorphic schists of various mineralogical character, traversed and locally modified by granite veins; these have all been described somewhat fully by Lotti, who refers the schists to presilurian sediments.[c]

Professor d'Achiardi enters into a detailed account of the characters of the granite, which presents several varieties of texture and composition, due in part at least to its proximity to the limestone; describes a narrow zone of alteration at the actual contact, showing a mutual action of the two rocks on each other; and describes the limestone itself as affected by the granite. The whole body of schists, in which the limestone beds occur, is thoroughly metamorphic, and the limestone has the character of either a saccharoidal marble or a slightly foliated cipolin; but the local contact action shows itself in the development of various accessory minerals in the marble, some conspicuous,

[a] Atti della Societa Toscana di Scienze Naturali residente in Pisa, Mem., vol. 29, 1902, (separ.) pp. 1-41, Pls. IV, V, VI.

[b] Id., Mem., vol. 16, 1898.

[c] Descrizione geol. dell' isola d' Elba; Mem. descr. d. Carta geol. d' Italia; Roma, 1886.

but chiefly minute. Wollastonite is prominent; others are pyroxene (malacolite), dipyre, vesuvianite, grossularite, etc. These were all studied in detail as to their proportions, vicinity to the contact, etc., and are illustrated by plates of magnified sections. The whole is a very interesting study of what may be called secondary metamorphism, where local contact has produced mineralogical changes in an altered sediment already thoroughly crystalline.

OPTICAL PROPERTIES OF TOURMALINE.

E. A. Wulfing, in an article on the different rates of vibration of light in tourmaline,[a] gives his investigations on the optical properties of tourmaline as compared with quartz, and contests the views of C. Viola in regard to these minerals, wherein the latter has questioned the theory of Fresnel. Viola experimented on quartz with the total reflectometer of Abbe, and praises the extreme accuracy of that instrument. Wulfing admits this claim, conceding its accuracy to the fourth decimal place, but holds that the differential method of Dufet gives more exact results, though only with extreme care on the part of the observer.

Viola's minute difference of 0.00016, in the exponents of the ordinary ray in quartz (as parallel or transverse to the *c* axis), Wulfing regards as unsatisfactory, from possible defects of the instrument, and also as obtained from but a single specimen, and hence as not sufficient for a conclusion so important as to discredit the theory of Fresnel.

In tourmaline crystals from Elba, Viola had found results with sodium light, which again appeared to show that the vibrations proceed otherwise than as stated by Fresnel. Wulfing commented on these in 1900,[b] and again in the present article, pointing out that Elba tourmalines are known to be optically variable, even in different parts of the same crystal, and that hence, in order to draw any important conclusions from such specimens, the measurements must needs be made in the different directions at the same point in a crystal. He then goes on to describe at length his method of cutting prismatic or pyramidal sections from tourmaline crystals, so as to examine the rates of vibration of a ray in axial or transverse direction from exactly the same point in the same material. He gives details of his results thus obtained, and concludes that the doctrine of Fresnel is thereby fully borne out.

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[a] Separat-Abdruck aus dem Centralblatt d. Min., Geol., u. Palæont.; Stuttgart, 1901, pp. 299-302.
[b] Hohenheimer Program, 1900, p. 48.

JADEITE.

MEXICO.

Dr. Leopoldo Batres, the Mexican archæologist, has lately published a remarkable monograph, sumptuously printed and illustrated, entitled "Explorations of Mount Alban."[a] This locality is a hill or small mountain, one of a group some 5 miles southwest of the city of Oaxaca, and is notable for a number of large ruined structures, chiefly of a religious character, on its sides and summit. These are very ancient, as is shown by many indications, and furnish some of the best examples of the little-known type of Mexican civilization termed the Zapotecan. The people who constructed the buildings and sculptures of this type Dr. Batres regards as having close relation with the Mayas, and the ruins present marked resemblances to those of Palenque and Uxmal.

The ruins on Mount Alban consist of groups of teocallis, or stepped pyramids with flat summits, whereon were doubtless temples, long since gone. The hillsides are also full of sepulchers and mortuary chambers, with remarkable architecture and carvings. In the vestibule of one of these Dr. Batres discovered a highly ornamented vase of pottery, containing about fifty small pieces of jadeite; some of them were elaborately carved amulets, others were beads, round or cylindrical, and some were of irregular forms. They were of fine quality and color, green and blue, but, strange to relate, bore traces of having been painted red. The carvings upon them, as also the ornamentation of the vase, are thoroughly Mayan, and in one case identical with an object from Palenque. All are figured in the monograph.

Both as specimens of jadeite and as archæological treasures, these are of great interest.

NEPHRITE.

NEW SOUTH WALES.

Dr. Card[b] records that jade (nephrite), but poor and of little or no value, as the polishing quality is not good, is reported from Wentworth mine, Lucknow, New South Wales.

EPIDOTE.

ALASKA.

The fine crystals of epidote from Prince of Wales Island, Alaska, announced in the last report of this Bureau,[c] have been made the subject

[a] Explorations of Mount Alban, by Leopoldo Batres (Inspeccion y Conservacion de Monumentos Arqueologicos de la Republica Mexicana); Mexico, 1902 (small 4to, 37 pp , 25 plates and map).

[b] Record of the Geological Survey of New South Wales for 1902, vol. 7, pt. 2, pp. 29–46.

[c] Mineral Resources U. S. for 1901, U. S. Geol Survey, 1902, p. 745.

of a detailed notice, with plate, by Dr. Charles Palache, of the Harvard Mineralogical Laboratory, Cambridge, Mass.[a] Specimens were sent to the laboratory by Mr. W. C. Hart, of Manitou, Colo., who describes the locality at Sulzer, Prince of Wales Island, and the associated minerals, much as in the announcement above noted. Mr. Palache adds, however, that: "The country rock is limestone, which is cut by numerous igneous dikes, and it seems probable that the deposit is the result of contact metamorphism of the limestone by the dike rocks, resembling closely in this respect the epidote occurrence with copper ore in the Seven Devils Mountains in Idaho." The crystals are dark green to nearly black, but oil green and translucent when thin or fractured. The forms are varied and peculiar, sometimes quite unlike the ordinary aspect of epidote, the larger ones presenting the unusual type of nearly square tables, flattened parallel to *a*, and attached by an edge, measuring up to 5.5 centimeters in diameter (2.2 inches) and 3 centimeters in thickness (1.2 inches). The small crystals tend more to the usual prismatic habit.

Dr. Palache's paper is minutely and exhaustively crystallographic; he determines a large number of faces, some of them new for epidote, and some but imperfectly measured before. In conclusion, he says: "This Alaska epidote ranks among the finest occurrences of American crystallized minerals, and is only surpassed in the size, beauty, and complexity of its crystals by the epidote from the Knappenwand in the Tyrol."

A few of the best specimens found in 1901 have been sent to New York, and as groupings of large crystals, beautified with the association of quartz crystals, they have no rivals.

SPODUMENE (KUNZITE).

CALIFORNIA.

Transparent lilac-colored spodumene.—A recent remarkable discovery of unaltered lilac-colored spodumene has lately been made in California. The crystals were obtained 50 feet from a deposit of colored tourmaline—itself of notable interest—a mile and a half northeast from Pala, San Diego County. This new discovery is less than a mile northeast from the celebrated rubellite and lepidolite locality at that place, where recent developments have brought to light immense quantities of amblygonite, the latter species occurring by the ton, while the lepidolite is estimated by the thousand tons. The locality is thus unequalled in the world for its abundance of lithia minerals. The rubellite crystals found here are entirely embedded in lepidolite, and until recently it was found impossible to remove them to show their form. They were, however, often polished with the lepidolite,

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[a] Proc. Am. Acad. Arts and Sciences, vol. 37, No. 19; March, 1902, pp. 531-535.

the rubellite appearing as radiations of pink in a darker gangue of a lilac-colored lepidolite. This year, however, the crystals of rubellite have been rubbed out, as it were—that is, made to stand out by removing the lepidolite matrix by means of brushes and cleaning tools, thus forming a most beautiful group of crystals.

At the new locality colored tourmaline crystals have been found that are remarkable in size and beauty, although they have been much broken in taking them out. Some are a foot long and 3 inches in diameter, with a red central core (rubellite) and a blue exterior (indicolite) separated by a pale intervening zone.

The spodumene crystals are beautiful in their color tones, varying in striking contrast from a deep pink-purple lilac, when taken at a depth, to a pale, almost colorless tint evidently due to weathering or to the action of the sunlight.

These spodumene crystals are of extraordinary size, transparency, and beauty, and are unrivaled by those from any known localities. Below are the weights and dimensions of six of the principal crystals:

Weights and dimensions of California spodumene crystals.

	Weight.	Weight.	Dimensions.
	Grams.	*Oz. troy.*	*Centimeters.*
No. 1..	528.7	17.1	17 by 11 by 1
No. 2..	528.7	17.1	22 by 8 by 1.5
No. 3..	297	9.55	19 by 5.5 by 1.5
No. 4..	256.6	8.25	23 by 4 by 2
No. 5..	340.5	10.95	13 by 6 by 2.53
No. 6..	239.5	7.70	18 by 4 by 2

Some crystals of spodumene purporting to come from Hermosillo, Mexico, were shown to the writer during the month of December. They are identical in habit, but much smaller than those from Pala. They were found in the White Queen mine, sec. 24, T. 9 S., R. 2 W., of the San Bernardino meridian, California. In either case no such spodumene crystals have ever before been found at any known locality. They are entirely distinct from the green crystals found at Stony Point, Alexander County, N. C., described by Dr. J. Lawrence Smith, and from the transparent yellow crystals found in Brazil, and described by Pisani.

The writer suggested that this was a distinct variety of gem of great beauty, and entitled to a new name. Dr. Charles Baskerville found that it differed from all other spodumene in its activity with ultra violet light, and named it kunzite.[a]

WEST AUSTRALIA.

Green spodumene.—In a recent report on the mines and minerals of West Australia, Mr. E. S. Simpson, mineralogist to the geological

[a] Science, August, 1903.

survey,[a] mentions an occurrence of spodumene of apple-green color in large prismatic crystals half a mile south of Ravensthorpe. Nothing is said of any portion of it as being transparent, but the color is of interest as presenting a type of this mineral intermediate between the ordinary whitish and altered form and the gem-variety hiddenite. Analysis shows this variety to be a spodumene rich in lithia and the alkalies and rather low in silica and alumina.

QUARTZ.

CALIFORNIA.

Small crystals of quartz resembling those from Herkimer County, N. Y., have been received from Dr. L. G. Yates, of Santa Barbara, Cal. They have been extensively advertised as white topaz, etc., on the strength of statements by local jewelers who claim to be experts on gems.

ELECTRICAL RESISTANCE OF QUARTZ.

The late Prof. Ogden N. Rood, of Columbia University, New York City, recently published[b] some investigations—almost his last work—on the electrical resistance, both internal and external (transmission and surface conduction), of various "non-conducting" bodies, usually so called. Among these were glass, quartz, and mica. The experiments were conducted with much difficulty and with great care, but owing to leakage at connections, etc., their results are announced as only approximate. The external or surface resistance of quartz was found to be for 1 square centimeter of crystal surface, 521,000,000 ohms, as compared with 1,590,000 for window glass, 22,000,000 for cobalt glass, and 50,760,000 for mica. Each of these values was the mean of several experiments. The internal resistance—1 square centimeter with a thickness of 1 millimeter—shows a surprising contrast, being for quartz only 885,000 ohms, while for mica (muscovite) it was 133,000,000. The tests on glass were unsatisfactory to Professor Rood, and he reserved them for further study. As the experiments on quartz, however, were made without reference, apparently, to the faces or axes of the crystals, fuller investigation of the subject from a more strictly mineralogical standpoint, with promise of interesting results, should follow the work thus begun by this eminent physicist.

CRYSTALLOGRAPHIC FEATURES OF QUARTZ.

In the Bulletin de la Société Française de Minéralogie,[c] several articles have appeared regarding peculiar crystallographic or related features in quartz. M. Ferdinand Gonnard furnishes four brief communications, with illustrations, on the occurrence of unusual planes

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[a] Simpson, Edward S., Bull. Geol. Survey Western Australia No. 6, Perth, 1902, p. 57.
[b] Am. Jour. Sci., 4th ser., vol. 14, pp. 161–165.
[c] Bull. Soc. franç. de Min., vol. 25, Nos. 3, 4, 5, March, April, May, 1902.

on crystals of quartz from various localities, particularly from Brazil and Baveno, and M. G. Friedel treats of a peculiar instance of quartz twinning, and of corrosion figures produced in quartz by alkalies applied at high temperatures, as indicating crystallographic modifications caused by heat. The experiments described in the last of these articles were suggested by a statement of Chatelier in the same publication[a] that at a temperature of 570° quartz undergoes certain alterations in its optical properties, though not in its outward aspect, which indicate a change in molecular symmetry. M. Friedel endeavored to confirm this determination, and succeeded in doing so by treating quartz crystals with strong alkalies at temperatures near 600°, thus developing figures of corrosion that indicated the existence and the character of such a molecular alteration. These papers are all too minutely technical for anything more than a brief reference to them here.

SMOKY QUARTZ.

MAINE.

Since 1897 numerous pockets of smoky quartz have been found on the Littlefield farm, at Mount Apatite, Auburn, Me. Several tons of crystals in all have been obtained. One exceptionally perfect crystal weighing 12 pounds was found imbedded on the edges of a mass of cleavelandite, a short distance from the farm of A. S. Berry, in a deposit of large quartz crystals, feldspar, and gem tourmalines, of which more than 150 were obtained. A perfect 3-inch ball was cut from a smoky-quartz crystal found at this deposit, and is now in the collection of E. R. Chadbourne, of Lewiston, Me.

AMETHYST.

VIRGINIA.

Specimens of amethyst from Virginia, but nothing of importance, have been known to students and collectors for years past. Recently, however, a promising locality has been opened and some good gem material taken out, which occurred in pockets connected with a well-marked vein or stratum of white quartz which extends for some miles along the base of the Blue Ridge, and at certain points carries galena. The main locality is situated in Amherst County, some 2 miles from Lowesville post-office and about the same distance from the James River, at the foot of the mountains. It occupies an area of some 11 acres, and the amethyst occurs but a few inches below the surface. Only a few days' work was done with the simplest tools in exploiting the deposit.

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[a] Bull. Soc. franç. de Min., vol. 13, p. 112.

NONCRYSTALLINE QUARTZ.

AGATE.

The Borgia Chaldean agate ax.—An object of great scientific interest is the famous inscribed Borgia Chaldean agate ax. This ax was obtained by the Cardinal Borgia while at the head of the propaganda. The Contessa Ettore Borgia offered it to the British Museum some ten or twelve years ago, but at so extravagant a value (about £3,000 or £4,000 sterling) that it was returned to her. It was ultimately acquired, for some 15,000 lire, by the late Comte Michel Tysckiewicz. It is now in the Morgan collection of the American Museum of Natural History, New York.

The following extract is from Maspero:

> Elle se trouvait dans l'ancienne collection du Cardinal Borgia et appartenait, il y a quelques années, au Comte Ettore Borgia. Elle a été publiée par Stevens (Flint Chips, p. 115), et en fac-simile par F. Lenormant (Tre Monumenti Caldei ed Assiri delle Collezioni Romane, 1879, pp. 4–9, et pl. VI, I); et Carvailhac (Âge de la Pierre en Asie), dans le troisième Congrès provincial des Orientalistes, tenu à Lyon (tom. I, pp. 321–332), a reproduit ce que Lenormant en avait dit.[a]

CHALCEDONY.

NEW SOUTH WALES.

Dr. Card[b] mentions that chalcedony containing included water (enhydros) has been found in magnificent specimens, some of them as much as 12 inches in diameter, at the Kingsgate bismuth mines.

CHRYSOPRASE.

NORTH CAROLINA.

An occurrence of chrysoprase is reported about 16 miles from Asheville, near Morgan Hill, Buncombe County, N. C. The material is encountered in several parallel seams, running with a general northeast–southwest strike, within a few feet of each other. At the surface the color is pale green, but as the rock was opened down to some 4 feet deep the color became darker and richer. Beyond a little test opening of this kind, no work has yet been done, and the value of the deposit can not as yet be judged.

OPAL.

CALIFORNIA.

Mr. C. R. Orcutt, of San Diego, Cal., refers to a great locality of opal in the region of the Mohave desert, in southern California. The

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[a] Extract concerning agate ax-hammer head, from Maspero: "Histoire Ancienne des Peuples de l'Orient Classique: Les Origines; Égypte, Chaldée," p. 755.

[b] Record of the Geological Survey of New South Wales, for 1902, vol. 7, pt. 2, pp. 29–46.

mineral is reported as occurring in large quantities in a porphyritic rock. The opal found at the surface is mostly chalcedonic, but some true precious opal has been obtained, and small stones have been cut from pieces of it.

IDAHO.

An extensive and promising opal locality is announced in Idaho, and is described in a letter from Mr. S. V. LeSieur, of Provo, Utah, who discovered it in May, 1902, and made further investigation of it later in the year. The locality is in Lemhi County, Idaho, on Panther Creek, on the west side of the valley, some 6 miles below its head, and at an altitute of 7,000 feet. Here a large dike of porphyry runs parallel with the creek for nearly a mile and a half, forming a ledge partly covered with overwash from the mountain slope, but at times outcropping and rising several feet. The width of the dike is estimated at as much as 150 feet; and the porphyry is full of opals of all kinds, qualities, and colors—milky, blue, green, brown, pink, etc.—and among them some of the perfectly transparent variety, the "fire" or flame opal. Many of the masses are large, but to obtain good-sized stones from them is difficult, as the opals are very brittle and the rock very hard. He succeeded in getting an opal of 60 carats which showed green reflections, and a brown opal of 150 carats, but otherwise no really fine stones above 10 carats weight. The opal here is largely of the glassy variety, with broad "flames" of color—a kind that is fragile and not well suited for jewelry. Its value as a mine for gem material, in view of the large proportion of loss by breakage, remains to be determined.

What must probably be the same locality was briefly mentioned in the report of this Bureau for 1895, on the authority of Mr. Don Maguire, of Ogden, Utah, but no subsequent references to it have appeared, and no development seems to have been made until now.

NEW SOUTH WALES.

The search for opals is still being carried on with as much interest as ever in the White Cliffs field of New South Wales. More than twenty claims are being worked for opal, and competition for the gem in open market is brisk, good specimens being sold for from $150 to $200 per ounce, although quite frequently less than that is paid for a quantity weighing many pounds.

Among the many kinds and large quantities of opal recently discovered and worked in New South Wales and other parts of Australia, there is a large amount of material that is very beautiful but not available for cutting into gems for setting, and much ingenuity has been shown in devising ways for utilizing this otherwise discarded material and bringing it into the arts in new forms of ornamental work. When the flake is too thin to cut a gem, it is cemented on one side to a piece of black oynx, producing a more brilliant effect than would the opal itself. If the flake is much thicker, this is sold as opal appliqué. When the opal is in smaller pieces, it is cemented as a mosaic upon slate or black onyx, producing an effect of great beauty. Still further, minute particles of opal are put into sealed tubes of glass or rock-crystal filled with liquid glass, and the liquid glass solidifying makes the whole seem one homogeneous mass of rock crystal and opal, and produces a brilliant object adapted for use as handles for parasols or canes.

A correspondent of the London Mining Journal, writing from Sydney in October, 1902, reports great prosperity and progress in the opal mining in the White Cliffs district. A number of new mines have been opened and prospectors are actively engaged on the outskirts of the region. Some very rich patches of beautifully colored opal have lately been discovered. German buyers are now visiting the field and purchasing largely. It seems that art jewelry is receiving much attention in Germany, and that Australian opal is coming into high favor for such work, particularly for hair ornaments, brooches, etc. As many as two hundred men are now employed at one of the leading mines—that known as Barratt's Block 25.

Dr. Card[a] reports opal, a translucent chrome-green variety, a beautiful stone admitting of a fine polish, from Port Macquarie; amygdules of precious opal in melaphyre, near Ballina; and rhodonite, massive, with magnetite, 8 miles north of Lyndhurst, and also in various districts of New England, New South Wales.

QUEENSLAND.

The existence of precious opal in Queensland has been known for many years, but the first mining activity was about 1878. Of late the rich production in New South Wales has attracted more attention; and although severe droughts have interfered with working and prospecting, yet a large amount of fine opal has been obtained. The estimated value of the product for the twelve years from 1891 to 1901, inclusive, is £131,000, about one-third the amount estimated for New South Wales.

The Queensland opal field was briefly described in the report of this Bureau for 1895. A very full account of it has appeared within the last year by Mr. C. F. V. Jackson, assistant Government geologist.[b] The opaliferous district extends from the southern border of Queensland nearly to latitude 21° south, between east longitude 141° and 146°. It is interesting to compare this report with that elsewhere noted

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[a] Record of the Geological Survey of New South Wales for 1902, vol. 2, pt. 2, pp. 29–46.

[b] The opal mining industry and the distribution of opal deposits in Queensland: Report Queensland Geol. Surv. No. 177; 8vo., 34 pp., with map; Brisbane, 1902.

(p. 34), on the Queensland sapphire deposits, which lie about 1 degree east of the middle portion of this area, but are separated from it by the great dividing range of mountains. Many of the geological features are very similar, but there seems to be no indication of either gem in the territory of the other.

The mode of occurrence is the same as in New South Wales (see descriptions of the latter in the reports of this Bureau for 1896, 1898, and 1901), but the precise geological relations are more exactly given in this recent account. The rock in which the opal has been deposited consists of the remains of a formation, once widely extended but now largely removed, known as the Desert Sandstone. This rock is Upper Cretaceous, and rests somewhat unconformably upon the Rolling Downs formation (Lower Cretaceous), which was laid down by a narrow sea that extended from the great bight on the south to the Gulf of Carpentaria on the north, dividing Australia into two islands. The Desert Sandstone was deposited during a period of less extensive depression following one of partial elevation. It is fragmental in character, of no great thickness, and consists of a lower body of soft and clayey deposits, and an upper portion that is siliceous and extremely hard. It is in the lower part of this latter, just above the softer portion, that the opaliferous zone or "band" occurs. Much of this intensely hard siliceous capping is strewn over the country in more or less rounded pieces, called "water dogs" by the miners, apparently identical with the "billy" of the sapphire district (see notice above, p. 35).

Opal is found occasionally in pieces and fragments on the surface, coming from decomposition of the rock, but this is not common, and there are in general no surface indications. Hence the mining is a haphazard affair, as the "band" may be rich or poor at any particular point where an opening is made down to it. The work is done usually with a pick, as blasting is found to shatter the opal too much. In many cases, Mr. Jackson says, exploratory drives are abandoned—quite too soon, in his opinion—before reaching the level of the "band," if the indications are not favorable in the overlying rock.

The rock matrix is a hard ferruginous sandstone, or siliceous ironstone, at times forming concretions, which lie in clayey sandstone so as to look like a conglomerate. These concretions, from a fraction of an inch up to 6 or 8 inches in thickness, have evidently been formed from the outside, and their centers are occasionally hollow, or contain a clear liquid or a white powder, but more generally they are filled with opal, common or precious, which at times extends in veins or strings into the outer layers. In other cases the "bowlders" are very much larger, and the opal is not present as a nucleus, but in seams and layers between the concentric shells of the concretions or traversing them in veins or cracks. At one or two places the pure opal forms little irregular concretionary masses in clay, and at others it occurs in "pencils" or "pipes," which are apparently stems or small trunks of plants replaced by silica; these are in the sandstone, and have much geological interest. All these accounts are very similar to those above referred to in the reports of this Bureau as to New South Wales.

There is a great area of opal-bearing country and a great variety and beauty of the material, but the aridity is such as frequently to compel the miners and prospectors to suspend work. Some of the miners cut their own opals and polish them, but rather poorly and wastefully. Mr. Jackson treats of the uses of the material; much that is very elegant is rejected because not fit for cutting the conventional rounded stones, and he hopes that the growing taste for more artistic work in precious stones may utilize much of this heretofore discarded material. The precious opal forms about one-tenth of that obtained, the rest being common opal of all kinds and colors.

At one or two localities near Springsure, and at a few points in other parts of Australia, opal occurs in its usual manner in the cavities of a trachyte. These have not been worked, however, to any extent as yet.

WEST AUSTRALIA.

The precious opal, so widely occurring in New South Wales and Queensland, as elsewhere referred to here (pp. 58–59), has not been found in West Australia, but a peculiar association of common opal with a silicified crocidolite, similar to that of South Africa, is described[a] from Yarra Yarra, in the northwest district of the colony, by Mr. Edward S. Simpson, mineralogist to the geological survey. In a letter to the writer, Mr. Simpson states that the common opal is yellow, brown, and green, in varying shades, and is traversed by small veins of the crocidolite. This crocidolite is chiefly brown with a golden chatoyancy, but is sometimes dark green with an almost white chatoyancy, and occasionally brownish-red with a reddish-amber chatoyancy. The two first-named kinds recall strongly from the description the two African types, corresponding respectively to a complete or partial alteration of the original crocidolite.

TURQUOISE.

ALABAMA.

Turquoise has been discovered in a new and hitherto unsuspected region, namely, in the middle eastern part of Alabama, at several points near Idaho, Clay County, about 95 miles due east of Birmingham, in the region of the Talladega Mountains. Some copper mines

[a] Simpson, Edward S., Rept. Geol. Survey Western Australia No. 6, pt. 3 p. 89, Perth, 1902; and in a letter.

were previously located in this vicinity. The turquoise seems to be of two distinct varieties—one, yellowish-green, occurring in compact veins from one-eighth to three-fourths of an inch in thickness, and resembling much of the New Mexican material, which frequently improves in color at a greater depth; the other is a bluish variety penetrating a gray matrix in all directions in seams spreading out from an eighth of an inch thick to the thinness of paper. The color, however, is more blue and the occurrence more distinctly resembles that of the Persian material.

One of the localities has been mined somewhat. The main mine was discovered accidentally by the finding of a piece of turquoise on the surface. Then an opening was made, and a considerable quantity of material was obtained, but no regular mining has yet been done. Unlike the western localities, there are no traces of aboriginal workings, according to Prof. Eugene A. Smith, the State geologist, nor have any objects made from turquoise been used among the recent Indians, nor has turquoise been found in their graves.

The geological relations of these deposits have not thus far been investigated.

ARIZONA.

In a recent paper upon the "Racial unity of the historic and prehistoric people of the Southwest, and particularly of New Mexico and Arizona," presented at the meeting of the "International Congress of Americanists," New York, December, 1902, by Prof. William P. Blake, Territorial geologist and professor at the University of Arizona, a delegate from that Territory, attention was especially directed to the very general distribution of fragments of the mineral known to the existing tribes as chalchuite in the ancient ruins throughout Arizona. "It occurs generally in the form of discoidal beads and tabular pendants, but often as mosaics. * * * There are several localities of this gem in Arizona and New Mexico, exhibiting extensive prehistoric mining. Old pits are found partly filled with débris and stone tools. * * * The identity of chalchuite with turquoise was shown by me in 1857. It has been claimed by some, notably by the late E. G. Squier, that the word 'chalchuite' means simply a green stone and is equally applicable to jade or to other green stones; but the fact that the Indians of to-day apply this name to the native turquoise only supports my contention that it has been so applied from prehistoric periods to the present, and that it does not refer to 'jade, or jasper,' or other ornamental stones."

Professor Blake has some very strong grounds for his view, which identifies the chalchuite with the New Mexican turquoise; but on the other hand, there is equally good evidence that much of the ancient chalchihuitl was jade, as has recently been shown by the researches of

Mrs. Zelia Nuttall, who has traced the geographical distribution of chalchihuitl as given in the earliest records of the Spanish conquest, and in the tribute rolls of Montezuma.[a] It seems very clear that the view of so eminent an archæologist as the late Mr. Squier is in the main correct, that the word denoted a highly valued green stone, with no exact mineralogical distinction. But we may now recognize that the name was applied especially to jade in southern Mexico and to turquoise in northern Mexico—the two stones occurring in those regions, respectively, and neither region possessing the other stone. The old records, the Spanish narratives, the ancient workings, and the still lingering traditions, are abundantly clear as to the two minerals meant by chalchihuitl in the two different sections of the country.

CALIFORNIA.

Further discoveries of turquoise are reported by Mr. C. R. Orcutt, of San Diego, Cal., at various points in the Mohave Desert in that State, not far from Victor, San Bernardino County. No particulars are given, and the announcement is merely put on record, until further accounts are received.

GERMANY.

THURINGIA.

A new locality for turquoise is reported in southern Thuringia.[b] It is located in the siliceous slate quarry among strata of middle Silurian age, near the highway between Weckersdorf and Langenwolschendorf in the dukedom of Reuss. The mineral occurs in slender bands, sometimes much elongated, evidently representing fillings of cavities.

APATITE (MOROXITE).

SOUTHWEST AFRICA.

Some blue-green crystals were obtained in a decomposed feldspar of a coarse-grained granite, on the river Swakop, southwest Africa, that were supposed to be sapphires. Dr. C. Klein,[c] of Berlin, found upon a careful examination that they were not such, but that from their hardness (5), specific gravity (3.2), hexagonal form, and glassy luster, they were really apatite of the moroxite variety, a mineral that, under its many strange occurrences of color and forms of crystal, has been at times mistaken for a variety of other minerals.

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[a] Nuttall, Zelia, Chalchihuitl in Ancient Mexico: Am. Anthropologist, vol. 3, 1901, pp. 227–238.

[b] Zeitschr. f. Naturw., vol. 72, pt. 6, July, 1900, p. 453. Neues Jahrbuch f. Min., Geol. und Pal., 1902, vol. 1, pt. 2. Mineralogie, Einzelne Mineralien, p. 187.

[c] Centralblatt für Min., Geol., u. Pal., Berlin, Oct. 23, 1902, No. 24, p. 748.

LAZULITE.

MADAGASCAR.

In the last report of this Bureau[a] an abstract was given of the account published by M. Lacroix of the gem minerals of Madagascar. Among those mentioned very briefly, yet as of possible value, was klaprothite (lazulite). In a more recent article,[b] M. Lacroix describes specimens of this mineral lately received by him from two localities in the island. Some of these were from Mount Bity and were found in the soil associated with the colored lithia tourmalines described in the last report. In their richness of color and their transparency in thin laminæ they resemble the lazulite from the diamond gravels of Minas Geraes in Brazil. They present fragments of crystals of 6 to 8 centimeters in diameter, which are attached to small portions of quartz and muscovite, and apparently came from quartz veins. The other specimens are from a different region, northeast of Betafo, and present a curious association—a rock composed of deep-blue lazulite and colorless cyanite, with small quantities of quartz, muscovite, tourmaline, sphene, and magnetite, finely mingled. This singular rock occurs in a region of pyroxenic and amphibolic gneiss, and is comparable only to a somewhat similar rock from Horrsjoberg, in Wermland.

AMBER.

ROUMANIA.

In a dissertation published at Bucharest[c] on the amber localities of Roumania, the author, Mr. G. Muntuanu-Murgoci, gives a general discussion of fossil resins with particular reference to the Roumanian amber, for which he indicates no less than forty-four important localities, which are shown on the map accompanying his paper.

These localities he divides into two sets, which are termed primary and secondary. The primary occurrences are in the Upper Eocene and in the Oligocene (menilite limestone), where the amber is associated with lignite. In consequence of this distribution the layers of amber are closely connected and directed by the formations of the southeast Carpathians. The secondary occurrences are in the Miocene (salt formation) and in alluvial deposits.

Although the Roumanian amber is not important to the country from an industrial standpoint, yet it is a valuable decorative product. Its color is usually dark red to brown; much of it is translucent, though

[a] Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, p. 768.

[b] Bull. Soc. franç. de Min., vol. 25, Nos. 4-5, April-May, 1902, p. 115.

[c] Muntuanu-Murgoei, G., Zaeemintale Succinului din Romania [The amber localities of Roumania], graduation dissertation, 56 pp., 6 illustrations, 1 map; Bucarest, 1902.

it frequently contains impurities. The Roumanians prize it very highly for ornamental uses, and value it much above the amber of the Baltic.

The publication contains an exhaustive and critical treatise on resins in general and the Roumanian localities in particular.

JET.

YORKSHIRE, ENGLAND.

A recent examination of sections of jet from Yorkshire leads Mr. A. C. Seward[a] to believe that the origin of jet is from the alteration of coniferous wood, and, in part, of wood of the Araucarian type. Sections from specimens which consist partly of petrified wood and partly of jet show a gradual passage from Araucarian wood to a pure jet which retains little trace of its ligneous origin.

GRAPHIC GRANITE.

URAL MOUNTAINS.

Graphic granite, or Hebrew stone, as the coarsely intertwined crystallization of quartz with feldspar is called, presents, when polished across the crystals themselves, a marked likeness to Hebraic characters. This substance is extensively polished in Russia and worked into beautiful art objects and sometimes into charms. It is found at various localities, but especially in the Ural Mountains, and many of the finest art productions of that region are made from it.

In a recent article[b] Prof. A. Karpinsky, of St. Petersburg, describes an examination of the graphic granite from Mursinka, in the Ural, and particularly of some specimens in which the feldspar crystals (orthoclase) are well preserved, but the quartz has entirely disappeared, leaving cavities which bear on their sides impressions of the striæ of quartz prisms. Similar specimens have been found at other localities in the Urals. Professor Karpinsky thinks that these traces of quartz prisms in the cavities disprove the statement of Noegbom,[c] that the silica was removed during the period of crystallization, and that water free from carbonic acid could, perhaps, dissolve the quartz more readily than the orthoclase. There is no evidence that any pseudomorphous alteration has occurred, as both Russian and Swedish specimens are known in which the quartz is partially removed, with no trace of pseudomorphism.

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[a] Seward, A. C., On the structure and origin of jet: Rept. Brit. Assoc. Adv. Sci. for 1901, pp. 856–857, London.

[b] Proc. Imp. Russ. Min. Soc., vol. 39, 1902, Prot. p. 23.

[c] Bull. Geol. Inst. Upsala, vol. 3, 1897, p. 436.

THE GEM-CUTTING INDUSTRY.

UNITED STATES.

Diamond-cutting industry in the United States.—In the brief period of ten years during which the diamond-cutting industry has been conducted on a commercial basis in the United States, it has advanced with such rapid growth that this country now commands a foremost position among the diamond-cutting countries of the world. The importation of $7,000,000 worth of rough diamonds during the twelve months ending June 30, 1903, evidences the growing prosperity of this industry here; and had not the rough diamond stock of the world been materially reduced by the demand exceeding the supply, it is probable that the United States would to-day be exporting polished diamonds to Europe instead of importing from there the additional quantities necessary to supply our demand. The effect of such a condition can be better appreciated when attention is called to the fact that out of about $19,000,000 worth of diamonds imported through New York City into this country during the fiscal year ending June 30, 1903, fully $8,000,000 represented wages paid to foreign laborers. Upon the $7,000,000 worth of rough diamonds imported during the fiscal year ending June 30, 1903, there is represented a saving to this country of over $3,000,000 paid to its own workmen. Upon this basis it is safe to estimate the saving in labor to this country in this industry alone during the last five years to be over $10,000,000; it has both given remunerative employment to many men and also kept this large sum of money in this country.

The ingenuity and enterprise of the American cutters have been material factors in their success. In Amsterdam, the acknowledged home of the industry, where it has been conducted for more than one hundred years, no innovations have been introduced. It has been left to the Americans to introduce a number of new mechanical labor-saving devices, which have unquestionably given them a great advantage over the European cutters, where diamond cutting is done by the ancestral "rule of thumb" handed down from father to son.

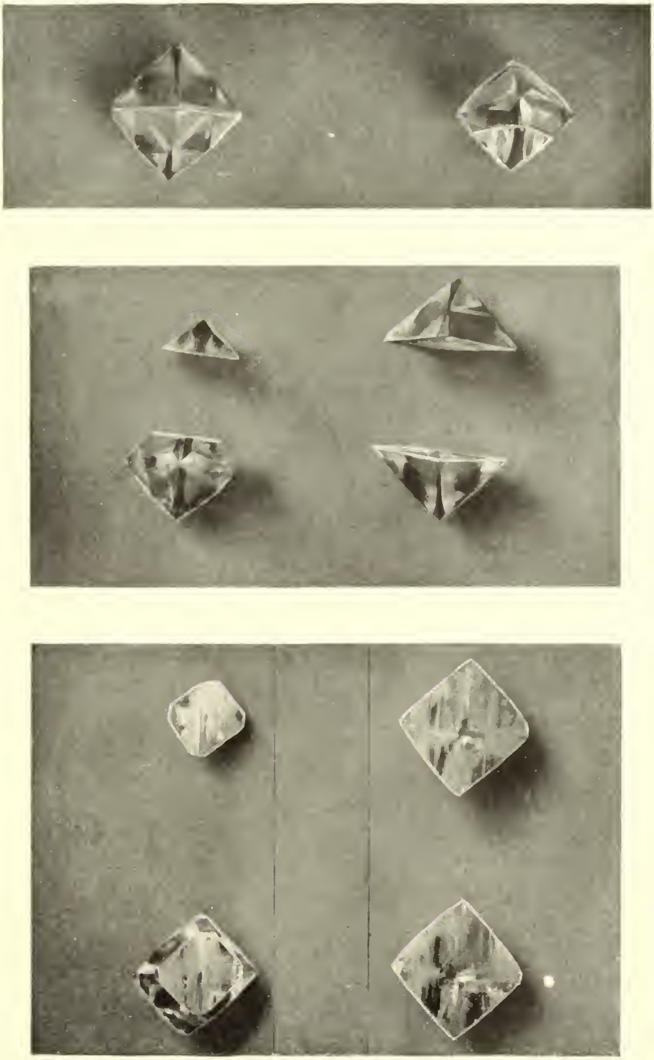
The banking system in Holland seems to be favorable to the diamond industry, but there is a greater supply of ready money in this country to conduct the industry, individual diamond-cutting firms importing fully $1,000,000 worth of rough stones.

In the early part of 1903 there seems to have been great difficulty in obtaining the rough diamonds, due both to the great demand for diamonds and to the fact that the output has not increased, owing either to the lack of capacity to supply a greater demand or to the regulation of supply by the De Beers Mines Company.

About nine days elapse from the time of shipment until the rough diamonds are received in New York, and as rough diamonds are not dutiable the shipments are made and cleared with great rapidity.

No small diamond-cutting establishments can exist at present unless they do only recutting or repairing work, as the diamond syndicate sells only in "series," as the parcels of rough diamonds are called. These parcels or series are made up of many varieties of diamonds known by the trade names of "bye-waters," "capes," "fine capes," "silver capes," and "crystals." Each series is made up of individual parcels of each of the above-named varieties, each parcel representing a proportion of these qualities as they are found in the mine. In other words, the series is made up so that when a dealer buys a "series," he buys every quality of diamond found in the mine in the proportion in which they are produced at that time. The individual diamonds in each of these several parcels weigh from 1 to 20 carats in their natural, rough, uncut condition. The finished stones contain only from 40 to 60 per cent of these weights; that is, from 40 to 60 per cent is ground and polished away in the various cutting processes. The principal new processes carried on in this country are sawing and splitting diamonds by means of grooving or notching them, and may be described as follows:

Sawing diamonds.—The process of sawing diamonds, whereby it is possible to saw in two, at the central part or girdle, an octahedron (known as six-point) or a long stone, or to remove an imperfection that it was impossible to cleave at a given point, has now come largely into use in the United States, and also at Antwerp and Amsterdam. This is especially true of the United States and Antwerp, where the larger diamonds are cut, and to a less extent of Amsterdam, where the smaller stones, known as mele, are more used; although there is no patent law in Holland to prevent its introduction. The invention, or inventions, are by Americans, and call to mind the old method of sawing the larger gems by means of small, flat lead strips, or saws, such as were used when the Regent diamond was cut in 1750. At that time thin strips of lead charged with diamond dust were employed; these were rarely drawn more than once across the stone. The great advantage of the new method will be appreciated when it is understood that thereby it is made possible to cut a 6-carat crystal in two along the best line to place the main table-faces of the two stones thus produced. One patentee claims the process of sawing off only the parts desired to be removed; the other makes a special claim that the dividing of the diamond at the girdle is an original claim apart from the former. The methods consist in holding the diamond firmly and very steadily under pressure against a rapidly revolving disk of sheet iron, or "phosphor" bronze. The wheels are much like those used in sawing thin sections for microscopic rock sections or for cutting jade, rock-crystal, and other hard stones. It is claimed that in thus dividing an octahedron at the center or girdle as little as 2 per cent of the weight of the crystal is lost—a great saving



DIAMOND SAWING.

of material. As evidencing the wonderfully keen responsive business acumen which has always characterized the "rough" syndicate, the price of all rough diamonds that could be improved or advanced in value by such sawing was immediately advanced when the process became known.

More recently certain expert cleavers, as they have been called, found that they could remove an occasional part of a diamond, such as the angle of an octahedron, by nicking the stone at a given point, and then by a sharp blow breaking off a piece, saving both the material and the time that would have been lost in removing the edge or piece by polishing.

Grooving diamonds.—A patent has been granted for a new process of grooving diamonds, these gems of course being also polished, and the claim is made that the grooving insures a greater brilliancy. The diamonds are sometimes cut with perfectly parallel grooves around a stone having eight, ten, twelve, or eighteen sides. The grooving is also applied to the facets of the brilliants, especially in the new forms of cutting in which the pavilion of the stone is entirely replaced by rose-cut facets; and the hollows of the concave grooves are as bright as the other faces. A diamond of any shape can be polished by this method.

New "dop" for diamonds.—Considerable attention has been given to a new dop that holds the diamond while it is being cut and polished. This instrument grasps the diamond in claws and holds it while it is undergoing the polishing process, thus doing away with the need for securing the diamond in place by means of a fusible metal which requires heating many times in the handling of a single stone, with the attendant risk of injuring the stone by the repeated heating. These dops have mechanical devices so arranged that a set of facets can be adjusted and cut on a diamond by a single setting of the diamond in the dop.

PRODUCTION.

In the following table is given a statement of the production of precious stones in the United States from 1896 to 1902, inclusive:

Production of precious stones in the United States, 1896–1902.

Stone.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Diamond	None.	None.	None.	$300	$150	$100	None.
Sapphire	$10,000	$25,000	$55,000	68,000	75,000	90,000	$115,000
Ruby	1,000	None.	2,000	3,000	3,000	500	None.
Topaz	200	None.	100	None.	None.	None.	None.
Beryl (aquamarine, etc.)	700	1,500	2,200	4,000	11,000	5,000	4,000
Emerald	None.	25	50	50	4,000	1,000	1,000
Phenacite	None.	None.	None.	None.	None.	None.	None.
Tourmaline	3,000	9,125	4,000	2,000	2,500	15,000	30,000
Peridot	500	500	500	500	500	500	500
Quartz, crystal	7,000	12,000	17,000	12,000	10,000	10,000	12,000
Smoky quartz	2,500	1,000	1,000	None.	1,000	1,000	2,000
Rose quartz	500	None.	100	100	100	150	200
Amethyst	500	200	250	250	500	500	2,000
Prase	100	None.	None.	None.	None.	None.	None.
Gold quartz	10,000	5,000	5,000	500	2,000	2,000	3,000
Rutilated quartz	500	None.	100	50	50	50	100
Dumortierite in quartz	50	None.	None.	None.	None.	None.	None.
Tourmalinated quartz	None.	None.	None.	None.	None.	1,000	None.
Agate	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Moss agate	1,000	1,000	1,000	1,000	1,000	500	500
Chrysoprase	600	None.	100	100	100	1,500	5,000
Silicified wood (silicified and opalized)	4,000	2,000	2,000	3,000	6,000	7,000	7,000
Opal	200	200	200	None.	None.	None.	150
Garnet (almandite)	500	7,000	5,000	5,000	500	100	None.
Rhodolite	None.	None.	None.	None.	20,000	21,000	1,500
Garnet (pyrope)	2,000	2,000	2,000	2,000	1,000	1,000	1,000
Topazolite	100	None.	None.	None.	None.	None.	None.
Amazon stone	1,000	500	500	250	250	200	500
Oligoclase	500	25	10	20	20	None.	None.
Moonstone	250	None.	None.	None.	None.	None.	None.
Turquoise	40,000	55,000	50,000	72,000	82,000	118,000	130,000
Utahlite (compact variscite)	500	100	100	100	100	250	None.
Chlorastrolite	500	500	5,000	3,000	3,000	3,000	4,000
Mesolite (thomsonite, so called)	500	500	1,000	1,000	1,000	1,000	1,000
Prehnite	100	100	100	50	50	None.	None.
Diopside	200	100	None.	None.	None.	None.	None.
Epidote	250	None.	None.	None.	None.	None.	None.
Pyrite	1,000	1,000	1,000	1,000	2,000	3,000	3,000
Malachite	None.	None.	None.	250	200	100	None.
Rutile	100	800	110	200	100	None.	None.
Anthracite (ornaments)	2,000	1,000	1,000	2,000	2,000	2,000	2,000
Catlinite (pipestone)	3,000	2,000	2,000	2,000	2,000	2,000	2,000
Fossil coral	1,000	500	500	50	50	100	None.
Arrow points	1,000	1,000	1,000	1,000	1,000	500	None.
Total	97,850	130,675	160,920	185,770	233,170	289,050	328,450

IMPORTS.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1867 to 1902, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1867–1902.

Year ending—	Diamonds.					Diamonds and other stones not set.	Set in gold or other metal.	Total.
	Glaziers'.	Dust.	Rough or uncut.	Set.	Unset.			
June 30—								
1867	$906					$1,317,420	$291	$1,318,617
1868	484					1,060,544	1,465	1,062,493
1869	445	$140				1,997,282	23	1,997,890
1870	9,372	71				1,768,324	1,504	1,779,271
1871	976	17				2,349,482	256	2,350,731
1872	2,386	89,707				2,939,155	2,400	3,033,648
1873		40,424	$176,426			2,917,216	326	3,134,392
1874		68,621	144,629			2,158,172	114	2,371,536
1875		32,518	211,920			3,234,319		3,478,757
1876		20,678	186,404			2,409,516	45	2,616,643
1877		45,264	78,033			2,110,215	1,734	2,235,246
1878		36,409	63,270			2,970,469	1,025	3,071,173
1879		18,889	104,158			3,841,335	538	3,964,920
1880		49,360	129,207			6,690,912	765	6,870,244
1881		51,409	233,596			8,320,315	1,307	8,606,627
1882		92,853	449,513			8,377,200	3,205	8,922,771
1883		82,628	443,996			7,598,176	[g] 2,801	8,126,881
1884	22,208	37,121	367,816			8,712,315		9,139,460
1885	11,526	30,426	371,679			5,628,916		6,042,547
Dec. 31—								
1886	8,919	32,316	302,822			7,915,660		8,259,747
1887	9,027	33,498	262,357			10,526,998		10,831,880
1888	10,025	29,127	244,876			10,223,630		10,507,658
1889	8,156	68,746	196,294			11,704,808		11,978,004
1890	147,227	179,154	340,915			[e] 12,429,395		13,105,691
1891	[a] 565,623	125,688	([c])			[f] 12,065,277		12,756,588
1892	532,246	144,487				[f] 13,845,118		14,521,851
1893	357,939	74,255				[f] 9,765,311		10,197,505
1894	82,081	53,691				[f] 7,291,342		7,427,214
1895	107,463	135,558				[f] 6,330,834		6,573,855
1896	78,990	65,690		([d])	([d])	[f] 4,474,311		4,618,991
1897	[b] 29,576	167,118	1,386,726	$330	$2,789,924	1,903,055		6,276,729
1898	8,058	240,665	2,513,800	6,622	5,743,026	1,650,770		10,162,941
1899	2,428	618,354	4,896,324	13,388	8,795,541	2,882,496		17,208,531
1900	8,333	605,495	3,658,645	10,721	7,803,066	1,472,328		13,561,588
1901	5,864	831,984	6,592,469	2,654	13,544,326	1,838,055		22,815,352
1902	10,738	798,523	8,221,389	175	13,834,168	1,888,793		24,753,586

[a] Including also engravers', not set, and jewels to be used in the manufacture of watches, from 1891 to 1894; from 1894 to 1896 miners' diamonds are also included.

[b] Including also miners' and engravers', not set.

[c] Included with diamonds and other stones from 1891 to 1896.

[d] Not specified prior to 1897.

[e] Includes stones set and not specially provided for since 1890.

[f] Including rough or uncut diamonds.

[g] Not specified since 1883.

TALC AND SOAPSTONE.

By Joseph Hyde Pratt.

OCCURRENCE.

Talc is one of the commoner minerals and in small quantities it is very widely distributed. The soapstone or steatite variety occurs more abundantly than the foliated or fibrous, and there are many more deposits of the former variety than can be profitably operated. On the other hand, there is a constant demand for deposits that will furnish a fibrous variety that can be used in the manufacture of paper, or deposits like the North Carolina talc that can be cut into pencils or ground to a pure product for the manufacture of various toilet powders. The deposits near Hewitt, Swain County, N. C., furnish the best quality of talc, that for cutting into tailors' pencils, and it is this variety that brings the highest price. At the present time this is a unique deposit as regards the quality of the talc.

During 1902 there was some prospecting for talc about 4 miles from Schuyler, Nelson County, Va. Some of the material found is suitable for grinding to powder, but a large proportion is of the steatite variety. In the town of Rochester, Vt., about 3 miles southeast of the village of Rochester, the United States Talc Corporation has commenced operations on talc deposits that were mined rather extensively during 1865 and 1866. This material will be put on the market as ground talc.

No new deposits produced any talc during 1902, and the entire production was from the old deposits that have been operated for a number of years.

PRODUCTION.

The production of talc and soapstone (exclusive of the fibrous variety from New York) during 1902 was 26,854 short tons, valued at $525,157, as compared with 28,643 tons, valued at $424,888, in 1901. This is a decrease of 1,789 tons in amount and an increase of $100,269 in value. This large increase in value with a small decrease in quantity, is due to a smaller production of the inferior grades of talc, with an increase in the quantity and value of the manufactured products. The above values include the manufactured product made from the talc, there being but a small amount of the production sold in the crude state, as nearly all that is mined is used by the original producer. The production is classified, therefore, as it is marketed, as rough, sawed into slabs, manufactured articles, and ground talc. The variation in the value of the manufactured articles as compared with that of the tonnage is due to the character of the article made, some years there being a larger number of expensive articles manufactured than in other years.

In the table below are given the production and value of talc and soapstone from the year 1893 to 1902, inclusive.

Production of talc and soapstone, 1893–1902.

Condition in which marketed.	1893.		1894.		1895.		1896.		1897.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Rough	5,760	$51,600	5,620	$50,780	1,041	$8,886	1,550	$13,375	1,020	$12,535
Sawed into slabs	104	4,400	1,303	19,500	863	12,320	923	15,481	1,107	21,726
Manufactured articles [a]	7,070	123,600	6,425	244,000	10,789	170,791	10,133	232,261	12,095	267,583
Ground [b]	8,137	75,467	9,796	87,045	8,802	74,498	9,577	92,948	7,701	63,785
Total [c]	21,071	255,067	23,144	401,325	21,495	266,495	22,183	354,065	21,923	365,629

Condition in which marketed.	1898.		1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Rough	1,380	$16,453	1,540	$18,800	3,086	$32,458	3,920	$30,874	2,816	$20,036
Sawed into slabs	1,305	13,240	1,499	12,392	1,065	19,520	225	4,261	436	7,722
Manufactured articles [a]	11,336	191,923	12,377	[d]229,310	10,551	174,270	12,618	257,146	13,476	412,028
Ground [b]	8,210	65,496	9,349	70,303	13,241	157,293	11,880	132,607	10,126	85,371
Total [c]	22,231	287,112	24,765	330,805	27,943	383,541	28,643	424,888	26,854	525,157

[a] Includes bath and laundry tubs; fire brick for stoves, heaters, etc.; hearthstones, mantels, sinks, griddles, slate pencils, tailors' pencils, gas tips, and numerous other articles of everyday use.

[b] For foundry facings, paper making, lubricators, dressing skins and leather, etc.

[c] Exclusive of the amount used for pigment, which is included among mineral paints.

[d] Includes manufactured materials to the value of $40,275, for which no quantities were given.

As is seen from the above table, there was a considerable decrease in the amount of rough talc sold, and of this amount nearly one-half was of the North Carolina production. With but a small increase in tonnage of the manufactured articles, there has been a large increase in value, due partly to the increase of the North Carolina talc that was manufactured into tailors' pencils and gas tips, and to the expensive articles made from the Virginia soapstone. Nearly all of the Virginia product is put on the market in the form of manufactured articles; most of that from New Jersey, Pennsylvania, and Maryland is put on the market as ground talc. The quantity of talc sawed into slabs was nearly double that of 1901, but sawed talc still represents but a small percentage of the total quantity mined.

There was a considerable falling off in the number of producers of talc in 1902 as compared with the number in 1901, and in some States there was but one producer. For this reason it has been necessary to group a number of the States together. Pennsylvania and New Jersey fall naturally together, as the principal deposits in these States are separated only by a river. In the following tables are given the production by States in 1902 and also from 1898 to 1901:

Production of talc and soapstone in 1902, by States.

State.	Quantity.	Value.
	Short tons.	
New Jersey and Pennsylvania	7,082	$52,812
Maryland and Virginia	13,221	372,163
North Carolina	5,239	88,962
Other States[a]	1,312	11,220
Total	26,854	525,157

[a] California, Massachusetts, and Georgia.

Production of talc and soapstone in 1898, 1899, 1900, and 1901, by States.

State.	1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Georgia	639	$4,054	1,062	[a] $42,085	6,477	$77,213	693	$4,717
North Carolina	1,695	27,320	1,817	31,880	4,522	75,308	5,819	77,824
Pennsylvania	3,778	25,436	5,012	32,872			2,552	19,132
Virginia	10,059	119,480	10,886	107,062	9,806	116,930	12,511	232,900
Other States[b]	6,060	110,822	5,988	[c] 116,906	7,138	114,090	7,068	90,315
Total	22,231	287,112	24,765	330,805	27,943	383,541	28,643	424,888

[a] Includes manufactured articles to the value of $36,000 for which no quantities were given.
[b] California, Maryland, Massachusetts, New Hampshire, New Jersey, and Vermont; also Pennsylvania in 1900.
[c] Includes $40,275 value for which no quantity was reported.

From these tables it appears that there was an increase in the value of the production from North Carolina, but a decrease in tonnage, this being due to the smaller quantity of the pyrophyllite soapstone mined in 1902 and to the increase in the quantity of the better quality of talc from the western part of the State. There was a still further decrease in the production of talc in Georgia and also a smaller number of producers. There was a slight increase in the quantity of soapstone mined by those who produced this material in Virginia, with a large increase in value in 1902 over the value of 1901, although there was a smaller number of producers.

The quantity and value of talc and soapstone produced in the United States since 1880, exclusive of that used as a mineral pigment and of the fibrous talc from New York, are given in the following table:

Annual production of talc and soapstone, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	8 441	$66,665	1892	23,908	$437,449
1881	7,000	75,000	1893	21,071	255,067
1882	6,000	90,000	1894	23,144	401,325
1883	8,000	150,000	1895	21,495	266,495
1884	10,000	200,000	1896	22,183	354,065
1885	10,000	200,000	1897	21,923	365,629
1886	12,000	225,000	1898	22,231	287,112
1887	12,000	225,000	1899	24,765	330,805
1888	15,000	250,000	1900	27,943	383,541
1889	12,715	231,708	1901	28,643	424,888
1890	13,670	252,309	1902	26,854	525,157
1891	16,514	243,981			

PRODUCTION OF FIBROUS TALC IN NEW YORK.

The fibrous talc mined in the State of New York is found in St. Lawrence County, and its production is treated separately for the reason that it is nearly double that of all the other States together, although the value is nearly the same, and that it is used principally for the one purpose of paper making. It is on account of its fibrous character that it is especially adapted for this purpose. In 1902 the production was 71,100 short tons, valued at $615,350, an increase of $131,750 in value but of only 1,900 tons in quantity, as compared with the production of 69,200 short tons, valued at $483,600, in 1901. In 1901 there was an increase of 5,700 tons in quantity, but a decrease of $15,900 in value, as compared with the production of 1900, which was 63,500 tons, valued at $499,500.

In the table below is shown the production of fibrous talc in New York since 1897:

Disposition of fibrous talc produced since 1897.

Uses.	1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Sold crude	9,800	$21,500	500	$1,250	500	$1,250
Paper filling Paint Wall plasters	47,209	375,436	53,856	410,180	54,155	436,900
Total	57,009	396,936	54,356	411,430	54,655	438,150

Disposition of fibrous talc produced since 1897—Continued.

Uses.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Sold crude	....	....	200	$600	100	$350
Paper filling; Paint; Wall plasters	63,500	$499,500	69,000	483,000	71,000	615,000
Total	63,500	499,500	69,200	483,600	71,100	615,350

The production of fibrous talc in 1902, both as to quantity and value, is the largest of any year since the productions have been recorded. During the last two years there has been a consolidation of a number of the smaller properties, and it was expected that there would be a correspondingly larger increased production, as there is a constantly increasing demand for this fibrous talc in the paper industry. Talc has almost entirely replaced the clay materials that were formerly used as fillers in paper, as it gives greater strength to the paper, but with the continued increase in the price of the talc these clays may again be introduced. With, however, a uniform price for the talc its use should increase very materially.

In the following table is well illustrated the constant increase in the production of the New York talc since 1880:

Production of fibrous talc, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	4,210	$54,730	1892	41,925	$472,485
1881	5,000	60,000	1893	35,861	403,436
1882	6,000	75,000	1894	39,906	435,060
1883	6,000	75,000	1895	39,240	370,897
1884	10,000	110,000	1896	46,089	399,443
1885	10,000	110,000	1897	57,009	396,936
1886	12,000	125,000	1898	54,356	411,430
1887	15,000	160,000	1899	54,655	438,150
1888	20,000	210,000	1900	63,500	499,500
1889	23,746	244,170	1901	69,200	483,600
1890	41,354	389,196	1902	71,100	615,350
1891	53,054	493,068			

IMPORTS.

The quantity of talc imported into the United States has been very irregular since 1889, which has been due to the constant development of the good deposits of the mineral in this country. The imported material comes mainly from France and Italy, and although it is superior in quality to most of that mined in the United States it is not better than some of that obtained in Swain and Cherokee counties, N. C. The amount and value of the talc imported into the United States since 1880 are shown in the following table:

Talc imported into the United States, 1880–1902.

Year.	Quantity.[a]	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	....	$22,807	1892	531	$5,546
1881	....	7,331	1893	1,360	12,825
1882	....	25,641	1894	622	6,815
1883	....	14,607	1895	3,165	26,843
1884	....	41,165	1896	1,966	18,693
1885	....	24,356	1897	796	8,423
1886	....	24,514	1898	761	9,338
1887	....	49,250	1899	254	3,544
1888	24,165	22,446	1900	79	1,070
1889	19,229	30,993	1901	2,386	27,015
1890	1,044	1,560	1902	2,859	35,366
1891	81	1,121			

[a] Quantity not reported previous to 1888.

CANADIAN PRODUCTION.

The production of talc in Canada since 1886 is given in the table below, and it will be observed that the fluctuation in value is much more pronounced than in the value given for the United States product:

Production of soapstone in Canada, 1886–1901.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1886	50	$400	1895	475	$2,138
1887	100	800	1896	410	1,230
1888	140	280	1897	157	350
1889	195	1,170	1898	None.	....
1890	917	1,239	1899	450	1,960
1891	None.	....	1900	420	1,365
1892	1,374	6,240	1901	None.	....
1893	717	1,920	1902	689	1,804
1894	916	1,640			

ABRASIVE MATERIALS.

By Joseph Hyde Pratt.

INTRODUCTION.

The abrasive materials treated in this report are as follows: Oilstones and whetstones, grindstones and pulpstones, buhrstones and millstones, pumice, infusorial earth and tripoli, crystalline quartz, garnet, corundum and emery, carborundum, crushed steel, artificial corundum, and adamite. These abrasive materials can readily be divided into three groups:

1. Those which occur as a rock formation and are cut and manufactured directly into the form desired, while retaining their original rock structure and appearance, as grindstones, whetstones, etc.
2. Those which occur as a constituent of either a rock or a vein and have to be mechanically separated from the associated gangue and cleaned, as corundum, garnet, etc.
3. Artificial abrasives, as carborundum, crushed steel, etc.

A few of the materials included under the head of abrasives are not used entirely for abrasive purposes, as crystalline quartz and infusorial earth. In the present report there is included only that production of the former that is used in the manufacture of sandpaper, scouring soaps, etc., and in the manufacture of wood finishing materials, the greater production of the quartz being used in the pottery and glass industries.

The entire production of infusorial earth and tripoli is included in this report, although but a small amount is actually used for any abrasive purposes.

While the aggregate amount of these abrasives produced each year is increasing, there is a noticeable variation in the production of the different kinds of abrasive materials. As their use is to a certain extent dependent on the growth of manufacturing industries, there will be a change in their production corresponding to the increase or decrease of these industries.

In 1902 the total value of all the natural abrasives produced in the United States was $1,326,755, as compared with $1,194,772 in 1901. A list of the values of the production of the different abrasives for the years 1900, 1901, and 1902 is given in the following table:

Value of abrasives produced in United States during 1900, 1901, and 1902.

Kind of abrasive.	Value.		
	1900.	1901.	1902.
Oilstones and scythestones	$174,087	$158,300	$221,762
Grindstones	710,026	580,703	667,431
Buhrstones and millstones	32,858	57,179	59,808
Pumice			2,750
Infusorial earth and tripoli	24,207	52,950	53,244
Crystalline quartz	40,705	41,500	84,335
Garnet	123,475	158,100	132,820
Corundum and emery	102,715	146,040	104,605
Total	1,208,073	1,194,772	1,326,755

Artificial abrasives produced in United States during 1900, 1901, and 1902.

Kind of abrasive.	1900.	1901.	1902.
	Pounds.	*Pounds.*	*Pounds.*
Carborundum	2,401,000	3,838,175	3,741,500
Crushed steel	700,000	690,000	735,000

OILSTONES, WHETSTONES, ETC.

There is included under this head all kinds of oilstones, whetstones, water hones, knife sharpeners of all varieties, razor hones, dental points, etc., that are manufactured from various sandstones and schists.

PRODUCTION.

There was a decided increase in the production of oilstones and scythestones in the United States during 1902, the value of which amounted to $221,762.[a] This is an increase of $63,462 over the value of the production of 1901, which was $158,300, and it is also the highest value recorded for these abrasives since their first publication in 1880. Until 1902, the year of maximum production was 1899, when the value of the output amounted to $208,283. This general increase in the production of this type of abrasives is due to the larger demand for the various abrasive articles manufactured from the novaculite (sandstone) found in Arkansas, and also to the successful introduction of the American stones into foreign markets.

As the producers of the abrasive materials used in the manufacture of oilstones and whetstones are in nearly all cases also the manufac-

[a] The crude product in 1902 as reported by the Census was valued at $113,968.

turers, the statistics given are for the finished product instead of the raw material. This production was confined to the following States: Arkansas, Michigan, Indiana, Ohio, and Kentucky, in which the material used was sandstone; and New Hampshire and Vermont, in which a quartz-schist was the material used.

The following table gives the value of the oilstones, whetstones, etc., produced from 1891 to 1902, inclusive:

Value of oilstones, whetstones, etc., produced in the United States, 1891–1902.

Year.	Value.	Year.	Value.
1891	$150,000	1897	$149,970
1892	146,730	1898	180,486
1893	135,173	1899	208,283
1894	136,873	1900	174,087
1895	155,881	1901	158,300
1896	127,098	1902	221,762

From 1880 to 1890, inclusive, the production and value of the rough stone have been published in these reports, except in the case of the output for 1890, when the value for the unfinished product was given for the novaculite of Arkansas, while in all other cases the value of the finished stones was given. The annual production from 1880 to 1890 was as follows:

Production of oilstones and whetstones, 1880–1890.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1880	420,000	$8,000	1886	1,160,000	$15,000
1881	500,000	8,580	1887	1,200,000	16,000
1882	600,000	10,000	1888	1,500,000	18,000
1883	600,000	10,000	1889	5,982,000	32,980
1884	800,000	12,000	1890	....	69,909
1885	1,000,000	15,000			

IMPORTS.

Although there has been a general increase in the production of oilstones and whetstones in the United States, there continues to be imported into this country from $30,000 to $60,000 worth of these abrasives. In 1902 this amounted to $56,456. They consist principally of razor hones from Belgium and Germany, and of "Turkey" oilstones from France and Italy.

The total value of all kinds of hones, oilstones, etc., imported into the United States since 1880 is shown in the following table:

Imports of hones and whetstones, 1880–1902.

Year ending—	Value.	Year ending—	Value.
June 30—		December 31—	
1880	$14,185	1891	$35,344
1881	16,631	1892	33,420
1882	27,882	1893	25,301
1883	30,178	1894	26,671
1884	26,513	1895	32,439
1885	21,434	1896	50,588
December 31—		1897	34,485
1886	21,141	1898	30,856
1887	24,093	1899	34,510
1888	30,676	1900	39,316
1889	27,400	1901	64,655
1890	37,454	1902	56,456

EXPORTS.

Although no separate record is kept of the exports of oilstones and scythestones, it is undoubtedly true that the value of these is in excess of the imports and that it is gradually increasing in quantity, while there will be but little increase in the imports. The material exported consists chiefly of New Hampshire scythestones, with smaller amounts of Indiana and Arkansas oilstones. There is a growing demand for the latter stone at good prices.

GRINDSTONES.

PRODUCTION.

The States producing grindstones in 1902 were Michigan, Montana, Ohio, West Virginia, and Wyoming, with by far the largest amount from Ohio. Pulpstones were produced in Ohio alone, and the Tippecanoe Pulp and Grindstone Company, of Empire, which is the largest producer, is using nearly all of its stone for this purpose. The total value of all kinds of grindstones produced in 1902 was $667,431, which is $86,728 greater than their value in 1901, which was $580,703. The production of 1900, valued at $710,026, is still the largest production recorded for any year. In comparing the values of the productions of the earlier years with those of the last few years it must be borne in mind that the price per ton has decreased from $15 to from $8 to $10, and that, therefore, the tonnage of grindstones used in the last four years is greater than that of any year before. Of the value of the production of 1902, $667,431, the sum of $23,088 is due to pulpstones, an increase of $4,288 over the value in 1901, which was $18,800.

This decided increase in the production of grindstones since 1898 has been largely due to the marked increase in all kinds of manufacturing industries during the same period.

In making reports of production to the Survey, some manufacturers use the ton as the unit of measurement and others state the number of grindstones made. In 1902, exclusive of pulpstones, the number of grindstones reported aggregated 29,543 pieces, valued at $100,875, as compared with 40,948 pieces, valued at $396,238, in 1901. The product reported by weight amounted to 44,504 tons, valued at $543,428, as compared with 16,807 tons, valued at $165,665, in 1901.

The value of the grindstones, including pulp stones, produced in the United States during 1902, by States, is given in the table below.

Value of grindstones produced in the United States during 1902, by States.

State.	Value.
Ohio	$560,412
West Virginia	22,347
Michigan, Montana, and Wyoming	84,672
Total	667,431

In the following table is given the value of the production of grindstones, including pulpstones, from 1880 to 1902, inclusive. The table illustrates the depression and revival of this industry during and since the financial depression of 1893 and the years immediately following.

Value of grindstones produced in the United States, 1880–1902.

Year.	Value.	Year.	Value.
1880	$500,000	1892	$272,244
1881	500,000	1893	338,787
1882	700,000	1894	223,214
1883	600,000	1895	205,768
1884	570,000	1896	326,826
1885	500,000	1897	368,058
1886	250,000	1898	489,769
1887	224,400	1899	675,586
1888	281,800	1900	710,026
1889	439,587	1901	580,703
1890	450,000	1902	667,431
1891	476,113		

IMPORTS.

There has been a gradual decrease in the imports of grindstones during the last three years. In 1902 these imports amounted to 5,456 long tons, valued at $76,906, as compared with a value of $88,871 in 1901, and of $92,581 in 1900. A large proportion of the above importation was of pulpstones from Newcastle-upon-Tyne, England. Other grindstones imported were from Bavaria and from Scotland. In reporting the imports of grindstones the Bureau of Statistics of the Department of Commerce and Labor has not made any separation of the amount of the finished and of the unfinished products since 1883.

The quantity and value of the grindstones imported into the United States since 1868 are given below.

Grindstones imported and entered for consumption in the United States, 1868–1902.

Year ending—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—	*Long tons.*		*Long tons.*		
1868	....	$25,640	....	$35,215	$60,855
1869	....	15,878	....	99,715	115,593
1870	....	29,161	....	96,444	125,605
1871	385	43,781	3,957.15	60,935	104,716
1872	1,202	13,453	10,774.80	100,494	113,947
1873	1,437	17,033	8,376.84	94,900	111,933
1874	1,443	18,485	7,721.44	87,525	106,010
1875	1,373	17,642	7,656.17	90,172	107,814
1876	1,681	20,262	6,079.34	69,927	90,189
1877	1,245	18,546	4,979.75	58,575	77,121
1878	1,463	21,688	3,669.41	46,441	68,129
1879	1,603	24,904	4,584.16	52,343	77,247
1880	1,573	24,375	4,578.59	51,899	76,274
1881	2,064	30,288	5,044.71	56,840	87,128
1882	1,705	30,286	5,945.61	66,939	97,225
1883	1,755	28,055	6,945.63	77,797	105,852
1884	....	....	....	....	[a]86,286
1885	....	....	....	....	50,579
December 31—					
1886	....	....	....	....	39,149
1887	....	....	....	....	50,312
1888	....	....	....	....	51,755
1889	....	....	....	....	57,720
1890	....	....	....	....	45,115
1891	....	....	....	....	21,028
1892	....	....	....	....	61,052
1893	....	....	....	....	59,569
1894	....	....	....	....	52,688
1895	....	....	....	....	54,276
1896	....	....	....	....	66,195
1897	....	....	....	....	49,496
1898	....	....	....	....	62,973
1899	....	....	....	....	63,852
1900	....	....	....	....	92,581
1901	....	....	....	....	88,871
1902	....	....	....	....	76,906

[a] Since 1884 not separately classified.

As the production of the American pulpstone increases, a constant decrease in the importation of these stones is to be expected, since the American stone is giving good satisfaction. The export of grindstones is on the increase, and now the total of the exports is about equal to the total of the imports.

BUHRSTONES AND MILLSTONES.

The American millstone varies from a sandstone to a quartz conglomerate. The rock from which it is made occurs along the eastern slopes of the Appalachian Mountains from New York to North Carolina, and is known by various names, according to the locality from which it is obtained. Most of the buhrstones are obtained from New York, though smaller amounts are made in Vermont, Pennsylvania, Virginia, and North Carolina. Besides the production recorded from these States, a small number of buhrstones are made in the mountain sections of North Carolina and Tennessee for local uses. There were formerly a very large number of buhrstones used in the United States, principally in grinding wheat, but at the present time there are but very few used for this purpose on account of the introduction of the roller-mill process. They are, however, now used extensively for grinding the coarser cereals, mineral-paint ores, fertilizers, cement rock, barytes, and other minerals, and for these uses the demand is increasing each year. For this kind of grinding the American stone is as satisfactory as the foreign stones which were formerly imported in large numbers from France, Germany, and Belgium.

PRODUCTION.

The value of the production of buhrstones in 1902 was $59,808, an increase of $2,628 over that of 1901, which was $57,179. This was more than twice the value of the production of 1900, which amounted to $28,115. From 1886 to 1894 there was a very large decrease, from $140,000 to $13,887, in the production of buhrstones. Since 1894, however, there has been a gradual increase in the production. This increase will probably continue for some years to come.

The production of 1902 was divided as follows: New York, $39,570; Pennsylvania, $1,978; Virginia, $11,435; North Carolina and Vermont, $6,825.

In the following table are given the value of the production of buhrstones in the United States since 1880:

Value of buhrstones produced in the United States, 1880–1902.

Year.	Value.	Year.	Value.
1880	$200,000	1892	$23,417
1881	150,000	1893	16,639
1882	200,000	1894	13,887
1883	150,000	1895	22,542
1884	150,000	1896	22,567
1885	100,000	1897	25,932
1886	140,000	1898	25,934
1887	100,000	1899	28,115
1888	81,000	1900	32,858
1889	35,155	1901	57,179
1890	23,720	1902	59,808
1891	16,587		

IMPORTS.

The importation of buhrstones began to decline sharply in 1883, and there has been a gradual falling off since then. There was some increase in the value of the imports in 1900 and 1901, but in 1902 they amounted to only $16,158, which is the smallest importation recorded. This general decrease in the imports is due not only to the introduction of the roller-mill process for making wheat flour, but also because the buhrstones produced in this country are as satisfactory as the foreign ones for the purposes for which the stones are now used.

The value of buhrstones and millstones imported into the United States since 1868 is given in the table below:

Value of buhrstones and millstones imported into the United States, 1868–1902.

Year ending—	Rough.	Made into millstones.	Total.	Year ending—	Rough.	Made into millstones.	Total.
June 30—				December 31—			
1868	$74,224	....	$74,224	1886	$29,273	$662	$29,935
1869	57,942	$2,419	60,361	1887	23,816	191	24,007
1870	58,601	2,297	60,898	1888	36,523	705	37,228
1871	35,406	3,698	39,104	1889	40,432	452	40,884
1872	69,062	5,967	75,029	1890	32,892	1,103	33,995
1873	60,463	8,115	68,578	1891	23,997	42	24,039
1874	36,540	43,170	79,710	1892	33,657	529	34,186
1875	48,068	66,991	115,059	1893	29,532	729	30,261
1876	37,759	46,328	84,087	1894	....	....	*a* 18,087
1877	60,857	23,068	83,925	1895	....	....	*a* 20,316
1878	87,679	1,928	89,607	1896	....	....	*a* 26,965
1879	101,484	5,088	106,572	1897	....	....	*a* 22,956
1880	120,441	4,631	125,072	1898	22,974	1,025	23,999
1881	100,417	3,495	103,912	1899	18,368	513	18,881
1882	103,287	747	104,034	1900	27,960	944	28,904
1883	73,413	272	73,685	1901	40,885	1,302	42,187
1884	45,837	263	46,100	1902	15,243	915	16,158
1885	35,022	455	35,477				

a Not separately classified.

PUMICE.

Pumice is a general name given to the loose, spongy, cellular, or frothlike parts of lava, this peculiar structure being undoubtedly due to the escape of steam or gas through the mass while in a state of fusion. Commercial pumice is also made from another volcanic product known as volcanic ash, which includes the finer detritus that is ejected in many eruptions and is often deposited at considerable distances. Both the solid pumice stone and the volcanic ash are mined as a source of commercial pumice.

The volcanic-ash deposits of Nebraska have been worked to some extent during 1902, the product being used largely in the manufacture of certain soaps and scouring powders. This production amounted to 700 tons, valued at $2,750.

Almost the entire demand for pumice is supplied by a deposit in the northwestern part of the island of Lipari, about 80 per cent of that used in the United States being shipped directly here from that island. If the Hawaiian product can compete with that from Lipari, it is in sufficient quantity to more than supply the demand of this country.

IMPORTS.

No record is kept by the Bureau of Statistics of the quantity of pumice imported into the United States, only its value being recorded. There has been no regularity in the importation of pumice; some years enough is imported to satisfy the market for a year or more. Thus, in 1896 no pumice was reported as imported into this country, and in 1902 the imports were valued at only $22,448. In other years it has varied in value from $43,788 to $65,930.

INFUSORIAL EARTH AND TRIPOLI.

OCCURRENCE AND USES.

There are included under this head all porous siliceous earths of organic origin, such as infusorial earths, diatomaceous earth, and tripoli. These are formed from the siliceous shells of diatoms and other microscopic species and occur in deposits that are sometimes many miles in area. This material has been mined during the last year in New Hampshire, New York, Maryland, Virginia, Georgia, Missouri, and California. There is also included under infusorial earth the siliceous material found near Carthage, Newton County, Mo., which extends over into Indian Territory and which is evidently residual silica left from an impure siliceous limestone by the leaching out of the calcium carbonate. It is especially adapted for filtering purposes and can readily be cut into any shape desired. Quartz is sometimes ground and put on the market under the name of infusorial earth or tripoli.

The infusorial or diatomaceous earth from near Richmond, Va., has been examined under the microscope, and diatom remains were readily recognized. The material contains only 70.14 per cent of silica, considerable alumina, and a little iron oxide. It is probably an infusorial earth mixed with more or less of clay material.

The deposits of California, near Lompoc, Santa Barbara County, are being vigorously investigated and developed by Mr. H. M. Hanmore, of Los Angeles. The material occurs within a few feet of the surface and can be quarried out in blocks of any dimensions required.

It is nearly pure white in color, contains, when free from water, as high as 97 per cent of silica, and is a true diatomaceous earth, as is readily determined when it is examined under the microscope. The deposit is of considerable thickness, has apparently been disturbed but very little, is light and porous, and can readily be cut into slabs. It is very homogeneous and is ready for use as soon as crushed. There was observed near the upper portion of the deposit an opaline silica which was very compact and dense.

Prof. W. P. Blake[a] has recently described a deposit of diatomaceous earth from Pinal County, Ariz., but on account of its distance (70 miles) from the railroad, it is not at present a commercial deposit.

But a small proportion of the infusorial earths and similar materials mined are used for abrasive purposes, such as the manufacture of polishing powders and scouring soaps. Their most extensive use is in the manufacture of dynamite, packing for boilers, steam pipes, and safes, and as a base for fire and heat retarding cements. It is also beginning to be used in some quantity for the manufacture of fireproof building materials, such as solid brick and hollow brick for partition walls, floors, etc. The California material is also being introduced into the manufacture of plasters, and the experimental work has thus far been very satisfactory; it is also used in the manufacture of tile. The Missouri product is largely used in the manufacture of various filtering apparatus, and it can be cut into any desired shape. It is probable that the California diatomaceous earth could be used for this same purpose, as it is firm, can be cut into any desired shape, and is affected but little or not at all by water.

PRODUCTION.

A considerable variation will be noticed in the quantity and value of infusorial earth produced in the United States from year to year, which is due partly to the substitution of other materials for it and partly to the production by some companies in one year of an amount of the raw material sufficient to last a year or two. The variation in value is chiefly due to the different conditions in which the material is marketed. The following table shows the value of the product when ready for sale to the manufacturer. In the case, however, of the Missouri product the value of the manufactured articles is used. In 1902 the production amounted to 5,665 short tons, valued at $53,244, which is an increase of 1,645 tons in quantity, and an increase of $294 in value, as compared with the production of 4,020 tons, valued at $52,950, in 1901. This slight increase in value is due to the fact that in 1902 the valuation refers to more of the raw material than it does in 1901.

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[a] Am. Inst. Min. Eng., Feb. Meeting, 1902.

In the table below are given the value and quantity of infusorial earth obtained in the United States since 1880:

Production of infusorial earth, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	1,833	$15,660	1892	....	$13,655
1881	1,000	10,000	1893	....	22,582
1882	1,000	8,000	1894	2,584	11,718
1883	1,000	5,000	1895	4,954	20,514
1884	1,000	5,000	1896	3,846	26,792
1885	1,000	5,000	1897	3,833	22,385
1886	1,200	6,000	1898	2,733	16,691
1887	3,000	15,000	1899	3,302	25,302
1888	1,500	7,500	1900	3,615	24,207
1889	3,466	23,372	1901	4,020	52,950
1890	2,532	50,240	1902	5,665	53,244
1891	....	21,988			

IMPORTS.

The tripoli imported into the United States is included with rotten stone, which is used for similar purposes. The value of the imports in 1902 was $39,926, which is nearly the same as the value of the production in this country. No record was kept by the Bureau of Statistics of the number of tons of this material imported.

CRYSTALLINE QUARTZ.

But a small amount of the quartz that is mined is brought under the head of abrasives, and of this amount less than a third is used in the manufacture of sandpaper and scouring soaps. The larger proportion of the production included here is used as a wood finisher, and is obtained from Connecticut. The larger amount reported as used in the manufacture of sandpaper was mined in Pennsylvania. In addition to these uses large quantities are used in the stone-cutting trade, especially by the marble dealers.

PRODUCTION.

In 1902 the production of crystalline quartz included under abrasives amounted to 15,104 short tons, valued at $84,335, as compared with 14,050 tons, valued at $41,500, in 1901. This large variation in the value is due to the fact that in 1902 the valuation reported was in some cases after the quartz had been crushed or ground. The actual value of the crude quartz varies from $2.50 to $5 per ton, and will average about $3 per ton. Using this valuation per ton for the crude quartz mined, the total value was $43,085. In the following table are given the value and quantity of crystalline quartz produced in the United States since 1894:

Production of quartz crystal, 1894–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1894	6,024	$18,054	1899	13,600	$39,000
1895	9,000	27,000	1900	14,461	40,705
1896	6,000	18,000	1901	14,050	41,500
1897	7,500	22,500	1902	15,104	84,335
1898	8,312	23,990			

GARNET.

There were no new garnet deposits that were producers in 1902, and the production was confined entirely to Connecticut, New York, Pennsylvania, and North Carolina. To be of commercial value the deposits of garnet must have good railroad facilities.

PRODUCTION.

The production of garnet in the United States during 1902, as reported to the Survey, amounted to 3,926 short tons, valued at $132,820, as compared with 4,444 tons, valued at $158,100, in 1901. The price of garnet varies considerably, according to the locality from which it is obtained. As reported to the Survey, the prices have varied from $20 to $60 per ton, the higher price being obtained for the North Carolina garnet. The average value per ton of the production in 1902 was $35.10, as compared with $35.57 per ton in 1901, and with $38.76 in 1900. The large increase in the production of garnet since 1900 is accounted for by the fact that the North Carolina production was not included in these statistics until that year.

The table below gives the production of each year since 1894.

Production of abrasive garnet, 1894–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1894	2,401	$90,660	1899	2,765	$98,325
1895	3,325	95,050	1900	3,185	123,475
1896	2,686	68,877	1901	4,444	158,100
1897	2,554	80,853	1902	3,926	132,820
1898	2,967	86,850			

CORUNDUM AND EMERY.

There is a constant increase in the demand for such abrasives as corundum and emery, which is due to the large increase in manufacturing, especially of agricultural machines, and also to the improved methods that have been devised for manufacturing emery and corundum stones and wheels of all shapes and sizes. That the supply could readily exceed the demand is very evident when it is considered that there are only about 16,000 tons of corundum and emery used in the United States. Of this amount, however, about 10,000 tons are imported, so there is room for a large increase in the domestic production of these abrasives. At the present time there are less than 500 tons of corundum used; this is not due to the small demand for it, but to the lack of this material on the market. If the price is maintained at 8 to 10 cents per pound there will be but a relatively small amount of corundum used; but with a slight decrease in price there will be a great increase in the use of corundum, which will be at the expense of the emery. At the same time, with a decrease in price, the more favorable must be the location of the deposits for mining and for railroad facilities in order to bear the competition with the emery. With the known occurrences of corundum in the United States there should be no difficulty in such production of it as fully to satisfy the market's demand.

In the North Carolina corundum fields there was no production of this mineral during 1902. The North Carolina Corundum Company, which was carrying on development work in 1902, expects to become a producer in 1903. These deposits are on Buck Creek, Clay County, associated with the largest peridotite area in the Southern Appalachians. There has been one find made in this section of a mass of solid yellow corundum weighing 125 pounds. The company is equipping the property with machinery for mining, cleaning, and preparing the corundum for market.

The Montana corundum deposits were producers of crude corundum ore to the extent of about 325 tons, most of which, however, is still lying on the dump. During January, 1903, about 25 tons were cleaned, but none was placed on the market, mainly on account of unfavorable freight rates. A favorable rate to Chicago has now been obtained, and the Montana Corundum Company is now (July, 1903) producing corundum at the rate of 800 to 1,000 tons per year. The commercial product has been tested by a number of users of this abrasive, and they have reported favorably regarding it. The Bozeman Corundum Company has been developing its property about 14 miles southwest from Bozeman. The corundum veins vary from a few inches to 3 feet in thickness, and are being exploited by means of shafts and drifts. About 5 miles west of the Montana Corundum Company's mine is the Anceny corundum deposit, which promises to develop into a property containing a large quantity of corundum.

A recent discovery has been made of corundum in Connecticut, which has been described by Prof. B. K. Emerson.[a] It occurs in Litchfield County, near Barkhamsted, but does not give any evidence of occurring in commercial quantity.

The deposits of corundum occurring in serpentine near Spanish Peak, California, described in the report for 1901, have been described in detail by Prof. Andrew C. Lamson.[b] He considers the rock as a new type, to which is given the name "plumasite."

The Canadian corundum deposits have continued to be operated during 1902, and the larger part of their production has been shipped to this country. The total production was nearly double that of 1901.

PRODUCTION.

In 1902 the production of corundum in the United States was almost entirely of the emery variety. The production of emery was confined to the same localities as the year before—the mines at Chester, Mass., and those in the vicinity of Peekskill, N. Y., there being an increase in the production from the latter locality and a large falling-off in the production from the Chester mines. The quantity of emery produced did not come up to what was expected. The total quantity of corundum and emery produced during 1902 was 4,251 short tons, valued at $104,605, a decrease of 54 tons, and of $41,435 in value, as compared with the production of 4,305 tons, valued at $146,040, in 1901. There was also a large falling off in the imports of emery and corundum for 1902.

In the table below are given the quantity and value of the production of emery and corundum in the United States since 1881, but in each case it is the total amount of the two that is given.

Annual production of corundum and emery, 1881–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1881	500	$80,000	1892	1,771	$181,300
1882	500	80,000	1893	1,713	142,325
1883	550	100,000	1894	1,495	95,936
1884	600	108,000	1895	2,102	106,256
1885	600	108,000	1896	2,120	113,246
1886	645	116,190	1897	2,165	106,574
1887	600	108,000	1898	4,064	275,064
1888	589	91,620	1899	4,900	150,600
1889	2,245	105,567	1900	4,305	102,715
1890	1,970	89,395	1901	4,305	146,040
1891	2,247	90,230	1902	4,251	104,605

[a] Am. Jour. Sci., vol. 14, Sept., 1902.

[b] Univ. of Cal. Publications, Bull. Dept. of Geol., vol. 3, p. 219, 1903.

IMPORTS.

There was a large falling off in the imports of corundum and emery in 1902, which amounted altogether in value to $214,842, as compared with $294,999 in 1901, a decrease of over $80,000 in value. There was, however, a decided increase in the importation of corundum as compared with the year before, most of which was obtained from Canada. The table below shows the quantity and value of emery and corundum imported into the United States from 1867 to 1902:

Emery and corundum imported into the United States, 1867–1902.

Year ending—	Grains.		Ore or rock.		Pulverized or ground.		Other manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Value.	
June 30—	*Pounds.*		*Long tons.*		*Pounds.*			
1867	....	....	428	$14,373	921,431	$38,131	....	$52,504
1868	....	....	85	4,531	834,286	33,549	....	38,080
1869	....	....	964	35,205	924,161	42,711	....	77,916
1870	....	....	742	25,335	644,080	29,531	....	54,866
1871	....	....	615	15,870	613,624	28,941	....	44,811
1872	....	....	1,641	41,321	804,977	36,103	....	77,424
1873	610,117	$29,706	755	26,065	343,828	15,041	$107	70,919
1874	331,580	16,216	1,281	43,886	69,890	2,167	97	62,366
1875	487,725	23,345	961	31,972	85,853	2,990	20	58,327
1876	385,246	18,999	1,395	40,027	77,382	2,533	94	61,653
1877	343,697	16,615	852	21,964	96,351	3,603	....	42,182
1878	334,291	16,359	1,475	38,454	65,068	1,754	34	56,601
1879	496,633	24,456	2,478	58,065	133,566	4,985	....	87,506
1880	411,340	20,066	3,400	76,481	223,855	9,202	145	105,894
1881	454,790	22,101	2,884	67,781	177,174	7,497	53	97,432
1882	520,214	25,314	2,765	69,432	117,008	3,708	241	98,695
1883	474,105	22,767	2,447	59,282	93,010	3,172	269	85,490
1884	143,267	5,802	4,145	121,719	513,161	21,181	188	148,890
1885	228,329	9,886	2,445	55,368	191,314	8,789	757	74,800
December 31—								
1886	161,297	6,910	3,782	88,925	365,947	24,952	851	121,638
1887	367,239	14,290	2,078	45,033	[a]144,380	6,796	2,090	68,209
1888	430,397	16,216	5,175	93,287	....	....	8,743	118,246
1889	503,347	18,937	5,234	88,727	....	....	111,302	218,966
1890	534,968	20,382	3,867	97,939	....	....	5,046	123,367
1891	90,658	3,729	2,530	67,573	....	....	....	71,302
1892	566,448	22,586	5,280	95,625	....	....	2,412	120,623
1893	516,953	20,073	5,066	103,875	....	....	3,819	127,767
1894	597,713	18,645	2,804	51,487	....	....	1,841	71,973
1895	678,761	25,066	6,893	80,386	....	....	27,586	133,038
1896	755,693	28,493	6,389	119,738	....	....	....	148,231
1897	539,176	20,865	5,213	107,655	....	....	2,211	130,531
1898	577,655	23,320	5,547	106,269	....	....	3,810	133,399
1899	728,299	29,124	7,435	116,493	....	....	11,514	157,131
1900	661,482	26,520	11,392	202,980	....	....	10,006	239,506
1901	1,086,729	43,217	12,441	240,856	....	....	10,926	294,999
1902	1,665,737	49,107	7,157	151,959	....	....	13,776	214,842

[a] To June 30 only; since classed with grains.

CANADIAN CORUNDUM.

As Canada is constantly increasing her production of corundum, and as over one-half of this production was exported to the United States, it may be of interest to give here the output of these Canadian mines. The total amount of commercial corundum produced was 1,611,200 pounds, which is approximately 805½ tons, valued at $88,616, or about $110 per ton. This is an increase of 742,610 pounds over the production of 1901, which was 868,590 pounds, and indicates a healthy growth in the corundum industry of Canada. But a small part of this production was sold in Canada, most of it being exported. Of this production there was sold in Canada 211,887 pounds, in England 176,342 pounds, in other parts of Europe 362,554 pounds, and in the United States 784,947 pounds. The increase in the amount of corundum sold in these countries in 1902 over that sold in 1901 is shown in the following table:

Sales of Canadian corundum in 1901 and 1902.

Where sold.	Quantity.		
	1901.	1902.	Increase.
	Pounds.	*Pounds.*	*Pounds.*
Canada	171,537	211,887	40,350
England	20,331	176,342	156,011
Other parts of Europe	5,320	362,554	357,234
United States	576,402	784,947	208,545
Total	773,590	1,535,730	762,140

The demand for corundum in England, Germany, France, and Sweden is beginning to be partly filled by the Canadian supply, as is also the demand in the United States. There are large deposits of this mineral in this country, and if they were thoroughly and systematically developed the United States should be in a position to export corundum instead of importing it.

ARTIFICIAL ABRASIVES.

CARBORUNDUM.

There was a slight decrease in the amount of carborundum produced in 1902 as compared with that of 1901, which was due to interruptions during the early part of 1902 in the Carborundum Company's supply of electrical current and the inability of that company during the latter part of the year to obtain a sufficient supply of raw materials—a result of the anthracite coal strike. If it had not been for these obstacles the production would have been considerably increased over that of 1901. It amounted in 1902 to 3,741,500 pounds, a decrease of 96,675 pounds, as compared with the production of 3,838,175 pounds in 1901. This is the first year since carborundum began to be manufactured that there has not been a large increase over the production of the year before. In 1903 there will undoubtedly be a large increase over last year's production. Much of the carborundum that is manufactured is now exported. The value of the carborundum varies from 8 to 10 cents per pound.

In the following table is given the production of carborundum since 1892, when it was first put on the market:

Production of carborundum, 1892–1902.

Year.	Amount.	Year.	Amount.
	Pounds.		*Pounds.*
1892	1,000	1898	1,447,200
1893	15,200	1899	1,741,245
1894	52,200	1900	2,634,900
1895	226,000	1901	3,838,175
1896	1,207,800	1902	3,741,500
1897	1,256,400		

CRUSHED STEEL.

The production of crushed steel by the Pittsburg Crushed Steel Company in 1902 was close to that of the last two years, and amounted to 735,000 pounds, as compared with 690,000 pounds in 1901. The value of this product is 5½ cents per pound free on board at Pittsburg.

The table below shows the production of crushed steel for the last five years.

Production of crushed steel in the United States, 1898–1902.

Year.	Amount.	Year.	Amount.
	Pounds.		*Pounds.*
1898	660,000	1901	690,000
1899	675,000	1902	735,000
1900	700,000		

The production of crushed steel, which is used largely by the building trades, is apt to fluctuate with their condition. New uses are being found for the different grades of crushed steel, and some grades are meeting with considerable success. The finer grades of crushed steel, known as "steel emery" and "rouge," are used in considerable quantity by the glass trade.

ARTIFICIAL CORUNDUM.

The manufacture of artificial corundum from bauxite, which was recently started by the Norton Emery Wheel Company, has been carried on by that company at its plant at Niagara Falls during most of the year 1902. Thus far its manufactured product has been used entirely by the company itself, and none has been put on the market as raw material. This artificial corundum is reported to give very good satisfaction, and the company expects in the near future to produce this material to the full capacity of the plant. It will then undoubtedly be put on the market.

ADAMITE.

Another artificial abrasive that has recently been introduced to the market is adamite, which at the present time is being manufactured at Vienna, Austria, and is handled in this country by the Adamite Abrasive Company, which crushes and grades the raw material received from Germany at its plant at North Tonawanda, N. Y. The Company intends in the near future to erect a plant at North Tonawanda to manufacture the adamite. This material makes a hard and tough abrasive, but no comparative tests as to its abrasive efficiency are as yet available. It breaks with a rough fracture, which is favorable for sustaining a good cutting edge.

BORAX.

By Joseph Struthers.

INTRODUCTION.

The known deposits of borax in the United States are in California, Nevada, and Oregon, and the production on a commercial scale was begun in 1864, at Clear Lake, 80 miles north of San Francisco, by the evaporation of the saline waters. The industry progressed favorably at this and other lakes in California until, in the early seventies, large quantities of the pure mineral were discovered in the alkaline marshes of California and of western Nevada, which caused the abandonment of the lake refineries and the erection of new plants, notably near Columbus, Nev., at Searles Marsh in the Armagosa Valley, and at the mouth of Furnace Creek in Death Valley, California. In spite of the difficulty and great cost of transporting the refined product by teams 100 miles to the railroad, the refineries continued in operation for several years, until the large increase in the domestic production, coupled with the increased imports from Italy, so reduced the price that this method of refining became no longer profitable, and the refineries were abandoned. About the year 1890 it was discovered that the borax crust on many of the marsh deposits was derived from the Tertiary beds of calcium borate (borate of lime) abounding in that region. The marshes were abandoned and a mine was established on a bedded deposit of mineral from 6 to 10 feet in thickness at Borate, 12 miles northeast of Daggett, Cal. The Pacific Coast Borax Company owns this plant at the present time and is the chief producer of borax and boric acid in the United States. The ore, which occurs in large masses more or less connected by stringers and bands, consists of the mineral colemanite (calcium borate) in a bedded deposit from 5 to 30 feet thick. The refined product reaches the market in the form of prismatic sodium borate (borax, $Na_2B_4O_7.10H_2O$) and boric acid (old name, boracic acid, H_3BO_3). There is another variety of borax called "octahedral borax," which differs from the common variety in that it contains five molecules of water of crystallization ($Na_2B_4O_7.5H_2O$) and is octahedral in form. The prismatic borax remains unaffected in transparency by exposure to the air, but the octahedral variety rapidly becomes opaque, and, absorbing five equivalents of water, is converted into the prismatic salt. Large plants for the concentration and refining of the crude ore have been erected in California at Alameda, near San Francisco (inoperative during 1902), at Marion, and at Daggett. The largest refinery, however, is situated at Bayonne, in New Jersey.

Other bedded deposits have been found in a number of places in Death Valley and about Owens Lake, both in Inyo County, Cal., but they have not yet been exploited sufficiently to determine their limits. The saline deposits of California have been fully described by M. R. Campbell in Bulletin No. 200 of the United States Geological Survey (1902) and by Gilbert E. Bailey in Bulletin No. 24 of the California State Mining Bureau (1902).

PRODUCTION.

The production of borax in the United States continues to be derived mainly from the colemanite deposits of California, although a small quantity is produced from the marsh deposits of California, Nevada, and Oregon. The reported returns for 1902 gave an aggregate commercial production of crude borax of 2,600 short tons, valued at $91,000, and of refined borax and boric acid 17,404 short tons, valued at $2,447,614, of which 862 short tons, valued at $155,000, were stated to be boric acid—a total of 20,004 short tons, valued at $2,538,614. The production during 1901 was 17,887 short tons of crude borax, valued at $314,811, and 5,344 short tons of refined borax, valued at $697,307, a total value of $1,012,118 in 1901.

The statistics of the production of borax in California are given in the subjoined table.

Production of borax in California, 1864–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1864	12	$9,478	1884	1,019	$198,705
1865	125	94,099	1885	942	155,430
1866	201	132,538	1886	1,285	173,475
1867	220	156,137	1887	1,015	116,725
1868	32	22,384	1888	1,405	196,636
1869	Nil.	Nil.	1889	965	145,473
1870	Nil.	Nil.	1890	3,201	480,152
1871	Nil.	Nil.	1891	4,267	640,000
1872	140	89,600	1892	5,525	838,787
1873	515	255,440	1893	3,955	593,292
1874	915	259,427	1894	5,770	807,807
1875	1,168	289,080	1895	5,959	595,900
1876	1,437	312,537	1896	6,754	675,400
1877	993	193,705	1897	8,000	1,080,000
1878	373	66,257	1898	8,300	1,153,000
1879	363	65,443	1899	20,357	1,139,882
1880	609	149,245	1900	25,837	1,013,251
1881	690	189,750	1901	23,231	1,012,118
1882	732	201,300	1902	[a] 20,004	2,538,614
1883	900	265,500			

[a] Census reported total production as 19,142 short tons, valued at $2,383,614.

IMPORTS.

The following table gives the imports of borax and borates into the United States from 1867 to 1902, inclusive.

Imports of borax and borates into the United States, 1867–1902.

Year.	Borax.		Borates, calcium, and sodium (crude and refined sodium borate).		Boric acid.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
1867	49,652	$6,601	5,672	$711	770,756	$73,396
1868	79,183	10,127	22,293	2,985	243,993	22,845
1869	89,695	12,799	54,822	8,011	998,033	109,974
1870	97,078	14,511	2,616	322	1,166,145	173,806
1871	134,927	20,705	5	1	1,204,049	185,477
1872	35,542	6,288	22,500	8,000	1,103,974	191,575
1873	9,284	2,152	Nil.	Nil.	1,222,006	255,186
1874	3,860	1,253	Nil.	Nil.	233,955	52,752
1875	5,153	1,224	588	78	41,742	6,280
1876	3,145	691	Nil.	Nil.	137,518	15,771
1877	3,500	676	55	12	107,468	11,231
1878	3,492	514	286	61	22,839	651
1879	3,472	490	Nil.	Nil.	306,462	21,888
1880	15,278	2,011	22,122	742	243,723	18,473
1881	4,136	865	Nil.	Nil.	187,058	15,771
1882	10,664	3,062	Nil.	Nil.	536,335	71,343
1883	5,611	1,359	Nil.	Nil.	4,334,432	580,171
1884	7,332	1,691	142	34	44,512	4,494
1885	240	41	Nil.	Nil.	48,517	4,035
1886	....	....	4	1	430,655	26,238
1887	....	....	33	4	376,184	19,885
1888	....	....	455	38	487,777	26,394
1889	....	....	Nil.	Nil.	676,736	36,814
1890	....	....	29,608	800	867,802	43,967
1891	....	....	414,151	17,681	666,765	41,019
1892	....	....	40	6	701,625	39,418
1893	11,230	1,327	543,967	13,659	771,775	40,568
1894	1,812	225	441,066	11,427	298,990	19,282
1895	612,730	26,429	4,234,261	105,604	925,158	42,056
1896	11,376	796	4,307,100	104,951	555,769	21,899
1897	19,087	1,128	5,204,612	79,268	....	....
1898	10,232	962	4,235,856	92,108	....	....
1899	51,221	3,508	42,165	2,979	582,002	20,560
1900	273,706	9,937	58,294	4,306	473,251	17,436
1901	545,045	20,643	103,700	9,411	725,005	26,629
1902	684,537	20,795	186,807	12,002	822,907	30,439

REVIEW OF THE BORAX INDUSTRY DURING 1902.

California.—The colemanite mines at Borate, 12 miles northeast of Daggett, which are operated by the Pacific Coast Borax Company, continue to yield a sufficient quantity of ore to satisfy the market requirements. In the mining of this material the increasing depth has added to the cost of extraction. During 1902 this company continued the search for colemanite deposits in the Death Valley region and acquired much additional property. The deposits in the Armagosa Valley are under careful examination, the ore therefrom being carried by traction engines to the railroad at Manvel, a distance of 100 miles, whence it is shipped to the refinery in order to determine its value. The extent of the deposits on this property will soon be ascertained. The large refining plant at Bayonne, N. J., which was destroyed by fire in April, 1902, has been entirely rebuilt. The Pacific Coast Borax Company continues to supply by far the greater part of the borax output of the United States, as well as a large proportion of the boric acid production, and the control of the domestic market of borax is practically in its hands.

The American Borax Company, which is under the control of the Standard Sanitary Company, of Pittsburg, Pa., has greatly extended its plant at Daggett and now has installed ten 20,000-gallon digesters in which the crude material from the mud deposits in that vicinity is treated by sulphurous acid. The new plant has largely increased the output of boric acid and boric-acid concentrates by this company, and, owing to the satisfactory results obtained, the company contemplates extending the works still further during the coming winter season. A new refinery is being erected near Pittsburg, Pa., for the final treatment of the products from the works at Daggett.

The Stauffer Chemical Company, of San Francisco, is actively developing the colemanite mines in Ventura County, which yield at present from 75 to 100 tons of very high-grade ore per month. This ore is used solely for the manufacture of refined boric acid at the company's works in San Francisco.

There has been a small output from the marsh deposits in California and Nevada, but the quantity is comparatively so insignificant that it has had no effect on the market.

Oregon.—In recent years the marsh deposits of sodium borate in Harney County have contributed yearly an output of refined borax amounting to about 400 tons. For 1902, however, no production was reported, the operations at the deposits having been confined solely to development work. The principal concern in this region is the Rose Valley Borax Company, which controls 2,000 acres of the richest portion of the marsh deposit near Lake Alvord, which extends over a total area of 10,000 acres. The description of this deposit and of the method of obtaining the ore is given in the report on borax contained in Mineral Resources for 1901.

Price.—The price of borax fluctuated but little during 1902, averaging from 7 to 7.25 cents per pound for refined borax and 6.75 to 7 cents per pound for concentrated borax. The latter grade is gradually disappearing from the market owing to its nonuniform quality. The refined article is now marketed under guarantee.

WORLD'S PRODUCTION.

The following table gives the production of borax and boron compounds in the principal countries of the world from 1896 to 1901, inclusive:

The world's production of borates, etc., 1896–1901.[a]

[Metric tons.]

Year.	United States. Calcium borate.	Chile. Calcium borate.[b]	India. Borax.[b]	Germany. Boracite.	Italy. Boric acid, crude.	Peru. Calcium borate.[b]	Turkey. Pandermite.[b c]
1896	12,310	7,486	340	184	2,616	1,179	12,626
1897	17,600	3,168	280	198	2,704	11,850	11,375
1898	13,911	7,034	184	230	2,650	7,178	(d)
1899	21,834	14,951	250	183	2,674	7,638	(d)
1900	23,456	13,177	224	232	2,491	7,080	(d)
1901	16,227	11,547	162	184	2,558	(e)	(d)

[a] From official reports of the respective countries except the United States.
[b] Exports.
[c] Fiscal years.
[d] Total exports 1897–1901 amounted to 43,851 tons, valued at £789,318.
[e] Statistics not yet available.

PRODUCTION IN FOREIGN COUNTRIES.

The Borax Consolidated, Limited (the international borax combination), has issued £400,000 of 5 per cent second mortgage debenture stock, the company now being capitalized at £2,800,000. For the fiscal year ending September 30, 1902, gross profits are reported of £250,209, as compared with £258,021 for the year preceding. From the gross profits for 1902, the following disbursements were made: Interest, £47,625; dividends on common and preferred shares, £52,000 (the total dividends thus amounting to £99,625); income tax, £3,201; which gave a balance of £147,383. Adding to this balance £15,795 brought forward from the previous year, and subtracting £17,825 for depreciation on reserve and sinking fund, leaves a surplus of £142,353, out of which it is proposed to pay a dividend of £1 per share, less income tax on the ordinary shares, making a total dividend payment of 17.5 per cent for the year. The net profits for 1902 amounted to £181,658, as compared with £190,278 in 1901. The working of the mines, deposits, and factories has been satisfactory, and by effecting economies in the cost of production the lower prices obtained for some of the products have been counterbalanced. There is a steady demand for borax; but, according to the manufacturers, the low prices in London during 1902, which varied from £12 to £13 per ton, left very little margin for profit.

Argentina.—Calcium borate deposits varying in thickness from a few inches to 3 feet are found in the "National Territory of the

Andes" (now a part of Argentina); the principal districts being Caurchari, Antuco, Partos Grandes, Hombre Muerto, Ratones, and Diablillos. The altitude of these districts ranges from 18,000 to 18,500 feet, and the transport of the mineral is accomplished by mule back over precipitous trails to the railroad at Salta, a distance of from 150 to 200 miles. A load of 300 pounds is carried by each mule and the time occupied in transport amounts to seven or eight days. Under the present conditions of labor the cost per ton, including mining, transportation, and delivery free on board ship at the coast, is about £7 6s. 5d. If to this amount the ocean freight, £1, and the insurance, etc., 1s. 6d., be added, the total cost per ton delivered in England is about £8 7s. 11d.

Bolivia.—The production of calcium borate in Bolivia during 1901 amounted to 3,065 metric tons, valued at $410,524 (Bolivian currency), as compared with 1,485 metric tons, valued at $148,510, in 1900.

Chile.—The borate deposit of Ascotan in the interior of the province of Antofagasta produces the greater part of the total output of boracite and borax. Of the production during 1900, which amounted to 13,177 metric tons of calcined boracite and 27 metric tons of borax, Ascotan contributed 10,920 metric tons, the remainder being obtained from the deposits in the province of Carcota. The exports of calcium borate during 1901 amounted to 11,454 metric tons, valued at $1,302,401 (Chilean currency), as compared with 13,177 metric tons, valued at $1,317,676 (Chilean currency), in 1900. Valuable borate deposits, said to contain more than 600,000 tons of mineral, are reported within reach of the port of Taltal.

Italy.—The production of boric acid in Italy during 1901 amounted to 2,558 metric tons, valued at $194,408, as compared with 2,491 metric tons, valued at $169,425, in 1900. The entire production is obtained from the natural fumeroles in the provinces of Pisa and Grosetto.

Peru.—Though borates occur in many localities in Peru, the only deposit which is operated with profit is at Salinas, near the boundary of the provinces of Arequipa and Moquegua. In 1900 the exports of borates amounted to 7,080 metric tons, valued at £56,638. The statistics for 1901 are not yet available.

Turkey.—The boracite deposits in Turkey were discovered in 1856, but were not operated until recent years. The mines of Sultan-Tchaïr are situated within the Sandjak of Karassi and in the Merkez-caza of Balikesser and Nahié of Ivèt, and all are now under control of the Borax Consolidated, Limited. The description of these deposits and the method of manufacturing borax from the mineral are given in Mineral Resources for 1901, pages 871–872. The total quantity of mineral exported from 1897 to 1901, inclusive, amounted to 43,851 tons, valued at £789,318.

BROMINE.

By Joseph Struthers.

PRODUCTION.

The production of bromine in the United States during 1902, including the quantity of bromine contained in potassium bromide, amounted to 513,890 pounds, valued at $128,472, as compared with 552,043 pounds, valued at $154,572, in 1901, a decrease for the year of 38,153 pounds in quantity and of $26,100 in value. The price per pound during 1902 averaged 25 cents, as compared with 28 cents in 1901 and with 27 cents in 1900. The production of bromine in the world continues to be controlled by the associated American producers and by the Leopoldshall-Stassfurt Convention, the latter being operative for several years to come.

There has been practically no change in the bromine industry in the United States during 1902. Nearly half of the output was obtained from Michigan and amounted to 61,452 pounds of bromine in potassium bromide, which, with the 165,000 pounds of liquid bromine produced, is equivalent to an aggregate of 226,452 pounds, as compared with the aggregate production in Michigan of 217,995 pounds in 1901.

The brines of Michigan have been well described in Water-Supply and Irrigation Paper No. 31.[a] So far as known, the entire central basin of the lower peninsula of Michigan contains one vast brine deposit, which carries a larger percentage of bromine than any brine yet discovered. The deposit extends from the Indiana boundary line on the south to Grayling on the north, and from the Saginaw Valley on the east to Lake Michigan on the west. The highest percentages of bromine are reported from the wells in Midland and Gratiot counties. The supply of brine seems to be unlimited, and wells in Midland County which have been pumped for more than twenty years show no signs of exhaustion. Since 1883 thirteen companies have been engaged in the bromine industry in Midland, and eight companies at different times have manufactured bromine at other localities in this basin. At present the entire production of the State is made by two companies in Midland. The St. Louis Chemical Company, at St. Louis, Gratiot County, is drilling a second well and will probably become an active producer in the near future.

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[a] Lower Michigan Mineral Waters; A Study into the Connection between their Chemical Composition and Mode of Occurrence, by Alfred C. Lane: Water-Supply and Irrigation Paper No. 31, U. S. Geol, Survey, 1899.

The subjoined table gives the production of bromine in the United States from 1880 to 1902, inclusive, which shows that Michigan is the most important producer, followed by Ohio, Pennsylvania, and West Virginia.

Production of bromine in the United States, 1880–1902.

Year.	Michigan.	Ohio.	Pennsylvania.	West Virginia.	Total.	Value.	
						Total.	Cents per pound.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*		
1880					404,690	$114,752	28
1881					300,000	75,000	25
1882					250,000	75,000	30
1883					301,100	72,264	27
1884					281,100	67,464	25
1885					320,000	92,800	29
1886					428,334	141,350	33
1887					199,087	61,715	31
1888					307,386	95,290	31
1889					418,891	125,667	30
1890	59,696	101,813	108,154	118,183	387,846	104,719	27
1891	47,320	121,681	85,832	113,953	368,786	73,757	20
1892	43,864	135,683	92,978	104,142	376,667	64,512	17
1893	42,568	113,575	111,403	80,852	348,398	87,100	25
1894	29,116	146,501	100,623	103,304	379,544	98,655	26
1895	30,280	152,360	104,647	107,567	394,854	102,662	26
1896	42,000	212,850	154,600	149,835	559,285	143,070	26
1897	[a]147,256	124,972	116,967	97,954	487,149	136,402	28
1898	[a]141,232	106,860	119,998	118,888	486,978	136,354	28
1899	[a]138,272	82,368	111,150	101,213	433,003	125,571	29
1900	[a]210,400	91,182	105,592	114,270	521,444	140,790	27
1901	[a]217,995	125,467	101,595	106,986	552,043	154,572	28
1902	[a]226,452	100,491	93,575	93,375	513,890	128,472	25

[a] Including the bromine equivalent of the product recovered as potassium bromide.

FLUORSPAR AND CRYOLITE.

By Joseph Hyde Pratt.

FLUORSPAR.

OCCURRENCE.[a]

Fluorite or fluorspar has been found widely distributed throughout the United States, but only in a few localities has it been found in sufficient quantity to be of value for commercial purposes. The largest deposits are in Hardin and Pope counties, Ill., and in Crittenden and Livingston counties, Ky. Fluorspar deposits have also been recently discovered in Smith, Trousdale, and Wilson counties, Tenn., and some of these have been worked during the last year by the Tennessee Fluorspar and Mining Company and the Tennessee Fluorspar Company. In the vicinity of Dome, Yuma County, Ariz., the Castle Dome Mining and Milling Company is mining the fluorite that occurs abundantly as a gangue mineral in many of the veins of that district, and during 1902 this territory was a producer of fluorite.

PRODUCTION.

There was a very large increase in the production of fluorspar in 1902 over that of 1901, which was partly due to its increased use for metallurgical purposes. The total production in 1902 was 48,018 short tons, valued at $271,832, as compared with 19,586 tons, valued at $113,803, in 1901. This increase in the production was not due to any one State, but there was a large increase in the production of both Illinois and Kentucky, and also additional production in Arizona.

Of this production 43,310 short tons, valued at $224,832, was reported to have been sold in the crude state, as compared with 15,450 tons, valued at $77,500 in 1901, which is an increase of 27,860 tons in quantity and of $147,332 in value. The amount of ground fluorspar sold in 1902 was 4,708 tons, valued at $47,000, as compared with 3,700 tons, valued at $34,100, in 1901. This is an increase of 1,008 tons in

[a] See Mineral Resources, U. S., 1901, p. 879; Bull. U. S. Geol. Survey, No. 213, pp. 205–213.

quantity and of $12,900 in value. It would have been expected that with this very large increase in the production of fluorspar in 1902 there would have been a decrease in price. The reverse, however, was true, and there was a decided increase in price of both the crude and ground flourspar, the average price of the former being $5.19 and of the latter $9.98 per ton. As compared with the prices for 1901, which were $5 for the crude fluorspar and $9.22 for the ground, this is an increase per ton of 19 cents for the crude and of 76 cents for the ground fluorspar. The highest recorded price is $11.50 and the lowest $2.85 per ton.

There were 18 producers of fluorspar in 1902, divided as follows: Two in Arizona, 5 in Illinois, 10 in Kentucky, and 1 in Tennessee. The State to produce the largest amount of fluorspar was Kentucky, with a production of 29,030 tons shipped, valued at $143,410, which is at the rate of $4.94 per ton. In the table below are given the amount and value of the production of fluorspar in the United States for 1902, by States.

Production of fluorspar in the United States in 1902, by States.

State.	Quantity.	Value.
	Short tons.	
Arizona and Tennessee	628	$6,872
Kentucky	29,030	143,410
Illinois	18,360	121,550
Total	48,018	271,832

In addition 800 tons of fluorspar, valued at $3,850, were mined but not marketed in 1902—a total of [a]48,818 tons, valued at $275,682.

There should be a continued increase in the use of fluorspar for metallurgical purposes and thus an increase in the production of this mineral. The annual production of fluorspar since 1882 is given in the table below:

Production of fluorspar in the United States from 1882 to 1902, inclusive.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	4,000	$20,000	1893	12,400	$84,000
1883	4,000	20,000	1894	7,500	47,500
1884	4,000	20,000	1895	4,000	24,000
1885	5,000	22,500	1896	6,500	52,000
1886	5,000	22,000	1897	5,062	37,159
1887	5,000	20,000	1898	7,675	63,050
1888	6,000	30,000	1899	15,900	96,650
1889	9,500	45,835	1900	18,450	94,500
1890	8,250	55,328	1901	19,586	113,803
1891	10,044	78,330	1902	[a]48,818	275,682
1892	12,250	89,000			

[a]Reported by the Census.

A calcium fluoride is produced as a by-product in the reduction of the mineral cryolite in the manufacture of aluminum salts by the Pennsylvania Salt Manufacturing Company, of Philadelphia. This amounts to 3,000 to 4,000 tons per year, and is used as a flux in open-hearth furnaces, acting in the same manner as fluorite, the natural fluoride. The material is not a pure calcium fluoride, but, as would be expected, it contains the impurities originally in the cryolite and the excess of the reagents added to carry out the reaction described below. The general composition of this product is as follows:

	Per cent.
Calcium fluoride	60.04
Calcium carbonate	12.24
Calcium hydrate	8.83

The remaining 18.39 per cent is composed chiefly of silica, alumina, ferric oxide, etc.

The records of the Bureau of Statistics of the Treasury Department do not make any separate statement of fluorspar imported into the United States, and it is included among minerals and oils not elsewhere specified.

The mineral cryolite, from which the manufactured calcium fluoride is made, is imported from Greenland, and its importation determines the amount of the production of this artificial fluoride.

CRYOLITE.

OCCURRENCE AND USE.

There have been no localities found in the United States that contain cryolite in commercial quantity, and Greenland continues to supply all of this mineral that is used. In a monograph on cryolite by I. I. Moltkehansen[a] the statement is made that the average Greenland ore contains 90.4 per cent of cryolite, 4.37 per cent of siderite, 4.47 per cent of quartz, 0.30 per cent of pyrite, 0.03 per cent of chalcocite, and a trace of galena. Many tons have been found, however, that were 99.5 per cent pure cryolite. The deposit at Ivigtok, Greenland, which has been worked to a depth of 120 feet, has been shown by boring to extend at least 120 feet deeper. There are only three months in the year when these cryolite deposits can be worked, and as the Danish Government controls the deposits they control the production. The largest amount of cryolite produced in one year was 30,000 tons mined in 1897.

The cryolite imported into the United States is used in the manufacture of aluminum and sodium salts.

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[a] To be published shortly.

The reduction of the cryolite to soluble salts is by calcining with lime, the reaction being represented by the following equation:

$$6CaO+2Na_3AlF_6=6CaF_2+3Na_2O.Al_2O_3$$

There is now used in this reduction a certain amount of bauxite, which gives a double sodium aluminum oxide containing two parts of Al_2O_3 instead of one.

Another reaction has been advanced for the reduction of cryolite, which is by means of superheated steam, represented by the equation:

$$2Na_3AlF_6+6H_2O=12HF+Al_2O_3.3Na_2O$$

Dr. Charles Doremus, of the City College of New York, who discovered this reaction, has obtained very satisfactory results in adapting this reaction to the commercial reduction of cryolite. The hydrofluoric acid could be saved directly or be readily converted into the sodium fluoride by passing it into a sodium carbonate solution.

PRODUCTION AND IMPORTS.

Each year there is imported into the United States from 5,000 to 10,000 tons of cryolite. In the table below are shown the imports of cryolite since 1871.

Imports of cryolite, 1871–1902.

Year ending—	Amount.	Value.	Year ending—	Amount.	Value.
June 30—	*Long tons.*		December 31—	*Long tons.*	
1871		$71,058	1887	10,328	$138,068
1872		75,195	1888	7,388	98,830
1873		81,226	1889	8,603	115,158
1874		28,118	1890	7,129	95,405
1875		70,472	1891	8,298	76,350
1876		103,530	1892	7,241	96,932
1877		126,692	1893	9,574	126,688
1878		105,884	1394	10,684	142,494
1879		66,042	1895	9,425	125,368
1880		91,366	1896	3,009	40,056
1881		103,529	1897	10,115	135,114
1882	3,758	51,589	1898	6,201	88,501
1883	6,508	97,400	1899	5,879	78,676
1884	7,390	106,029	1900	5,437	72,763
December 31—			1901	5,383	70,886
1885	8,275	110,750	1902	6,188	85,650
1886	8,230	110,152			

GYPSUM AND GYPSUM PRODUCTS.[a]

By George I. Adams.

PRODUCTION BY CLASSES OF PRODUCT.

The production of gypsum is reported as crude gypsum, land plaster, plaster of Paris, and wall plaster, which represent the conditions in which gypsum first reaches the market. The quantity and value of each of these classes and the totals for 1902 are set forth in the following table. For the sake of comparison the production for 1901, somewhat differently classified, is also given below.[b] The total production is estimated as crude, while the total value is that of the product as it first reaches the market.

Production of gypsum in United States, 1902.

Grade.	Quantity.	Value.	Average price per ton.
	Short tons.		
Crude	81,455	$93,914	$1.15
Land plaster	60,791	106,237	1.75
Wall plaster	350,685	1,326,262	3.78
Plaster of Paris	188,702	562,928	2.98
	[c]816,478	2,089,341	....

Production of gypsum in United States, 1901.

Grade.	Quantity.	Value.	Average price per ton.
	Short tons.		
Crude	68,669	$71,773	$1.05
Land plaster	59,058	109,551	1.85
Calcined	399,686	1,325,317	3.31
	[c]633,791	1,506,641	....

[a] For a discussion of the gypsum deposits of the United States, their geologic occurrence and economic development, readers are referred to a bulletin of the U. S. Geological Survey by George I. Adams, now in press. It may be had upon application to the Director.

[b] The statistics presented in this report have been checked and corrected to agree with all the available data on record in the division of mining and mineral resources.

[c] Estimated as crude.

During recent years there has been a considerable advance in the industry, which has resulted mainly from the increased use of gypsum wall plasters in modern buildings. The table of production shows that the amount of gypsum manufactured into wall plaster and plaster of Paris is about one-fourth greater than in 1901. Much of the gypsum sold as plaster of Paris is subsequently manufactured into wall plaster by local firms, who add retarder and sand and fiber in such proportions as prepare it for immediate use with the addition of water. A considerable amount (about 3,000 tons annually) is utilized in bedding plate glass during the process of grinding and polishing. The production of land plaster is confined to certain of the Eastern States, where it is used as a fertilizer, and to a few localities in the West, where it is employed in neutralizing "black alkali." The gypsum which is sold crude is in large part ground locally and utilized as land plaster. Some of it enters as a small percentage into the composition of certain Portland cements.

The following table has been compiled to show the progress of the gypsum industry during the last thirteen years. The annual production and value of the three varieties of gypsum are given, together with the value per ton of each. This table shows particularly the remarkable increase in the amount of gypsum calcined into plaster of Paris and wall plaster, which now approximates 82 per cent of the total output of gypsum. The value assigned to calcined plaster is for the quantity produced after calcination, and not for the crude gypsum used:

Production of gypsum in the United States, 1890–1902, classified as to variety.

Year.	Total quantity produced.	Sold crude.			Ground into land plaster.		
		Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
	Short tons.	*Short tons.*			*Short tons.*		
1890	182,995	18,742	$19,148	$1.02	56,525	$143,014	$2.53
1891	208,126	18,574	28,690	1.54	51,700	117,356	2.27
1892	256,259	58,080	80,797	1.39	47,668	106,247	2.23
1893	253,615	42,808	71,860	1.68	50,408	106,365	2.11
1894	239,312	34,702	56,149	1.62	41,996	95,944	2.28
1895	265,503	26,624	37,837	1.42	35,079	85,355	2.43
1896	224,254	17,302	19,134	1.11	27,354	59,749	2.18
1897	288,982	23,164	27,020	1.17	31,562	67,083	2.13
1898	291,638	5,758	7,200	1.25	40,929	90,777	2.22
1899	486,235	58,352	66,762	1.14	50,033	100,797	2.01
1900	594,462	35,479	44,127	1.24	45,682	82,806	1.81
1901	633,791	68,669	71,773	1.05	59,058	109,551	1.85
1902	816,478	81,455	93,914	1.15	60,791	106,237	1.75

Production of gypsum in the United States, 1890–1902, classified as to variety—Continued.

Year.	Calcined into wall plaster and plaster of Paris.				Total value.
	Weight before calcining.	Calcined plaster produced.	Value.	Average price per ton.	
	Short tons.	Short tons.			
1890	107,728	79,257	$412,361	$5.20	$574,523
1891	137,852	110,006	482,005	4.38	628,051
1892	150,511	106,141	508,448	4.79	695,492
1893	160,399	122,937	518,390	4.22	696,615
1894	162,614	127,158	609,626	4.79	761,719
1895	203,800	150,801	674,255	4.47	797,447
1896	179,598	137,505	494,461	3.60	573,344
1897	234,256	180,935	661,761	3.66	755,864
1898	244,951	190,083	657,303	3.46	755,280
1899	377,850	286,227	1,119,521	3.91	1,287,080
1900	513,301	396,284	1,500,270	3.79	1,627,203
1901	506,064	399,686	1,325,317	3.31	1,506,641
1902	674,232	539,387	1,889,190	3.50	2,089,341

PRODUCTION BY STATES.

At present the gypsum industry is carried on commercially in 16 States and Territories, which, named in the order of their importance as producers, are Michigan, Iowa, Texas, New York, Ohio, Kansas, Oklahoma, California, Wyoming, Colorado, Virginia, Utah, Montana, South Dakota, Nevada, and Oregon.

The deposit formerly worked in the Indian Territory has been exhausted, and the crude material to supply the plant there is obtained from Oklahoma. There is a deposit of gypsite in Florida, near Lake Panasoffkee, which may prove to be of economic importance. It is well situated in regard to the general market. The new developments are principally in the West. The wide distribution of the deposits in that section permits of the utilization of only those which are of high grade and are conveniently situated with respect to transportation facilities. An attempt has been made to govern the industry in a large section of the country by the organization of the United States Gypsum Company, which controls the greater portion of the deposits in Iowa, and in part also those which have been developed in Kansas, Michigan, New York, and Oklahoma.

New York.—The gypsum deposits of New York extend in a narrow belt through the central part of the State. They are developed at Oakfield, Wheatland, Mumford, Garbutt, Victor, Port Gibson, Alabama, Union Springs, Marcellus Falls, Fayetteville, Manlius, Jamesville, Cottons, Clocksville, Perryville, and Valley Mills. At a number of these places the industry is of only local importance, the production being confined to land plaster. There are, however, some large plants which produce principally wall plaster. The latest developments of the industry in this State have been the erection of modern mills for the manufacture of wall plaster.

Virginia.—The gypsum-producing localities in Virginia are confined to a small area near Saltville. At Plasterco there is a plant having railroad facilities. At this place wall plaster is manufactured. In addition there are a number of quarries which produce small quantities of gypsum, which is used locally as land plaster.

Ohio.—The gypsum industry in Ohio is in the vicinity of Gypsum, which lies between Sandusky and Port Clinton. The product is converted principally into wall palaster.

Michigan.—Grand Rapids and vicinity is the chief center of the gypsum industry in Michigan. At this place there are a number of mills. The deposits at Alabaster, on the border of Lake Huron, are coming into more importance. The new developments are principally at this place.

Iowa.—Fort Dodge is the center of the gypsum area in Iowa. The deposits are confined to a limited territory, but are extensively utilized, especially in the manufacture of wall plaster.

Kansas.—In this State the principal producing localities at the present time are Blue Rapids, Hope, Gypsum City, Burns, Dillon, Mulvane, and Medicine Lodge. The deposits consist of rock gypsum and gypsite. The first gypsite deposits utilized in this country were those of Kansas. At the present time, however, gypsite is known in other States, and is more eagerly sought than the rock gypsum, since it can be manufactured at less cost and is especially suitable for making wall plaster.

Oklahoma.—The building of railways in Oklahoma during the last few years has permitted the development of gypsum at a number of places. The deposits are of vast extent. Only those which are well located are utilized. The plants are situated at Peckham, Okarche, Watonga, and Ferguson. The deposits at Cement are worked to supply a mill at Marlow, Ind. T.

Texas.—The gypsum in Texas, although of great extent, at the present time is utilized in a commercial way only at Acme and Quanah, in the northern part of the State.

Montana.—The gypsum deposits which have been developed in Montana are situated at Bridger and Armington. The material used is rock gypsum.

South Dakota.—The deposits in thė Black Hills of South Dakota are utilized for the manufacture of wall plaster at Spearfish and Hot Springs.

Wyoming.—The principal economic developments of gypsum in Wyoming are at Laramie and Red Buttes. At Laramie the material used is gypsite, and at Red Buttes rock gypsum. In addition there is some development in the vicinity of Sheridan, in the northern part of the State.

Colorado.—The principal production of gypsum in Colorado is in the locality of Loveland. The material used is rock gypsum.

New Mexico.—There are vast deposits of gypsum in New Mexico, and a plant is now under construction at Ancho for the manufacture of wall plaster. The deposits in this Territory include an area of gypsum sand known as "the white sands," which is of considerable interest. The material occurs in dunes and is readily available for manufacturing, but there are no railroad facilities in the locality of the deposits.

Arizona.—The principal production of gypsum in former years has been in the vicinity of Tucson. Recently deposits have been opened at Woodruff and Snowflake, but have not been developed in a commercial way.

Utah.—There is a large plant at Nephi which is engaged in the manufacture of various classes of gypsum products.

Nevada.—The deposits at Moundhouse are worked, and the product is manufactured at Empire. Formerly the deposit at Lovelocks was worked, and recently new developments at that place have been undertaken.

California.—In southern California gypsum is manufactured, principally at Los Angeles. At a number of places it is developed in a small way. In this State local deposits are utilized as land plaster for neutralizing black alkali.

Oregon.—The only plant in Oregon is on the eastern border of the State, at the station of Lime.

In the following tables, which show the production of gypsum, by States, for 1901 and 1902, it has been necessary to combine the output of certain States in which there are less than three producers, in order to protect individual statistics.

Production of gypsum in the United States in 1902, by States.

State or Territory.	Total quantity.	Sold crude.		Ground into land plaster.		Calcined into wall plaster and plaster of Paris.			Total value.
		Quantity.	Value.	Quantity.	Value.	Before calcining.	After calcining.	Value.	
	Short tons.	*Short tons.*		*Short tons.*		*Short tons.*	*Short tons.*		
California, Ohio, and Virginia	101,545	2,360	$6,790	16,357	$35,450	82,828	66,263	$248,153	$290,393
Colorado and Wyoming	16,051					16,051	12,841	73,372	73,372
Iowa, Kansas, and Texas	295,769	957	1,180	4,331	6,497	290,481	232,385	799,678	807,355
Michigan	240,227	68,885	70,460	13,022	16,340	158,320	126,656	372,821	459,621
New York	110,364	9,153	15,184	25,981	43,750	75,230	60,184	200,236	259,170
Oklahoma	34,156					34,156	27,325	111,215	111,215
Other States	18,366	100	300	1,100	4,200	17,166	13,733	83,715	88,215
Total	816,478	81,455	93,914	60,791	106,237	674,232	539,387	1,889,190	2,089,341

Production of gypsum in the United States in 1901, by States.

State or Territory.	Total quantity.	Sold crude.		Ground into land plaster.	
		Quantity.	Value.	Quantity.	Value.
	Short tons.	*Short tons.*		*Short tons.*	
California	3,550	3,550	$4,200		
Colorado and Wyoming	17,394	150	150	16	$62
Iowa, Kansas, and Texas	213,419	2,750	3,575	3,079	5,025
Michigan	185,150	46,086	47,986	9,808	10,708
New York	119,565	11,678	10,908	33,591	61,093
Oklahoma	15,930				
Virginia	15,236	1,054	1,104	9,675	25,995
Other States	63,547	3,401	3,850	2,889	6,668
Total	633,791	68,669	71,773	59,058	109,551

State or Territory.	Calcined into plaster of Paris.			Total value.
	Before calcining.	After calcining.	Value.	
	Short tons.	*Short tons.*		
California				$4,200
Colorado and Wyoming	17,228	13,595	$76,223	76,435
Iowa, Kansas, and Texas	207,590	164,720	620,736	629,336
Michigan	129,256	103,933	208,549	267,243
New York	74,296	55,273	169,668	241,669
Oklahoma	15,930	13,205	66,031	66,031
Virginia	4,507	3,752	18,045	45,144
Other States	57,257	45,208	166,065	176,583
Total	506,064	399,686	1,325,317	1,506,641

Since the Eleventh Census the statistics of production are relatively complete, and the total production and value of each State and of the United States, from 1890 to 1900, inclusive, are shown in the following table:

Production and value of gypsum by States, 1890–1900.

State.	1890.		1891.		1892.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
California	4,249	$29,178	3,000	$36,360		
Colorado	4,580	22,050	4,720	19,400	1,500	$1,500
Iowa	20,900	47,350	31,385	58,095	12,000	28,500
Kansas	20,250	72,457	40,217	161,322	46,016	195,197
Michigan	74,877	192,099	79,700	223,725	139,557	306,527
New York	32,903	73,093	30,135	58,571	32,394	61,100
Ohio	12,748	87,533	9,123	36,586	13,275	49,521
South Dakota	2,900	7,750	3,615	9,618		
Texas					1,926	8,640
Utah			3,000	15,000	2,600	16,300
Virginia	6,350	20,782	5,959	22,574	6,991	28,207
Wyoming	3,238	22,231	1,992	6,200		
Total	182,995	574,523	212,846	647,451	256,259	695,492

Production and value of gypsum by States, 1890–1900—Continued.

State or Territory.	1893.		1894.		1895.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
California	....	....	6	$30	5,158	$51,014
Colorado	....	....	895	4,800	1,371	8,281
Indian Territory	....	....	....	....	13,100	46,125
Iowa	21,447	$55,538	17,906	44,700	25,700	36,600
Kansas	43,631	181,599	64,889	301,884	72,947	272,531
Michigan	124,590	303,921	79,958	189,620	66,519	174,007
Montana	....	....	175	1,820	....	....
New York	36,126	65,392	31,798	60,262	33,587	59,321
Ohio	11,646	39,884	20,827	69,597	21,662	71,204
Oklahoma	....	....	1,300	7,500	....	....
South Dakota	5,150	12,550	4,295	16,050	6,400	20,600
Texas	4,011	13,372	6,925	27,300	10,750	36,511
Utah	....	....	1,920	12,225	2,134	11,484
Virginia	7,014	24,359	8,106	24,431	5,800	17,369
Wyoming	....	....	312	1,500	375	2,400
Total	253,615	696,615	239,312	761,719	265,503	807,447

State or Territory.	1896.		1897.		1898.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Arizona	....	....	30	$250	30	$700
California	1,452	$11,738	351	2,774	3,800	24,977
Colorado	1,600	10,547	1,575	10,305	165	726
Indian Territory	8,000	24,000	10,734	40,050	....	....
Iowa	18,631	34,020	29,430	64,900	24,733	45,819
Kansas	49,435	148,371	54,353	189,679	59,180	191,389
Michigan	67,634	146,424	94,874	193,576	93,181	204,310
Montana	385	1,940	425	2,300	1,123	7,272
New York	23,325	32,812	33,440	78,684	31,655	81,969
Ohio	22,634	63,583	18,592	50,856	21,303	61,884
Oklahoma Territory	....	....	....	....	3,150	12,000
Oregon	....	....	....	....	150	450
South Dakota	6,115	20,000	8,350	19,240	2,740	9,200
Texas	16,022	48,070	24,454	65,651	34,215	58,130
Utah	2,866	13,600	2,700	13,500	2,610	10,080
Virginia	5,955	17,264	6,374	16,899	8,378	23,388
Wyoming	200	975	3,300	7,200	5,225	22,986
Total	224,254	573,344	288,982	755,864	291,638	755,280

Production and value of gypsum by States, 1890–1900—Continued.

State or Territory.	1899.		1900.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Arizona	47	$1,200	35	$900
California	2,950	14,950	3,280	10,088
Colorado	871	3,904	967	5,300
Indian Territory	12,000	26,000	6,500	15,000
Iowa	75,574	296,220	184,600	561,588
Kansas	85,046	247,690	48,636	150,257
Michigan	144,776	283,537	129,654	285,119
Montana	582	3,698	1,025	7,980
New York	52,149	105,533	58,890	150,588
Nevada			1,000	4,805
Ohio	27,205	73,520	39,034	119,946
Oklahoma Territory	11,526	36,600	18,437	60,380
Oregon	550	1,895	550	1,710
South Dakota	550	4,000	2,050	13,800
Texas	53,773	125,000	80,622	192,418
Utah	2,352	10,240	2,397	4,984
Virginia	11,480	32,043	11,940	18,111
Wyoming	4,804	21,050	4,845	24,229
Total	486,235	1,287,080	594,462	1,627,203

IMPORTS.

The gypsum which is imported into the United States comes chiefly from Nova Scotia and enters the ports of the New England and northern Atlantic States. A considerable amount has been received from Mexico in previous years and has entered at San Francisco, but none was imported from there in 1902.

The gypsum which is imported is nearly all calcined and converted into wall plaster. A small amount of it is used as land plaster, and some manufacturers of fertilizers mix it with their product. The following tables show the imports by countries and by customs districts in which they were entered:

Imports of crude, ground, or calcined (dutiable) gypsum, by countries, in 1900, 1901, and 1902.

Country from which imported.	1902.		1901.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*	
France	132	$1,902	185	$1,311	342	$2,397
United Kingdom	190	1,854	93	987	59	836
Nova Scotia and New Brunswick	259,353	275,877	196,932	216,636	203,347	234,563
Mexico			2,236	9,700	1,014	4,500
Other countries	20	23	1	36	88	602
Total	259,695	279,656	199,447	228,670	204,850	242,898

Imports of crude, ground, or calcined (dutiable) gypsum, by customs districts, in 1900, 1901, and 1902.

Customs district into which imported.	1902.		1901.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*	
Aroostook, Me	57	$148	415	$796	290	$418
Bangor, Me	235	111	390	234	153	92
Bath, Me	703	429	740	446	736	966
Passamaquoddy, Me	8,395	7,628	8,232	7,942	9,503	10,530
Portland and Falmouth, Me			180	135		
Boston and Charlestown, Mass	5,760	11,546	5,921	11,118	6,450	11,925
Gloucester, Mass	235	144	230	141		
Fairfield, Conn	360	990	315	866	284	688
New Haven, Conn	3,515	3,124	1,916	1,325	3,942	2,818
New York, N. Y	157,699	167,444	117,989	138,565	121,728	150,074
Newark, N. J	30,388	35,091	19,700	21,751	21,491	22,857
Perth Amboy, N. J	6,218	3,733	2,780	1,661	4,230	2,538
Philadelphia, Pa	33,343	39,471	23,900	25,233	21,216	25,828
Delaware	1,630	960	1,387	816	2,325	1,401
Baltimore, Md	3,987	3,040	5,635	3,381	3,822	2,834
Norfolk and Portsmouth, Va	5,600	4,815	7,480	4,488	5,715	3,746
Alexandria, Va	1,550	930			2,000	1,320
San Francisco, Cal			2,236	9,700	1,014	4,500
Other districts	20	22	1	72	32	333
Total	259,695	279,656	199,447	228,670	204,850	242,898

Gypsum imported into the United States, 1867–1902.

Year ending—	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.	Total value.
	Quantity.[a]	Value.	Quantity.	Value.		
June 30—	*Long tons.*		*Long tons.*			
1867		$29,895	97,951	$95,386		$125,281
1868		33,988	87,694	80,362		114,350
1869		52,238	137,039	133,430	$844	186,512
1870		46,872	107,237	100,416	1,432	148,720
1871		64,465	100,400	88,256	1,292	154,013
1872		66,418	95,339	99,902	2,553	168,873
1873		35,628	118,926	122,495	7,336	165,459
1874		36,410	123,717	130,172	4,319	170,901
1875		52,155	93,772	115,664	3,277	171,096
1876		47,588	139,713	127,084	4,398	179,070
1877		49,445	97,656	105,629	7,843	162,917
1878		33,496	89,239	100,102	6,989	140,587
1879		18,339	96,963	99,027	8,176	125,542
1880		17,074	120,327	120,642	12,693	150,409
1881		24,915	128,607	128,107	18,702	171,724
1882	5,737	53,478	128,382	127,067	20,377	200,922
1883	4,291	44,118	157,851	152,982	21,869	218,969
1884	4,996	42,904	166,310	168,000	([b])	210,904
1885	6,418	54,208	117,161	119,544		173,752
1886	5,911	37,642	122,270	115,696		153,338
1887	4,814	37,736	146,708	162,154		199,890
Dec. 31—						
1888	3,340	20,764	156,697	170,023		190,787
1889	5,466	40,291	170,965	179,849		220,140
1890	7,568	55,250	171,289	174,609		229,859
1891	9,560	97,316	110,257	129,003		226,319
1892	6,832	75,608	181,104	232,403		308,011
1893	3,363	31,670	164,300	180,254		211,924
1894	2,027	16,823	162,500	179,237		196,060
1895	3,295	21,526	192,549	215,705	10,352	247,583
1896	3,292	21,982	180,269	193,544	11,722	227,248
1897	2,664	17,028	163,201	178,686	16,715	212,429
1898	2,973	18,501	166,066	181,364	40,979	240,844
1899	3,265	19,250	196,579	220,603	58,073	297,926
1900	3,109	19,179	209,881	229,878	66,473	315,530
1901	3,106	19,627	235,204	238,440	68,603	326,670
1902	3,647	23,225	305,367	284,942	52,533	360,700

[a] Quantity not reported previous to 1882. [b] Not specified from 1884 to 1894, inclusive.

WORLD'S PRODUCTION.

The United States is the second country in the world in the production of gypsum. France produces 63 per cent of the entire amount. The United States produces about 19 per cent. Canada is third, producing about 9 per cent, and Great Britain fourth, with approximately 7 per cent; after which follow Germany and Algeria as important producers, with less than 2 per cent each. In the following table the production of the various countries since 1893 is set forth:

The world's production of gypsum, 1893–1902.

Year.	France.		United States.		Canada.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1893	....	....	253,615	$696,615	192,568	$196,150
1894	1,693,831	$2,891,365	239,312	761,719	223,631	202,031
1895	2,175,448	3,392,768	265,503	797,447	226,178	202,608
1896	1,866,498	2,661,200	224,254	573,344	207,032	178,061
1897	1,845,874	2,673,033	288,982	755,864	239,691	244,531
1898	1,931,712	2,777,816	291,638	755,280	219,256	230,440
1899	1,802,812	2,641,020	486,235	1,287,080	244,566	257,329
1900	1,761,835	2,772,221	594,462	1,627,203	252,001	259,009
1901	2,182,229	3,449,747	633,791	1,506,641	293,879	340,148
1902	(a)	(a)	816,478	2,089,341	332,045	356,317

Year.	Great Britain.		German Empire.		Algeria.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1893	158,122	$287,940	....	....	....	....
1894	169,102	321,822	....	....	36,355	$114,900
1895	196,037	348,400	23,994	$11,040	50,127	133,226
1896	213,028	361,509	31,736	14,598	41,350	114,361
1897	203,151	325,513	28,821	13,228	40,510	109,648
1898	219,549	345,882	28,315	13,166	41,156	110,660
1899	238,071	372,073	32,760	19,660	44,037	117,895
1900	233,002	348,210	39,103	17,199	41,446	139,190
1901	224,919	344,650	[b] 35,013	[b] 23,139	38,955	132,286
1902	251,615	(a)	(a)	(a)	(a)	(a)

Year.	India.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
1893	....	....	2,357	$6,625
1894	3,548	$1,566	3,104	9,006
1895	7,511	2,987	2,093	5,252
1896	8,248	3,130	1,050	2,590
1897	9,025	3,333	4,167	8,162
1898	9,249	1,503	4,279	7,551
1899	7,216	768	4,402	8,866
1900	4,865	424	....	....
1901	(a)	(a)	....	....
1902	(a)	(a)	....	....

[a] Not yet available. [b] Includes Baden.

PHOSPHATE ROCK.

By Joseph Struthers.

PRODUCTION.

The phosphate rock industry in Florida and South Carolina is gradually recovering from the setback it received in 1900 from the scarcity of transportation facilities, combined with high ocean freight rates and low prices. In Florida during 1902 the production, based on the marketed output, was greater than in 1901, and although in South Carolina and Tennessee the output was slightly below the report for 1901, the general conditions were more satisfactory than in the earlier year. In reporting the production of phosphate rock in the United States it has been deemed more desirable to consider the quantities sold during the year as equivalent to the production rather than the phosphate actually mined, an arrangement which shows more clearly the relation between the consumption and the actual supply.

The tendency toward consolidation, which began to make itself evident a few years ago, continued during 1902. The larger companies have acquired much additional property and are applying modern business methods in the endeavor to establish a uniform price for the product—a condition which is highly desirable for the future of the industry. Furthermore, the large fertilizing interests have extended their property holdings in order that they may become independent of the market by controlling their own supply of raw material. The necessity for centralized effort with its concomitant advantages is particularly evident in the phosphate industry, as the deposits of high-grade rock are limited; no new discoveries of note have been recorded and the older mines are gradually becoming exhausted.

Summarizing the present condition of the phosphate industry as a whole, it may be stated that the speculative element which predominated the field in early years of development has become almost entirely eliminated, and the industry in all States is now established on a substantial and permanent basis.

A description of the methods of mining phosphate rock in Florida, South Carolina, and Tennessee will be found in the earlier volumes of Mineral Resources.

The State of Florida has been the chief producer of phosphate rock since 1894, and the progress of the industry continues to show an improvement, although the value of the marketed output during 1902 was considerably less than in the preceding year. The decrease in the production was chiefly that of river pebble, which resulted from the destruction by fire early in January, 1902, of the calcining plant of the sole operating company. Making an allowance for this circumstance by assuming an output equal to that of the preceding year, the total production of phosphate rock in Florida during 1902 would have been considerably greater than in the year 1901. The small decrease in the production of hard rock during 1902 was more than counterbalanced by the increase in the production of land pebble, so that, all things considered, the progress of the industry in Florida was very satisfactory. There has been no production of soft rock in Florida since 1897, in which year an output of only 2,300 tons was reported. Comparing the production by varieties during 1902 and 1901, the record as given in the table is, respectively, as follows:

Hard rock, 429,384 long tons, valued at $1,743,694, as compared with 457,568 long tons, valued at $2,393,080, in 1901.

Land pebble, 350,991 long tons, valued at $810,792, as compared with 247,454 long tons, valued at $660,702, in 1901.

River pebble, 5,055 long tons, valued at $9,711, as compared with 46,974 long tons, valued at $105,691, in 1901.

A total of 785,430 long tons, valued at $2,564,197, as compared with 751,996 long tons, valued at $3,159,473, in 1901.

In South Carolina during 1902 the total production of phosphate rock was 313,365 long tons, valued at $919,725, as compared with 321,181 long tons, valued at $961,840, in 1901, the respective reports being: Land rock, 245,243 long tons, valued at $753,220, in 1902, as compared with 225,189 long tons, valued at $716,101, in 1901, thus showing an increase of 20,054 tons and $37,119. Offsetting this increase, however, was the decreased production of river rock, which amounted to 68,122 long tons, valued at $166,505, in 1902, as compared with 95,992 long tons, valued at $245,739, in 1901, a decrease in quantity of 27,870 long tons, and in value of $79,234.

The total production of phospate rock in Tennessee, based on the marketed output during 1902, was 390,799 long tons, valued at $1,206,647, as compared with 409,653 long tons, valued at $1,192,090, in 1901, a decrease of 18,854 tons; the value, however, increased $14,557 owing to the better prices that ruled during 1902.

The production of phosphate rock from other States, which is referred to in detail in the next section, aggregated 720 tons, valued at $2,875.

The total quantity of phosphate rock reported to the United States Geological Survey as marketed during 1902 amounted to 1,490,314 long tons, valued at $4,693,444, as compared with 1,483,723 long tons, valued at $5,316,403, in 1901, an increase in quantity of 6,591 long tons and a decrease in value of $622,959.

The total quantity of phosphate rock reported as mined during 1902 was 1,548,720 long tons, valued at $4,922,943, as compared with 1,440,408 long tons in 1901.

The following table gives the production in the United States of phosphate rock, classified by grades, from 1892 to 1902, inclusive, based on the marketed product:

Production of phosphate rock in the United States, 1892–1902, based on the quantity marketed.

State.	1892.		1893.		1894.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock	[a] 155,908	$859,276	215,685	$1,117,732	326,461	$979,383
Soft rock	6,710	32,418	13,675	64,626	....	....
Land pebble	21,905	111,271	86,624	359,127	98,885	296,655
River pebble	[b] 102,820	415,453	122,820	437,571	102,307	390,775
Total	287,343	1,418,418	438,804	1,979,056	527,653	1,666,813
South Carolina:						
Land rock	243,653	1,236,447	308,435	1,408,785	307,305	1,252,768
River rock	150,575	641,262	194,129	748,229	142,803	492,808
Total	394,228	1,877,709	502,564	2,157,014	450,108	1,745,576
Tennessee	....	....	....	....	19,188	67,158
Grand total	681,571	3,296,127	941,368	4,136,070	996,949	3,479,547

State.	1895.		1896.		1897.		1898.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock	307,098	$1,302,096	296,811	$1,067,525	360,147	$1,063,713	366,810	$1,396,108
Soft rock	6,916	32,000	400	2,300	2,300	4,600	....	....
Land pebble	181,011	593,716	97,936	176,972	92,132	180,794	155,084	293,688
River pebble	73,036	185,090	100,052	300,556	97,763	244,408	79,000	158,000
Total	568,061	2,112,902	495,199	1,547,353	552,342	1,493,515	600,894	1,847,796
South Carolina:								
Land rock	270,560	898,787	267,072	792,457	267,380	748,050	298,610	856,225
River rock	161,415	512,245	135,351	389,192	90,900	238,522	101,274	251,047
Total	431,975	1,411,032	402,423	1,181,649	358,280	986,572	399,884	1,107,272
Tennessee	38,515	82,160	26,157	57,370	128,723	193,115	308,107	498,392
North Carolina	....	....	7,000	17,000	....	....	....	....
Grand total	1,038,551	3,606,091	930,779	2,893,372	1,039,345	2,673,202	1,308,885	3,453,460

[a] Includes 52,708 tons of hard rock carried over in stock from 1891.
[b] Includes 12,120 tons of river pebble carried over in stock from 1891.

Production of phosphate rock in the United States, 1892–1902, etc.—Continued.

State.	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock	460,297	$2,119,130	424,977	$2,229,373	457,568	$2,393,080	429,384	$1,743,694
Land pebble	177,170	515,458	221,403	612,703	247,454	660,702	350,991	810,792
River pebble	88,953	169,473	59,863	141,236	46,974	105,691	5,055	9,711
Total	726,420	2,804,061	706,243	2,983,312	751,996	3,159,473	785,430	2,564,197
South Carolina:								
Land rock	223,949	738,969	266,186	877,405	225,189	716,101	245,243	753,220
River rock	132,701	339,130	62,987	164,565	95,992	245,739	68,122	166,505
Total	356,650	1,078,099	329,173	1,041,970	321,181	961,840	313,365	919,725
Tennessee	430,192	1,192,916	454,491	1,328,707	409,653	1,192,090	390,799	1,206,647
North Carolina	440	(*a*)						
Pennsylvania	2,000	9,000	900	4,500	893	3,000	100	400
Alabama			334	534				
Arkansas			75	225			550	1,650
Other States							70	825
Grand total	1,515,702	5,084,076	1,491,216	5,359,248	1,483,723	5,316,403	1,490,314	4,693,444

a Value included in South Carolina land rock.

In considering the foregoing table, as well as those relating to the domestic production which are given later in this section, it must be remembered that the marketed product is taken as a basis of production. The quantity of phosphate rock which was actually mined in Florida during 1902 was 8,868 long tons more than the quantity marketed in that year. The total quantity of hard rock mined in Florida during 1902 was 447,445 long tons, which is 18,061 long tons more than the reported marketed output. With regard to land pebble, there were 331,397 tons mined, as compared with 350,991 long tons sold, which shows a decrease in stock carried over from 1902 of 19,594 long tons from the quantity on hand at the first of the year. The marketed product of river pebble during 1902 was 5,055 long tons, whereas the quantity mined amounted to 5,456 long tons, an increase of 401 long tons to be added to the stock on hand at the first of the year.

In South Carolina during 1902 the quantity of land rock reported as mined was 254,566 long tons, as compared with 245,243 long tons sold, which shows an increase of 9,313 long tons to be added to the stock on hand at the first of the year. With regard to river rock, the quantity mined was 75,803 long tons, and that marketed was 68,122 long tons; in this case also the stock on hand at the beginning of 1902 should be increased by 7,681 long tons to give the stock on hand at the end of the year.

The phosphate mines in Tennessee during 1902 yielded a product of 396,015 long tons, and the quantity sold was 390,799 long tons, which gives an increase of stock at the end of the year of 5,216 long tons.

IMPORTS.

The following table shows the imports of fertilizers of all kinds into the United States from 1868 to 1902, inclusive:

Fertilizers imported and entered for consumption in the United States, 1868–1902.

Year ending—	Guano.		Crude phosphates and other substances used for fertilizing purposes.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—	*Long tons.*		*Long tons.*		
1868	99,668	$1,336,761	....	$88,864	$1,425,625
1869	13,480	217,004	....	61,529	278,533
1870	47,747	1,414,872	....	90,817	1,505,689
1871	94,344	3,313,914	....	105,703	3,419,617
1872	15,279	423,322	....	83,342	506,664
1873	6,755	167,711	....	218,110	385,821
1874	10,767	261,085	....	243,467	504,552
1875	23,925	539,808	....	212,118	751,926
1876	19,384	710,135	....	164,849	874,984
1877	25,580	873,459	....	195,875	1,069,334
1878	23,122	849,607	....	285,089	1,134,696
1879	17,704	634,546	....	223,283	857,829
1880	8,619	108,733	....	317,068	425,801
1881	23,452	399,552	....	918,835	1,318,387
1882	46,999	854,463	133,956	1,437,412	2,291,905
1883	25,187	537,080	96,586	798,116	1,335,196
1884	28,090	588,033	35,119	406,233	994,266
1885	20,934	393,039	40,068	611,284	1,004,323
Dec. 31—					
1886	13,520	306,584	82,608	1,179,724	1,486,308
1887	10,195	252,265	53,100	644,301	896,566
1888	7,381	125,112	36,405	329,013	454,125
1889	15,991	313,956	35,661	403,205	717,161
1890	4,612	59,580	31,191	252,787	312,367
1891	11,937	199,044	29,743	214,671	413,715
1892	3,073	46,014	92,476	666,061	712,075
1893	5,856	97,889	106,549	718,871	816,760
1894	5,757	105,991	126,820	904,247	1,010,238
1895	4,270	51,642	80,088	450,379	502,021
1896	6,532	79,815	113,955	639,858	719,673
1897	4,930	55,715	200,598	970,836	1,026,551
1898	4,482	50,783	[a]17,966	98,610	149,393
1899	2,700	27,006	17,330	128,579	155,585
1900	5,161	38,184	21,252	181,462	219,646
1901	7,820	89,202	21,439	140,940	230,142
1902	8,393	164,783	57,558	388,479	553,262

[a] Until 1898 the crude potassium salts, kieserite and kainite, were included under "Other substances used for fertilizing purposes" in addition to apatite and bone dust or bone ash. The imports of kieserite and kainite since 1898, inclusive, are as follows: 1898, long tons, 121,506 ($621,443); 1899, long tons, 133,472 ($777,602); 1900, long tons, 181,353 ($1,201,272); 1901, long tons, 240,937 ($1,360,619); 1902, long tons, 225,413 ($1,016,032).

WORLD'S PRODUCTION.

In the following table will be found a statement of the world's production of phosphate rock from 1896 to 1901, inclusive:

World's production of phosphate rock, 1896–1901.

[Metric tons.]

Country.	1896.		1897.		1898.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	165,738	$500,905	228,141	$912,564	269,500	$1,078,000
Belgium	[a] 297,470	537,320	[a] 350,056	436,762	[a] 156,920	303,230
Canada	517	3,420	824	3,984	665	3,665
France	582,667	3,502,027	535,390	2,852,887	568,558	3,115,958
Norway	1,106	17,280	872	12,960	3,593	53,352
Redonda (Br. West Indies)	....	....	812	5,525	750	4,725
Russia	3,776	11,065	5,917	22,132	1,870	4,784
Spain	770	3,080	2,084	16,672	4,500	46,003
United Kingdom	3,048	26,250	2,032	17,500	1,575	13,565
United States	945,982	2,803,372	1,056,322	2,673,202	1,330,264	3,453,460

Country.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	324,983	$1,299,932	319,422	$1,277,688	265,000	$1,060,000
Belgium	[a] 190,090	342,180	[a] 215,670	367,164	222,520	361,398
Canada	2,722	18,000	1,284	7,105	937	6,280
France	645,868	3,334,145	587,919	2,827,291	535,676	2,614,543
Norway	1,500	22,140	300	4,445	([b])	....
Redonda (Br. West Indies)	1,507	9,270	2,230	13,720	Nil.	....
Russia	16,863	58,640	25,663	([c])	([b])	....
Spain	3,510	35,100	4,170	18,590	4,220	16,880
United Kingdom	1,469	12,645	630	5,425	71	680
United States	1,540,506	5,084,076	1,515,179	5,359,248	1,507,681	5,316,403

[a] Cubic meters. [b] Statistics not yet available. [c] Value not reported.

SALT.

By Joseph Struthers.

PRODUCTION.

The production of salt in the United States during 1902 amounted to 23,849,221 barrels (of 280 pounds), valued at $5,668,636, as compared with 20,556,661 barrels, valued at $6,617,449, in 1901, and 20,869,342 barrels, valued at $6,944,603, in 1900. The largely increased production during 1902 is a fair reflection of the continued general prosperity of the United States, and the increase would have been much greater had it not been curtailed in the Eastern States by the shortage of coal for fuel. Even with this hindrance the aggregate production of all varieties shows the largest quantity yet recorded for any one year.

For convenience in discussing the details of the industry, salt is classified into "table and dairy," "common fine," "common coarse," "packers," "coarse solar," "rock," "milling," and "other grades." The last-named division embraces products not properly classible among the preceding, and includes salt in the form of brine, which is used in very large quantities for the manufacture of soda ash, sodium bicarbonate, sodium hydrate (caustic soda), and other sodium salts. During 1902 the aggregate quantity of all varieties of sodium salts, reduced to a basis of 58 per cent ash, manufactured in the United States (not including sodium chloride, or common salt) amounted to 619,492 short tons, equivalent, approximately, to more than 2,500,000 barrels of salt in the form of brine, as compared with 529,104 short tons, equivalent to more than 2,000,000 barrels, in 1901.

The tables on the following pages illustrate clearly the progress that has been made in the salt industry in the United States since 1880, and record the enormous increase in the production, from 5,961,060 barrels in 1880 to 23,849,221 barrels in 1902—an increase of 400 per cent. During the last twenty-three years the annual production has increased regularly except in 1889, when the output was 50,000 barrels, or about 0.6 per cent, less than that of 1888, and in 1901, when the output was practically 300,000 barrels, or about 1.5 per cent less than in 1900. Notwithstanding, and perhaps because of the rapid increase in the production of salt in the United States during the last twenty years, the business has not always been a lucrative one. This condition was due in a great many cases to overproduction and keen competition for trade, and as a natural result the tendency to form combinations, which has been marked in other industries during the last few years, extended also to the salt manufacturers. Combinations have been effected among the majority of producers of the most important of the salt-producing States—i. e., New York, Michigan, Kansas, Ohio, Utah, and California. In the last-named State, however, the combination of prominent salt producers, which maintained the price of coarse salt at $18 per ton, was formally indicted by the Federal grand jury and was enjoined by the United States circuit court from forcing prices above a reasonable compensation for the cost of manufacture. The National Salt Company of New York, also, the largest individual producer of common salt, was declared insolvent on September 30, 1902, and placed in the hands of a receiver.

The following table shows the distribution of the total salt production of the United States, by grades, during the last ten years, from which it will be observed that the production of common fine salt has approximated 37 per cent of the total output during this period:

Production of salt, by grades, in the United States, 1893–1902.

Year.	Table and dairy.	Common fine.	Common coarse.	Packers.	Solar.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1893	1,791,577	5,478,054	444,498	96,657	2,110,287
1894	2,839,140	5,281,754	438,074	103,041	587,305
1895	2,173,123	6,099,480	280,284	118,801	983,870
1896	2,230,409	6,598,733	300,365	163,035	2,531,086
1897	2,555,278	6,868,798	516,143	609,378	3,614,491
1898	2,198,339	8,583,128	873,671	379,635	3,077,024
1899	1,866,165	6,883,352	4,562,217	182,930	3,483,858
1900	2,312,130	6,773,217	1,921,321	145,305	1,086,916
1901	2,177,447	7,159,953	1,630,560	84,636	1,200,141
1902	2,027,798	6,692,587	1,571,137	466,987	1,172,484

Year.	Rock.	Milling.	Other grades.	Total production.	Total value.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	
1893	1,884,145	5,141	6,413	11,816,772	$4,154,668
1894	2,266,606	95,621	1,356,876	12,968,417	4,739,285
1895	2,089,763	40,107	1,884,221	13,669,649	4,423,084
1896	1,783,886	133,271	109,941	13,850,726	4,040,839
1897	1,649,459	....	159,655	15,973,202	4,920,020
1898	2,183,801	156,579	160,457	17,612,634	6,212,554
1899	2,544,036	96,178	89,878	19,708,614	6,867,467
1900	2,974,033	85,357	5,571,063	20,869,342	6,944,603
1901	3,237,938	72,460	5,003,526	20,566,661	6,617,449
1902	2,889,836	127,521	8,900,881	23,849,221	5,668,636

The total annual production of salt in the United States since 1880 is given in the subjoined table, which shows that in proportion to the production the value in some of the earlier years was greater than it has been since 1892. This is due in part to the fact that the competition was not so strong during the first ten years of which records have been available, and in part to the fact that the value of the product when reported by a great many of the manufacturers included the value of the packages in which the salt was shipped. Since 1893 the value as stated includes only the net value of the product, exclusive of any boxes, bags, barrels, or other packages.

Production and value of salt in the United States, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Barrels.			*Barrels.*	
1880	5,961,060	$4,828,566	1892	11,698,890	$5,654,915
1881	6,200,000	4,200,000	1893	11,897,208	4,154,668
1882	6,412,373	4,320,140	1894	12,968,417	4,739,285
1883	6,192,231	4,251,042	1895	13,669,649	4,423,084
1884	6,514,937	4,197,734	1896	13,850,726	4,040,839
1885	7,038,653	4,825,345	1897	15,973,202	4,920,020
1886	7,707,081	4,825,345	1898	17,612,634	6,212,554
1887	8,003,962	4,093,846	1899	19,708,614	6,867,467
1888	8,055,881	4,374,203	1900	20,869,342	6,944,603
1889	8,005,565	4,195,412	1901	20,566,661	6,617,449
1890	8,876,991	4,752,286	1902	23,849,221	5,668,636
1891	9,987,945	4,716,121			

The chief salt-producing States are Michigan and New York, the combined output therefrom in recent years amounting to about 75 per cent of the total production of the United States. Prior to 1893 Michigan was the foremost producer; in that year, however, New York assumed the lead and maintained it until 1901, when Michigan regained supremacy, only to be again displaced by New York in 1902. The percentage of the total production of the four leading salt-producing States during 1902 is as follows: New York, 8,523,389 barrels (35.8 per cent); Michigan, 8,131,781 barrels (34.1 per cent); Kansas, 2,158,486 barrels (9.1 per cent); and Ohio, 2,109,987 barrels (8.9 per cent). These four States contributed 87.9 per cent of the total quantity of salt produced in the United States during the year.

Production of salt, by States and Territories, during 1899, 1900, 1901, and 1902.

State or Territory.	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*		*Barrels.*	
New York	7,489,105	$2,540,426	7,897,071	$2,171,418	7,286,320	$2,089,834	8,523,389	$1,938,539
Michigan	7,117,382	2,205,924	7,210,621	2,033,731	7,729,641	2,437,677	8,131,781	1,535,823
Kansas	1,645,350	546,291	2,233,878	1,076,945	2,087,791	614,365	2,158,486	514,401
Ohio	1,460,516	575,864	1,425,283	696,326	1,153,535	455,924	2,109,987	593,504
Oklahoma	....	....	5,861	6,136	7,506	5,986	7,102	7,562
California	642,563	281,741	621,857	216,291	601,659	133,656	682,660	253,085
Texas	312,436	204,330	(a)	(a)	(a)	(a)	347,906	143,683
West Virginia	221,534	107,987	243,873	118,407	231,722	94,732	208,592	97,721
Utah	236,135	115,100	249,128	151,662	334,484	326,016	417,501	270,626
Pennsylvania	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Other States	583,593	289,804	981,770	473,687	1,134,003	459,259	1,261,827	313,692
Total	19,708,614	6,867,467	20,869,342	6,944,603	20,566,661	6,617,449	23,849,221	5,668,636

[a] Included in other States.

DOMESTIC CONSUMPTION.

The following table has been compiled to show the increase in the proportion of salt produced in the United States which has entered into the domestic consumption. Of the total consumption of salt in the United States the quantity of salt of domestic production used increased from 63.5 per cent in 1880 to 94.81 per cent in 1902, while the consumption of salt imported into the United States decreased from 36.5 per cent of the total in 1880 to 5.25 per cent in 1902. The actual consumption in 1902 was 25,132,579 barrels, or more than 3.7 times that of 1880. In 1880 the production in the United States was 5,961,060 barrels and the imports 3,427,639 barrels. The corresponding figures for 1902 show a remarkable increase, to 23,849,221 barrels of domestic salt produced, while the imports decreased to 1,319,744 barrels.

The following table presents the production, imports, exports, and domestic consumption since 1880:

Supply of salt for domestic consumption, 1880–1902.

[Barrels.]

Source.	1880.	1881.	1882.	1883.
Domestic production	5,961,060	[a] 6,000,000	6,412,373	6,192,231
Imports	3,427,639	3,839,994	3,085,168	3,099,698
Total	9,388,699	9,839,994	9,497,541	9,291,929
Exports	4,436	9,091	8,417	10,829
Domestic consumption	9,384,263	9,830,903	9,489,124	9,281,100
Increase over preceding year	....	446,640	[b] 341,779	[b] 208,024
Percentage of imports to total consumption	36.5	39.1	32.5	33.4

[a] Estimated. [b] Decrease.

Supply of salt for domestic consumption, 1880–1902—Continued.

Source.	1884.	1885.	1886.	1887.
Domestic production	6,514,937	7,038,653	7,707,081	8,003,962
Imports	3,246,349	3,227,380	2,818,623	2,587,745
Total	9,761,286	10,266,033	10,525,704	10,591,707
Exports	14,003	14,649	17,246	16,732
Domestic consumption	9,747,283	10,251,384	10,508,458	10,574,975
Increase over preceding year	466,183	504,101	257,074	66,517
Percentage of imports to total consumption	33.3	31.5	26.8	24.5

Source.	1888.	1889.	1890.	1891.
Domestic production	8,055,881	8,055,565	8,876,991	9,987,945
Imports	2,232,253	1,833,452	1,838,024	1,694,048
Total	10,288,134	9,889,017	10,715,015	11,681,993
Exports	19,140	19,209	17,597	15,889
Domestic consumption	10,268,994	9,869,808	10,697,418	11,666,104
Increase over preceding year	[a] 305,981	[a] 399,186	827,610	968,686
Percentage of imports to total consumption	21.7	18.5	17.2	14.5

Source.	1892.	1893.	1894.	1895.	1896.
Domestic production	11,698,890	11,897,208	12,968,417	13,669,649	13,850,726
Imports	1,633,419	1,244,711	1,550,555	1,996,970	1,858,614
Total	13,332,309	13,141,919	14,518,972	15,666,619	15,709,340
Exports	18,603	20,686	38,763	36,855	63,391
Domestic consumption	13,313,706	13,121,233	14,480,209	15,629,764	15,645,949
Increase over preceding year	1,647,602	[a] 192,473	1,358,976	1,149,555	16,185
Percentage of imports to total consumption	12.3	9.49	10.71	12.78	11.88

Source.	1897.	1898.	1899.	1900.	1901.	1902.
Domestic production	15,973,202	17,612,634	19,708,614	20,869,342	20,566,661	23,849,221
Imports	1,493,033	1,325,212	1,350,366	1,427,921	1,440,950	1,319,744
Total	17,466,235	18,937,846	21,058,980	22,297,263	22,007,611	25,168,965
Exports	54,195	61,715	90,000	53,650	67,376	36,386
Domestic consumption	17,412,040	18,876,131	20,968,980	22,243,613	21,940,235	25,132,579
Increase over preceding year	1,766,091	1,464,091	2,092,849	1,274,633	[a] 303,378	3,192,344
Percentage of imports to total consumption	8.57	7.02	6.4	6.4	6.6	14.5

[a] Decrease.

IMPORTS AND EXPORTS.

The imports of salt into the United States from 1867 to 1881, as reported by the Bureau of Statistics of the Treasury Department, show an increase from 483,775,185 pounds in the former year to 1,075,198,397 pounds in 1881, the largest quantity yet recorded. From 1881 the imports decreased almost as steadily until 1893, when 348,519,173 pounds were reported, the smallest yearly quantity recorded since 1867. The decrease was largely in the imports of fine salt, due to the domestic production of table, dairy, and other special grades of salt equal, if not superior, in quality and price to the imported article. The tariff act of 1894 placed salt upon the free list, and importations increased to 434,155,708 pounds in 1894 and to nearly 560,000,000 pounds in 1895. In 1896 the imports of foreign salt amounted to 520,411,822 pounds. The tariff act of 1897 returned salt to the dutiable list. Salt in bags, barrels, or other packages is now subjected to a duty of 12 cents per 100 pounds (33.6 cents per barrel), and salt in bulk is taxed at the rate of 8 cents per 100 pounds, or 22.4 cents per barrel. The duty on imported salt in bond used in curing fish taken by vessels licensed to engage in the fisheries and in curing fish on the navigable waters of the United States or on salt used in curing meats for export may be remitted. The quantity of salt imported in 1897 was nearly 20 per cent less than in 1896, the total amounting to 418,049,214 pounds, and in 1898 the imports fell off to 371,059,452 pounds, with one exception the smallest amount reported in thirty-two years. In 1899 the imports increased to 378,102,567 pounds, but the value showed a decline of about $9,000 from that of 1898. The imports increased to 399,817,824 pounds in 1900, to 403,465,946 pounds in 1901, and decreased to 369,528,186 pounds in 1902. Since 1867 the imports have been as follows:

Salt imported and entered for consumption in the United States, 1867–1902.

Year ending—	In bags, barrels, and other packages.		In bulk.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*	
1867	254,470,862	$696,570	229,304,323	$336,302
1868	308,446,080	915,546	219,975,096	365,458
1869	297,382,750	895,272	256,765,240	351,168
1870	288,479,187	797,194	319,776,433	507,874
1871	283,993,799	800,454	274,730,573	355,318
1872	258,232,807	788,893	257,637,230	312,569
1873	239,494,117	1,254,818	388,012,132	525,585
1874	358,375,496	1,452,161	427,294,209	649,838
1875	318,673,091	1,200,511	401,270,315	549,111
1876	331,266,140	1,153,480	379,478,218	462,106
1877	359,005,742	1,059,941	444,044,370	532,831
1878	352,109,963	1,062,995	414,813,516	483,909
1879	375,286,472	1,150,018	434,760,132	532,706
1880	400,970,531	1,180,082	449,743,872	548,425
1881	412,442,291	1,242,543	529,361,041	658,068
1882	329,969,300	1,086,932	399,100,228	474,200
1883	312,911,360	1,035,946	412,938,686	451,001
1884	340,759,010	1,093,628	441,613,517	433,827
1885	351,276,969	1,030,029	412,322,341	386,858
Dec. 31—				
1886	319,232,750	966,993	366,621,223	371,000
1887	275,774,571	850,069	343,216,331	328,201

Salt imported and entered for consumption in the United States, 1867-1902—Continued.

Year ending—	In bags, barrels, and other packages.		In bulk.	
	Quantity.	Value.	Quantity.	Value.
Dec. 31—	*Pounds.*		*Pounds.*	
1888	238,921,421	$620,425	272,650,231	$246,022
1889	180,906,293	627,134	234,499,635	249,232
1890	172,611,041	575,260	243,756,044	252,848
1891	150,033,182	492,144	220,309,985	221,569
1892	150,799,014	488,108	201,366,103	196,371
1893	98,037,648	358,575	146,945,390	63,404
1894	60,793,685	206,229	101,525,281	86,718
1895	601,086	1,723	1,874,644	1,874
1896	350,620	814	1,627,030	1,640
1897	36,801,048	114,072	50,775,105	46,412
1898	114,573,146	361,366	178,458,117	165,784
1899	119,720,721	372,921	158,263,237	133,862
1900	113,194,092	368,802	198,697,810	193,873
1901	117,140,960	413,896	171,067,229	165,803
1902	118,480,793	422,304	151,169,362	138,552

Year ending—	For the purpose of curing fish.		Not elsewhere specified.		Total quantity.	Total value.
	Quantity.	Value.	Quantity.	Value.		
June 30—	*Pounds.*		*Pounds.*		*Pounds.*	
1867	....	....	....	....	483,775,185	$1,032,872
1868	....	....	....	....	528,421,176	1,281,004
1869	....	....	....	....	554,147,990	1,246,440
1870	68,597,023	$87,048	....	....	706,852,643	1,392,116
1871	64,671,139	66,008	....	....	623,395,511	1,221,780
1872	57,830,929	60,155	....	....	573,700,966	1,161,617
1873	86,756,628	86,193	....	....	714,262,877	1,866,596
1874	105,613,913	126,896	....	....	891,283,618	2,228,895
1875	110,294,410	119,607	....	....	830,237,846	1,869,259
1876	118,760,638	126,276	....	....	829,504,996	1,741,862
1877	132,433,972	140,787	....	....	935,484,084	1,733,559
1878	100,794,611	96,898	....	....	867,718,090	1,643,802
1879	94,060,114	95,841	....	....	904,106,718	1,778,565
1880	109,024,446	119,667	....	....	959,738,849	1,848,174
1881	133,395,065	144,347	....	....	1,075,198,397	2,044,958
1882	134,777,569	147,058	....	....	863,847,097	1,708,190
1883	142,065,557	154,671	....	....	867,915,603	1,641,618
1884	126,605,276	122,463	....	....	908,977,803	1,649,918
1885	140,067,018	121,429	....	....	903,666,328	1,538,316
Dec. 31—						
1886	103,360,362	94,721	....	....	789,214,335	1,432,714
1887	105,577,947	107,089	....	....	724,568,849	1,285,359
1888	113,459,083	111,120	....	....	625,030,735	977,567
1889	97,960,624	100,123	....	....	513,366,552	976,489
1890	98,279,719	96,648	....	....	514,646,804	924,756
1891	103,990,324	89,196	....	....	474,333,491	805,909
1892	105,192,086	90,327	....	....	457,357,203	774,806
1893	103,536,135	87,749	....	....	348,519,173	509,728
1894	93,723,885	79,482	178,112,857	$263,707	434,155,708	636,136
1895	8,668,490	12,195	548,007,449	739,122	559,151,669	754,914
1896	8,351,913	11,814	510,082,259	687,890	520,411,822	702,158
1897	32,961,953	33,962	297,511,108	370,592	418,049,214	565,038

Salt imported and entered for consumption in the United States, 1867–1902—Continued.

Year ending—	For the purpose of curing fish.		Not elsewhere specified.		Total quantity.	Total value.
	Quantity.	Value.	Quantity.	Value.		
Dec. 31—	*Pounds.*		*Pounds.*		*Pounds.*	
1898	78,028,189	$61,503			371,059,452	$588,653
1899	100,118,609	72,899			378,102,567	579,682
1900	87,925,922	71,632			399,817,824	631,307
1901	115,257,757	96,625			403,465,946	676,324
1902	99,878,031	86,698			369,528,186	647,554

Salt of domestic production exported from the United States, 1790–1902.

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
Sept. 30—	*Bushels.*		June 30—	*Bushels.*	
1790	31,935	$8,236	1866	70,644	$300,980
1791	4,208	1,052	1867	605,825	304,030
1830	47,488	22,978	1868	624,970	289,936
1831	45,847	26,848	1869	442,947	190,076
1832	45,072	27,914	1870	298,142	119,582
1833	25,069	18,211	1871	120,156	47,115
1834	89,064	54,007	1872	42,603	19,978
1835	126,230	46,483	1873	73,323	43,777
1836	49,917	31,943	1874	31,657	15,701
1837	99,133	58,472	1875	47,094	16,273
1838	114,155	67,707	1876	51,014	18,378
1839	264,337	64,272	1877	65,771	20,133
1840	92,145	42,246	1878	72,427	24,968
1841	215,084	62,765	1879	43,710	13,612
1842	110,400	39,064	1880	22,179	6,613
June 30—			1881	45,455	14,752
1843 [a]	40,678	10,262	1882	42,085	18,265
1844	157,529	47,755	1883	54,147	17,321
1845	131,500	45,151	1884	70,014	26,007
1846	117,627	30,520	1885	[b] 4,101,587	26,488
1847	202,244	42,333	Dec. 31—	*Pounds.*	
1848	219,145	73,274	1886	4,828,863	29,580
1849	312,063	82,972	1887	4,685,080	27,177
1850	319,175	75,103	1888	5,359,237	32,986
1851	344,061	61,424	1889	5,378,450	31,405
1852	1,467,676	89,316	1890	4,927,022	30,079
1853	515,857	119,729	1891	4,448,846	23,771
1854	548,185	159,026	1892	5,208,935	28,399
1855	536,073	156,879	1893	5,792,207	38,375
1856	698,458	311,495	1894	10,853,759	46,780
1857	576,151	190,699	1895	7,203,024	30,939
1858	533,100	162,650	1896	10,711,314	43,202
1859	717,257	212,710	1897	11,593,321	52,320
1860	475,445	129,717	1898	17,280,193	63,624
1861	537,401	144,046	1899	25,200,191	86,465
1862	397,506	228,109	1900	15,021,861	65,410
1863	584,901	277,838	1901	18,865,247	86,414
1864	635,519	296,088	1902	10,188,771	55,432
1865	589,537	358,109			

[a] Nine months.

[b] Pounds from 1885.

In connection with the foregoing tables it is interesting to note the sources from which the imported salt is obtained and the market supplied by the exports of domestic salt. For this purpose the following tables, showing the countries from which we import, the quantity and value of the salt received from each, and also the quantity and value of the salt exported, by countries, are given for the three fiscal years ending June 30, 1900, 1901, and 1902. It will be observed that Great Britain is the principal exporter of salt to the United States, the quantity imported from the United Kingdom averaging somewhat over 40 per cent of the total imports. Next in importance are the West Indian islands (chiefly British), followed by Italy. The amount received from all other countries is comparatively small.

The principal exports are through the port of San Francisco to the Central American States, Mexico, the Hawaiian Islands, Japan, and Asiatic Russia. About 25 per cent, or a little more, is shipped across the Great Lakes to the Dominion of Canada.

The imports and exports for the last three fiscal years, with the countries from which imported and to which exported, are given in the following tables:

Imports of salt during the fiscal years ending June 30, 1900, 1901, and 1902.

Country from which imported.	Year ending June 30, 1900.		Year ending June 30, 1901.		Year ending June 30, 1902.	
	Dutiable and free.		Dutiable and free.		Dutiable and free.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
United Kingdom	174,211,930	$449,520	165,659,476	$447,012	151,316,042	$488,652
Italy	89,445,529	43,851	86,370,630	46,391	90,826,888	61,137
Canada	8,359,966	14,971	5,865,395	13,821	8,721,684	25,245
West Indies	133,734,505	111,939	135,477,860	118,118	119,448,756	102,964
Other countries	5,040,510	5,582	14,551,271	11,425	11,561,475	10,371
Total	410,792,440	625,863	407,924,632	636,767	381,874,845	688,369

Exports of salt during the fiscal years ending June 30, 1900, 1901, and 1902.

Country to which exported.	Year ending June 30, 1900.		Year ending June 30, 1901.		Year ending June 30, 1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds*	
United Kingdom	3,000	$49	11,950	$213	22,000	$500
Bermuda	135,140	1,346	155,825	1,619	196,368	1,874
British Honduras	19,152	304	10,260	151	13,891	96
Dominion of Canada:						
Nova Scotia, New Brunswick, etc	51,630	679	31,115	705	74,680	1,133
Quebec, Ontario, etc	2,888,751	10,409	2,413,357	6,301	5,073,350	10,761
British Columbia	2,197,726	7,042	2,509,484	10,513	2,267,235	14,030
Newfoundland and Labrador	95,865	973	104,011	946	67,140	696

Exports of salt during the fiscal years ending June 30, 1900, 1901, and 1902—Continued.

Country to which exported.	Year ending June 30, 1900.		Year ending June 30, 1901.		Year ending June 30, 1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Central American States:	*Pounds.*		*Pounds.*		*Pounds.*	
Costa Rica	106,380	$1,309	141,188	$1,321	139,980	$1,610
Guatemala	15,995	167	371,634	1,903	476,287	2,888
Honduras	131,487	1,506	165,408	1,354	60,215	706
Nicaragua	285,400	2,947	332,063	2,942	346,913	2,913
Salvador	4,500	17				
Mexico	1,090,033	9,243	1,177,080	10,273	1,728,915	15,873
West Indies:						
British	226,900	1,177	188,311	1,382	158,875	658
Danish	2,300	25	1,300	16	2,000	26
French	11,211	133	11,613	155	14,102	171
Haiti	2,400	37	4,897	68	3,348	50
Porto Rico	13,602	105				
Santo Domingo	30,292	335	38,226	485	24,902	336
Cuba	399,431	2,227	357,095	1,868	62,965	386
Colombia	121,371	1,043	173,875	2,013	189,786	1,694
Japan	1,111,400	2,485	1,485,430	5,061	454,665	1,546
China			40	1		
Russia, Asiatic	2,502,000	6,220	3,535,300	12,236	5,608,750	23,104
French Oceania	114,850	475	158,075	700	75,348	811
British Australasia	162,400	748	459,916	3,690	215,600	949
Hawaiian Islands	851,500	3,689				
Philippine Islands	74,800	416				
British Africa	7,300	71	8,785	88	400	3
Other countries	75,103	656	336,899	1,312	43,453	435
Total	12,731,919	55,833	14,183,167	67,316	17,321,168	83,249

WORLD'S PRODUCTION.

With the exception of the production of the United States and Canada, the latest statistics available for the countries contributing to the world's supply of salt are for the calendar year 1901. The subsequent table, accordingly, brings the output for these countries down to that year only. It shows that the United States, which since 1892 has held second place among the countries of the world, became the leader in 1897, ranking Great Britain by about 5 per cent. This advantage was increased in 1898 by a gain in the production of the United States and a decrease in the output of Great Britain, and was further augmented in 1899 by an increase in production nearly eight times as large as that of Great Britain for that year. In 1901 the United States reported a decrease in production compared with 1900 amounting to 42,370 short tons, and the output of Great Britain was 87,243 short tons less than in 1900. It is thus shown that the United States has not only maintained but has materially increased the lead over her principal rival in recent years. The total output of salt in the United States during 1901 was 44 per cent greater than that of Great Britain for that year.

The world's salt production, 1890–1901.

Year.	United States.		United Kingdom.		France.[a]		German Empire.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1890	1,242,778	$4,752,286	2,403,462	$5,354,400	955,434	$3,458,174	1,157,023	$3,939,877
1891	1,398,312	4,040,839	2,288,800	4,737,596	932,292	2,868,945	1,289,888	4,100,340
1892	1,637,845	5,654,915	2,191,307	4,177,795	1,100,898	3,318,366	1,286,675	4,168,915
1893	1,665,609	4,154,668	2,154,912	3,565,827	1,248,560	3,291,422	1,339,311	4,140,279
1894	1,815,438	4,739,285	2,501,221	3,703,601	1,001,498	2,762,216	1,381,211	4,333,707
1895	1,913,751	4,423,084	2,434,043	3,442,292	988,273	2,421,378	1,332,557	4,336,161
1896	1,939,102	4,040,839	2,265,040	3,233,073	1,178,038	2,492,402	1,436,648	4,417,922
1897	2,236,248	4,920,020	2,131,912	3,017,564	1,070,290	2,236,755	1,440,358	3,838,426
1898	2,465,769	6,212,554	2,103,718	3,016,011	1,132,415	2,156,196	1,510,527	3,954,743
1899	2,759,206	6,867,467	2,141,680	3,134,873	1,331,962	2,484,103	1,578,693	3,978,750
1900	2,921,708	6,944,603	2,084,709	3,059,600	1,199,675	2,415,973	1,668,912	4,627,500
1901	2,877,932	6,617,449	1,997,566	2,864,950	1,014,093	2,012,800	1,724,747	5,064,500

Year.	Japan.		Italy.		Austria-Hungary.[b]	
	Quantity.	Value.[c]	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	544,030	....	524,552	$999,933	515,736	$17,863,887
1891	616,795	....	492,144	927,812	508,022	17,436,392
1892	633,449	....	461,738	857,692	490,390	16,069,952
1893	744,717	....	466,146	990,283	524,552	16,475,059
1894	708,500	....	477,166	912,118	565,326	17,256,516
1895	671,446	....	526,370	1,030,350	530,062	17,075,675
1896	586,323	....	497,915	935,466	538,951	15,497,873
1897	691,947	....	507,778	968,031	554,078	15,725,518
1898	712,878	....	497,002	802,108	639,830	19,535,222
1899	640,559	$3,862,939	432,720	616,144	578,000	18,112,471
1900	726,545	4,808,185	404,715	602,440	465,833	15,415,773
1901	([d])	....	479,706	668,982	569,725	15,556,431

Year.	Russia.		Spain.		India.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	1,531,736	$2,613,611	678,531	$1,750,444	1,159,395	$1,948,104
1891	1,489,008	4,978,589	642,292	1,687,300	1,139,468	1,690,294
1892	1,608,595	4,627,700	750,059	2,505,855	1,008,330	1,750,317
1893	1,489,687	4,281,970	166,913	82,076	940,547	1,546,597
1894	1,493,572	3,317,160	227,645	85,786	1,452,654	2,538,121
1895	1,705,896	3,887,090	359,604	918,775	1,282,522	2,058,678
1896	1,484,782	4,917,250	574,970	1,113,494	1,131,472	1,753,371
1897	1,682,337	4,357,253	560,484	1,118,720	1,033,601	1,560,415
1898	1,642,980	4,255,318	527,858	989,704	1,104,513	1,902,377
1899	1,852,861	2,767,168	659,140	1,052,988	1,031,149	1,637,836
1900	2,169,332	([e])	495,965	834,535	1,125,611	1,146,363
1901	([d])	([d])	380,363	599,934	1,234,839	1,821,764

[a] Includes product of Algeria.
[b] Government monopoly.
[c] No value obtainable.
[d] Production and value in 1900 is used in making up the total for the world's production in 1901.
[e] Unit value taken the same as in 1899 in making up the total for the world's production for 1900 and 1901.

The world's salt production, 1890–1901—Continued.

Year.	Canada.		Other countries.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.[a]	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	43,754	$198,857	....	....	10,218,401	$42,879,573
1891	45,021	161,179	....	....	10,225,247	42,629,286
1892	45,486	162,041	....	....	10,581,323	43,293,548
1893	62,324	195,926	....	....	10,058,567	38,724,117
1894	57,199	170,687	[b] 2,772	$9,515	10,978,702	39,828,712
1895	52,376	160,455	[c] 159,129	1,155,738	11,284,583	40,809,676
1896	43,960	169,693	[d] 128,959	408,111	11,219,837	38,879,494
1897	51,348	225,730	[d] 35,373	204,468	11,303,807	38,172,900
1898	57,126	248,639	[e] 463,707	1,567,034	12,145,445	44,639,906
1899	57,095	234,520	123,179	755,531	12,551,685	41,641,851
1900	62,055	279,458	81,717	511,737	12,470,570	42,456,593
1901	59,439	262,328	[f] 541,613	2,463,670	13,775,900	45,980,672

[a] Not including production of Japan, for which no value is obtainable.

[b] Cape Colony and Ceylon.

[c] Cape Colony, Ceylon, Greece, Bosnia, and Herzegovina.

[d] Cape Colony, Greece, Bosnia, and Herzegovina.

[e] In addition to this quantity Brazil produced 26,882; Peru, 19,836; Roumania, 119,103; Switzerland, 52,116; Turkey, 247,663. Total, 465,600 short tons, for which no value is given.

[f] In addition to this quantity Argentina produced 28,000 short tons; Chile (approximately), 11,000; China (estimated), 250,000; Egypt (estimated), 350,000; Roumania (approximately), 100,000, and Switzerland, 55,766, an aggregate of 694,766 short tons, for which no value is given.

SULPHUR AND PYRITE.

By Joseph Struthers.

SULPHUR.

PRODUCTION.

The production of sulphur and of pyrite for the manufacture of sulphuric acid in the United States during 1902 was 207,874 long tons, valued at $947,089, as compared with a combined production of 241,691 long tons, valued at $1,257,879, in 1901. The production of sulphur during 1902 was derived from Louisiana, Nevada, and Utah, in the order of the importance of their output. Oregon and Idaho, which contributed to the output during 1901, reported no production for 1902.

The quantities of sulphur produced in the United States during 1901 and 1902 are the largest annual outputs that have ever been recorded, which indicates that the development of this important branch of the mineral industry is worthy of considerable attention. Until the last two years the production of domestic sulphur has averaged less than 1 per cent of the total consumption, an insignificant amount compared with the imports from foreign countries.

During 1902 the quantity of sulphur consumed in the United States from domestic and foreign sources, including the sulphur content of iron pyrite, which is used in the manufacture of sulphuric acid, amounted to 483,297 long tons.

The following table shows the annual production of sulphur in the United States since 1880:

Sulphur production of the United States, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	600	$21,000	1892	2,688	$80,640
1881	600	21,000	1893	1,200	42,000
1882	600	21,000	1894	500	20,000
1883	1,000	27,000	1895	1,800	42,000
1884	500	12,000	1896	5,260	87,200
1885	715	17,875	1897	2,275	45,590
1886	2,500	75,000	1898	1,200	32,960
1887	3,000	100,000	1899	4,830	107,500
1888	....	....	1900	3,525	88,100
1889	450	7,850	1901	(a)	(a)
1890	....	....	1902	(a)	(a)
1891	1,200	39,600			

a See table of pyrite production on page 940.

DOMESTIC CONSUMPTION.

In considering the consumption of sulphur in the United States it is necessary to include the quantity of iron pyrite used in the manufacture of sulphuric acid, a use which has shown a remarkable growth during the last ten years. Accurate statistics in regard to the consumption of iron pyrite prior to 1891 are not available, as the statistics of imports previous to that year did not separate the pyrite imported for this purpose. Prior to 1884 pyrite was included among other sulphur ores in the statistics compiled by the Bureau of Statistics of the Treasury Department. From 1884 to 1887 pyrite ores were separately reported, but the small quantities reported indicate that a considerable quantity was imported either under the former classification of sulphur ore or as iron ore, under which it was classified from 1887 to 1891, unless it contained copper exceeding 3.5 per cent. A comprehensive review of the growth of the consumption of sulphur and pyrite must therefore necessarily begin with 1891, the year in which the total quantity of sulphur used (imported and domestic) was 118,258 long tons. The sulphur content of the iron pyrite consumed in 1891 was 93,233 long tons, making a total of 211,491 long tons. In 1902 the domestic production of sulphur amounted to 7,443 long tons and the imports to 174,939 long tons, a total of 182,382 long tons. In this year the sulphur content of the net imports of pyrite amounted to 196,786 long tons, and that from the domestic production of pyrite was 104,129 long tons, making a total of 300,915 long tons, or nearly three times the quantity so consumed in 1893. The use of iron pyrite as a raw material in place of sulphur for the manufacture of sulphuric acid continues to increase steadily. By far the greater part of the sulphur consumed in the United States is used in the manufacture of paper stock by the sulphite process. The wood pulp is digested under pressure with sulphurous acid or the acid sulphite of calcium and magnesium, which, reacting upon the lignin and other incrusting materials of the fiber, transforms them into soluble products which are subsequently removed in the liquor.

The statistics for the last decade of production and imports of sulphur, and of the sulphur content of domestic and imported pyrite, exhibiting together the total domestic consumption, are presented in the following table:

Estimated consumption of sulphur in the United States, 1893–1902.

Source.	1893.	1894.	1895.	1896.	1897.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Sulphur:					
Domestic	1,071	446	1,607	4,696	2,031
Imported[a]	105,823	125,459	122,096	139,280	141,905
Sulphur content of pyrite:[b]					
Domestic	34,100	47,673	44,697	51,968	64,440
Imported	87,715	74,596	85,796	90,076	116,796
Total domestic consumption	228,709	248,174	254,196	286,020	325,172

Estimated consumption of sulphur in the United States, 1893-1902—Continued.

Source.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Sulphur:					
Domestic	1,071	4,300	3,147	6,866	7,443
Imported[a]	164,504	141,533	167,696	175,210	174,939
Sulphur content of pyrite.[b]					
Domestic	87,014	78,630	92,077	105,671	104,129
Imported	113,748	121,441	145,118	181,668	196,786
Total domestic consumption	366,337	345,904	408,038	469,415	483,297

[a] Includes crude sulphur, flowers of sulphur, refined sulphur, and sulphur lac.
[b] Based on average sulphur content of 45 per cent.

PRODUCTION OF SULPHUR IN ITALY.

In the following table the statistics of the quantity and value of the sulphur produced in Italy since 1860 (practically all of which is from the island of Sicily) are taken from the official report Rivista del Servizio Minerario:

Production of sulphur in Italy, 1860-1901.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1860	155,067	$3,693,636	1881	367,163	$8,088,237
1861	163,217	3,865,950	1882	438,751	9,002,010
1862	162,825	3,872,376	1883	439,332	8,181,887
1863	179,637	4,273,992	1884	401,431	7,048,751
1864	177,707	4,134,870	1885	418,708	6,748,077
1865	168,829	3,756,507	1886	368,327	5,396,720
1866	195,019	4,579,547	1887	336,715	4,572,979
1867	195,873	4,641,046	1888	370,486	4,827,512
1868	198,097	4,822,158	1889	365,524	4,758,005
1869	197,493	5,071,715	1890	363,305	5,455,201
1870	200,597	4,702,716	1891	389,171	8,593,413
1871	196,518	4,869,515	1892	411,828	7,569,781
1872	235,323	5,746,251	1893	410,958	5,716,018
1873	269,794	6,566,050	1894	399,260	4,876,715
1874	247,221	6,813,675	1895	364,807	3,989,877
1875	204,086	5,562,575	1896	419,501	5,919,554
1876	271,605	6,372,385	1897	488,676	8,680,800
1877	256,141	5,184,313	1898	494,278	9,368,268
1878	300,238	5,896,665	1899	554,638	10,392,415
1879	370,268	7,040,165	1900	535,522	10,212,903
1880	353,883	7,037,859	1901	572,106	10,734,192

EXPORTS OF SULPHUR FROM SICILY.

In connection with the foregoing statistics, the following table, showing the exports of sulphur from Sicily and the countries to which exported during the last five years, will be found of interest. This table is compiled from the annual statement published by Mr. Alfred S. Malcolmson, of New York:

Total exports of sulphur from Sicily, 1896–1902.

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United States	124,923	118,137	138,435	128,441	162,505	144,817	168,920
France	76,739	84,895	88,657	96,043	103,647	74,394	67,634
Italy	54,009	73,052	62,652	87,230	101,073	74,516	45,601
United Kingdom	21,913	24,520	26,983	25,038	23,973	22,464	25,475
Greece and Turkey	18,556	13,866	24,808	18,656	19,647	21,702	20,499
Portugal	12,001	7,054	8,257	12,269	10,937	11,335	12,842
Russia	18,752	17,532	12,285	19,211	22,090	15,110	17,294
Germany	15,680	19,721	27,048	25,933	28,702	23,448	25,908
Austria	13,799	15,993	15,796	18,519	21,594	18,842	19,085
Spain	5,910	4,039	3,233	7,757	6,187	2,979	....
Belgium	7,527	9,253	8,402	7,481	9,721	7,471	12,322
Holland	3,834	3,599	5,646	6,408	18,595	10,848	8,648
Sweden, Norway, and Denmark	14,540	11,226	12,331	12,476	22,681	24,486	24,918
Other countries	8,562	7,651	12,791	13,569	6,810	9,887	18,171
Total	396,745	410,538	447,324	479,031	558,162	462,299	467,317

IMPORTS.

The following statements, showing the quantity and value of sulphur imported into the United States for a series of years, are obtained from the Bureau of Statistics of the Treasury Department:

Sulphur imported and entered for consumption in the United States, 1867–1902.

Year ending—	Crude.		Flowers of sulphur.		Refined.		All other.[a]		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
June 30—	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*		
1867	24,544	$620,373	110	$5,509	251	$10,915	....	....	$636,797
1868	18,151	446,547	16	948	65	2,721	....	....	450,216
1869	23,590	678,642	97	4,576	645	27,149	....	....	710,367
1870	27,380	819,408	76	3,927	157	6,528	....	$1,269	831,132
1871	36,131	1,212,448	66	3,514	92	4,328	....	754	1,221,044
1872	25,380	764,798	36	1,822	57	2,492	....	....	769,112
1873	45,533	1,301,000	55	2,924	36	1,497	....	....	1,305,421
1874	40,990	1,260,491	51	2,694	57	2,403	....	....	1,265,588
1875	39,683	1,259,472	18	891	....	....	....	....	1,260,363
1876	46,435	1,475,250	41	2,114	44	1,927	....	....	1,479,291
1877	42,963	1,242,888	116	5,873	1,171	36,962	....	....	1,285,723
1878	48,102	1,179,769	159	7,628	150	5,935	....	....	1,193,332
1879	70,370	1,575,533	138	6,509	69	2,392	....	....	1,584,434
1880	87,837	2,024,121	124	5,516	158	5,262	....	....	2,034,899
1881	105,097	2,713,485	98	4,226	71	2,555	....	....	2,720,266
1882	97,504	2,627,402	159	6,926	59	2,196	....	....	2,636,524
1883	94,540	2,288,946	79	3,262	115	4,487	....	....	2,296,695
1884	105,112	2,242,697	178	7,869	126	4,765	....	....	2,255,331
1885	96,839	1,941,943	121	5,351	114	4,060	....	....	1,951,354
1886	117,538	2,237,989	213	8,739	116	3,877	....	....	2,250,605
1887	96,882	1,688,360	279	9,980	84	2,383	....	....	1,700,723
Dec. 31—									
1888	98,252	1,581,583	128	4,202	27	734	....	....	1,586,519
1889	135,933	2,068,208	15	1,954	10	299	....	....	2,070,461
1890	162,674	2,762,953	12	1,718	103	3,060	....	....	2,767,731
1891	116,971	2,675,192	206	6,782	10	1,997	....	....	2,683,971
1892	100,938	2,189,481	158	5,439	26	4,106	....	....	2,199,026
1893	105,539	1,903,198	241	5,746	43	1,017	....	....	1,909,961
1894	125,241	1,703,265	173	4,145	45	1,207	....	....	1,708,617
1895	121,286	1,546,481	581	12,888	229	4,379	....	50,005	1,613,754
1896	138,168	1,967,454	665	13,266	447	8,226	....	183,683	2,172,629
1897	136,563	2,395,436	....	....	....	....	5,342	58,637	2,454,073
1898	151,225	2,891,767	507	14,548	163	4,396	12,609	159,213	3,069,924
1899	140,182	2,484,801	335	9,917	184	4,519	832	23,966	2,523,203
1900	166,825	2,917,172	628	17,437	243	6,279	....	....	2,940,888
1901	174,194	3,261,397	748	20,201	268	6,308	....	....	3,287,906
1902	174,160	3,256,990	738	19,954	14	369	27	3,325	3,283,309

[a] Includes sulphur lac and other grades not otherwise provided for, but not pyrite.

Statement, by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year, 1900–1902.

Countries whence exported and customs districts through which imported.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRY.	*Long tons.*		*Long tons.*		*Long tons.*	
Canada	....	....	933	$24,957	776	$18,631
England	7,425	$155,882	7,484	156,205	7,681	161,387
Italy	138,011	2,369,037	139,492	2,474,684	163,571	3,111,971
Japan	9,958	186,847	11,798	219,193	15,448	290,826
Other countries	5	146	4	65	4	69
Total	155,399	2,711,912	159,711	2,875,104	187,480	3,582,884
DISTRICT.						
Baltimore, Md	12,798	213,893	9,040	153,664	12,137	225,804
Boston and Charlestown, Mass	10,023	203,014	11,048	217,274	12,124	251,366
Champlain, N. Y	....	....	....	....	....	....
New Orleans, La	1,000	16,111	2,213	54,694	....	....
New York, N. Y	85,885	1,467,947	89,756	1,585,084	100,109	1,891,554
Philadelphia, Pa	7,448	120,284	11,100	185,319	16,719	304,777
Portland, Me	24,880	436,692	20,039	363,473	30,032	596,931
San Francisco, Cal	8,237	152,335	9,359	172,176	10,497	200,255
Savannah, Ga	751	13,675	1,000	18,190	....	....
Vermont, Vt	....	....	439	12,285	....	....
Willamette, Oreg	1,630	33,134	2,087	40,515	3,475	63,696
All other	2,747	54,827	3,630	72,430	2,387	48,501
Total	155,399	2,711,912	159,711	2,875,104	187,480	3,582,884

WORLD'S PRODUCTION.

World's production of sulphur for 1899, 1900, and 1901.

Country.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*		*Metric tons.*	
United States	4,383	$107,500	3,199	$88,100	6,976	$223,430
Austria[a]	555	1,526	862	2,256	4,911	12,107
France[a]	11,744	28,884	11,551	26,427	7,000	16,400
Germany	1,663	36,000	1,445	31,000	963	20,250
Greece	1,237	22,266	891	16,038	3,212	67,290
Hungary	116	3,600	123	3,820	137	3,847
Italy	554,638	10,392,415	544,119	10,212,903	563,096	10,734,192
Japan	10,235	211,735	14,435	298,660	(b)	....
Russia	451	9,412	(b)	....	(b)	....
Spain	1,100	31,350	750	18,000	610	13,115
	[a] 58,922	102,150	[a] 64,364	[a] 109,947	[a] 49,856	59,306
Sweden	....	....	70	1,890	Nil.	....
Total	645,044	10,946,838	641,809	10,809,041	636,761	11,149,937

[a] Crude rock.

[b] Statistics not yet reported.

PYRITE.

PRODUCTION.

The combined production of pyrite for the manufacture of sulphuric acid and of sulphur in the United States during 1902 amounted to 207,874 long tons, valued at $947,089, as compared with a combined production of 241,691 long tons, valued at $1,257,879, in 1901. In this connection it must be remembered that there is a large quantity of pyrite produced for pyritic and allied smelting, which will increase the production reported for these years to a total approximating 300,000 long tons each. Of the total output, Virginia contributed nearly one-half, followed by Georgia and North Carolina, Colorado, Massachusetts, California, Indiana and Ohio, Missouri and New York, in the respective order of the quantities of output. The production of iron pyrite from Indiana and Ohio was in the form of the so-called "coal brasses," obtained as a by-product in mining coal in these States. No new pyrite mines of importance were opened during the year, although development work was carried on in localities which have long been known as producers, notably in New York, Virginia, and North Carolina.

During 1902 there was recorded a very considerable increase in the quantity of pyrite imported, the statistics of imports for 1902 and 1901 being, respectively, 440,363 long tons ($1,650,852) and 403,706 long tons ($1,415,149). Since 1891 the quantity of pyrite annually imported has largely exceeded the annual domestic production.

The purchase of all domestic and foreign pyrite and other ores used for the sulphur content in the United States continues practically in the hands of four trade combinations, and, as the total purchases of the ores amount annually to about 500,000 tons, stocks of foreign ores can be accumulated at the seaboard and shipped inland in quantities to secure lowest freight rates. These conditions favor the importation of foreign ores and leave but little incentive to develop domestic mines of uncertain character.

Assuming that the stocks carried forward from one year to another are practically the same, and estimating the domestic consumption by combining the imports and the domestic production, it will be seen that the quantity of iron pyrite consumed in this country in 1902 was 668,701 long tons, as compared with 638,531 long tons in 1901 and 527,099 long tons in 1900. Notwithstanding the large increase in the imports of pyrite in 1901, the price of the domestic product advanced from $3.67 per ton in 1900 to $4.35 per ton in 1901, although it declined to $4.28 in 1902. In a similar manner the value of pyrite imported increased from $3.27 per ton in 1900 to $3.51 per ton in 1901 and to $3.74 in 1902.

The quantity and value of pyrite mined for the sulphur content in the United States since 1882 have been as follows:

Production of pyrite in the United States, 1882–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1882	12,000	$72,000	1893	75,777	$256,552
1883	25,000	137,500	1894	105,940	363,134
1884	35,000	175,000	1895	99,549	322,845
1885	49,000	220,500	1896	115,483	320,163
1886	55,000	220,000	1897	143,201	391,541
1887	52,000	210,000	1898	193,364	593,801
1888	54,331	167,658	1899	174,734	543,249
1889	93,705	202,119	1900	204,615	749,991
1890	99,854	273,745	1901	241,691	1,257,879
1891	106,536	338,880	1902	207,874	947,089
1892	109,788	305,191			

IMPORTS AND EXPORTS.

The following table shows the imports of pyrite containing not more than 3.5 per cent of copper from 1884 to 1902, inclusive:

Imports of pyrite containing not more than 3.5 per cent of copper, 1884–1902.[a]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1884	16,710	$50,632	1895	190,435	$673,812
1885	6,078	18,577	1896	200,168	648,396
1886	1,605	9,771	1897	259,546	747,419
1887	16,578	49,661	1898	252,773	717,813
1891	100,648	392,141	1899	269,868	1,077,061
1892	152,359	587,980	1900	322,484	1,055,121
1893	194,934	721,699	1901	403,706	1,415,149
1894	163,546	590,905	1902	440,363	1,650,852

[a] Previous to 1884 classed among sulphur ores; from 1887 to 1891 classed among other iron ores; since 1891 includes iron pyrite containing 25 per cent or more of sulphur.

The exports of pyrite in 1902 were 3,060 long tons, valued at $19,860.

CONSUMPTION.

The imports of iron pyrite for use in the manufacture of sulphuric acid not having been stated separately by the Bureau of Statistics of the Department of Commerce and Labor for years prior to 1901, a comparison with preceding years can not be made. The table on the following page shows the quantity of pyrite mined and imported during the last five years, and as no exports are reported by the Treasury Department prior to 1902 these figures may be accepted as representing the domestic consumption. The table shows also the estimated quantity of sulphur yearly displaced by pyrite on a basis of 45 per cent of sulphur content of the latter.

It will be observed that in the eleven years covered by the following table the quantity of sulphur displaced by pyrite for acid making has increased more than 200 per cent. In 1891 the amount of sulphur displaced by the use of pyrite was 93,233 long tons; in 1902 the amount of sulphur displaced was 300,915 long tons, more than three times that of 1891. This increased use of pyrite for acid making has been due very largely to the development of the sulphite wood-pulp industry for the manufacture of paper in which sulphur is used. There is but one sulphite mill in the United States using pyrite in place of sulphur in the treatment of the wood pulp, although in Europe a considerable quantity of pyrite is utilized for this purpose. Another important factor has been the increased production of phosphate rock from Florida and Tennessee and the domestic manufacture of superphosphates. For these purposes a chemically pure sulphuric acid is not essential, and that made from pyrite serves the purpose equally as well as that made from sulphur.

Quantity of pyrite consumed in the United States, and estimated amount of sulphur displaced by it, 1891–1902.

Source.	1891.	1892.	1893.	1894.	1895.	1896.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Domestic product	106,536	109,788	75,777	105,940	99,549	115,483
Imports	100,648	152,359	194,934	163,546	190,435	200,168
Domestic consumption	207,184	262,147	270,711	269,486	289,984	315,651
Sulphur displaced, estimated on basis of 45 per cent content	93,233	117,966	121,820	121,269	130,493	142,043

Source.	1897.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Domestic product	143,201	193,364	174,734	204,615	234,825	231,398
Imports	259,546	252,773	269,868	322,484	403,706	440,363
Domestic consumption	402,747	446,137	444,602	527,099	638,531	671,761
Less exports						3,060
						668,701
Sulphur displaced, estimated on basis of 45 per cent content	181,236	200,762	200,071	237,195	287,339	300,915

CANADIAN PRODUCTION.

The production of iron pyrite in Canada increased from 35,261 short tons in 1901 to 35,616 short tons in 1902, and the value per ton increased from \$3.70 to \$3.92. The production after 1894 showed a declining tendency until 1900, when it received the benefit of the increased demand in the United States.

Since 1886 the production of pyrite in Canada has been as follows:

Annual production and value of pyrite in Canada, 1886–1902.

Calendar year.	Quantity.	Value.	Calendar year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1886	42,906	$193,077	1895	34,198	$102,591
1887	38,043	171,194	1896	33,715	101,155
1888	63,479	285,656	1897	38,910	116,730
1889	72,225	307,292	1898	32,218	128,872
1890	49,227	123,067	1899	27,687	110,748
1891	67,731	203,193	1900	40,031	155,164
1892	59,770	179,310	1901	35,261	130,544
1893	58,542	175,626	1902	35,616	138,939
1894	40,527	121,581			

WORLD'S PRODUCTION.

The following table has been compiled, chiefly from official sources, to show the pyrite production in the principal producing countries and to exhibit to what an extent pyrite has supplanted sulphur for acid making. In the case of Spain the exports are taken instead of the production for such years as they are available. The published figures of pyrite production in Spain show an output in each year averaging from 20 to 25 per cent of the exports. As the export figures are probably taken from the custom-house records, they are considered more reliable.

World's production of iron pyrite and quantity of sulphur displaced, 1892–1901.

Country.	1892.	1893.	1894.	1895.	1896.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Spain[a]	435,906	393,453	511,769	480,255	98,393
France	226,304	227,288	278,452	248,934	295,325
Portugal	....	2,046	....	192,174	204,105
United States	109,788	75,777	105,940	99,549	115,483
Germany	113,391	119,379	132,621	124,994	127,092
Norway	57,629	52,890	69,720	48,217	59,534
Hungary	27,575	67,093	75,635	68,083	51,851
Italy	27,225	28,987	22,274	37,966	44,993
Canada	53,372	52,270	36,185	30,534	30,103
Newfoundland	....	37,889	40,770	34,318	27,267
Russia	13,893	20,958	19,187	12,988	12,791
United Kingdom	13,967	15,837	15,523	9,048	10,017
Bosnia	....	....	....	197	1,968
Belgium	2,529	6,200	3,001	3,454	2,519
Sweden	1,229	472	645	217	993
Total	1,082,808	1,100,539	1,311,722	1,390,928	1,082,434
Sulphur displaced[b]	487,263	495,242	590,275	625,918	487,095

[a] Exports, except in 1896. [b] Based on estimated 45 per cent of sulphur content.

World's production of iron pyrite and quantity of sulphur displaced, 1892–1901—Cont'd.

Country.	1897.	1898.	1899.	1900.	1901.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Spain[a]	217,545	255,896	316,212	350,296	393,397
France	298,571	306,002	313,087	300,170	302,605
Portugal	206,886	244,229	271,228	339,892	331,641
United States	143,201	193,364	174,734	204,615	234,825
Germany	131,160	134,650	142,299	166,724	154,954
Norway	92,966	88,320	94,099	97,387	(*b*)
Hungary	43,740	57,146	78,241	85,602	92,428
Italy	57,383	66,120	75,308	70,465	87,969
Canada	34,471	28,766	24,721	35,742	31,483
Newfoundland	32,790	32,335	26,154	Nil.	7,532
Russia	19,069	24,175	22,877	22,789	(*b*)
United Kingdom	10,583	12,102	12,230	12,279	10,241
Bosnia and Herzegovina	3,611	236	423	1,673	4,498
Belgium	1,798	145	278	394	....
Sweden	509	380	148	176	Nil.
Total	1,294,283	1,443,866	1,552,039	1,688,204	1,651,573
Sulphur displaced[c]	582,427	649,739	698,418	759,692	743,208

[a] Exports, except in 1896.

[b] Statistics not yet available.

[c] Based on estimated 45 per cent of sulphur content.

BARYTES.

By Joseph Hyde Pratt.

OCCURRENCE.

The commercial deposits of barytes do not usually occur in well-defined veins, but are more often found in a series of pockets, lenses, or seams of varying dimensions. These are more or less in line, often following the dip of the rock with which they are associated, and this rock is in many cases a limestone. Barite is a heavy, white mineral with perfect prismatic cleavage, and is known commercially as barytes. In chemical composition it is a barium sulphate ($BaSO_4$).

In the United States this mineral has been found in quantity in Connecticut, Virginia, North Carolina, Tennessee, and Missouri, and all but the first-named State have been producers of it during the last few years. None of these barytes deposits are worked to any great depth, the deepest work having been done on the Virginia deposits.

PRODUCTION.

The production of crude barytes in 1902 was considerably in excess of that of the year before, amounting to 61,668 short tons, valued at $203,154, as compared with 49,070 tons, valued at $157,844, in 1901. This is an increase of 12,598 tons in quantity and of $45,310 in value. This production, though considerably less in quantity, was $15,064 greater in value than that of 1900, which was 67,680 short tons, valued at $188,089, and which remains the largest on record. The average price per ton for the 1902 production was about $3.29, an increase of 7 cents from $3.22, the price in 1901, which in turn was an increase of 44 cents over $2.78, the price in 1900. There has been an increased demand for barytes during the last year, and this will be still further increased as it becomes more generally used in the production of the hydrate.

The States producing barytes in 1902 were Virginia, North Carolina, Tennessee, and Missouri. Both Virginia and Missouri increased very largely their production in 1902, while in Tennessee there was a very large falling off. It is expected, however, from the development work that has been done in the last named State, that its production in 1903 will be larger than that of 1902. Georgia, which produced a small amount of barytes in 1901, reported nothing in 1902.

In the following table is shown the production of barytes in the United States in 1902, by States:

Production of crude barytes in 1902, by States.

State.	Quantity.	Value.
	Short tons.	
Missouri	31,334	$104,677
North Carolina	14,679	44,130
Tennessee	3,255	14,647
Virginia	12,400	39,700
Total	61,668	203,154

The annual production of crude barytes in the United States since 1882 is shown in the following table:

Production of crude barytes, 1882-1902.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
	Short tons.				*Short tons.*		
1882	22,400	$80,000	$3.57	1893	28,970	$88,506	$3.06
1883	30,240	108,000	3.57	1894	23,335	86,983	3.73
1884	28,000	100,000	3.57	1895	21,529	68,321	3.17
1885	16,800	75,000	4.46	1896	17,068	46,513	2.73
1886	11,200	50,000	4.46	1897	26,042	58,295	2.23
1887	16,800	110,000	[a] 6.55	1898	31,306	108,339	3.50
1888	22,400	75,000	3.35	1899	41,894	139,528	3.33
1889	21,460	106,313	[b] 4.95	1900	67,680	188,089	2.78
1890	21,911	86,505	3.95	1901	49,070	157,844	3.22
1891	31,069	118,363	3.81	1902	61,548	195,983	3.18
1892	32,108	130,025	4.05				

[a] Value at St. Louis, and includes some floated barytes.
[b] Value includes floated barytes when sold first in that form.

IMPORTS.

Although the production of barytes in the United States has been on the increase, there are still a few thousand tons of both manufactured and crude barytes imported each year, chiefly from Germany. In 1902 the manufactured barytes imported amounted to 3,908 short tons, valued at $37,389, and the unmanufactured amounted to 3,929 short tons, valued at $14,322.

In the table below is given the amount of manufactured and crude barytes imported into the United States since 1867:

Imports of barytes, 1867–1902.

Year ending—	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*	
1867	14,968,181	$141,273	....	....
1868	2,755,547	26,739	....	....
1869	1,117,335	8,565	....	....
1870	1,684,916	12,917	....	....
1871	1,385,004	9,769	....	....
1872	5,804,098	43,521	....	....
1873	6,939,425	53,759	....	....
1874	4,788,966	42,235	....	....
1875	2,117,854	17,995	....	....
1876	2,655,349	25,325	....	....
1877	2,388,373	19,273	....	....
1878	1,366,857	10,340	....	....
1879	453,333	3,496	....	....
1880	4,924,423	37,374	....	....
1881	1,518,322	11,471	....	....
1882	562,300	3,856	....	....
1883	411,666	2,489	....	....
1884	3,884,516	24,671	5,800,816	$8,044
1885	4,095,287	20,606	7,841,715	13,567
December 31—				
1886	3,476,691	18,338	6,588,872	8,862
1887	4,057,831	19,769	10,190,848	13,290
1888	3,821,842	17,135	6,504,975	9,037
1889	3,601,506	22,458	13,571,206	7,660
1890	[a] 1,563	16,453	[a] 4,815	13,133
1891	2,149	22,041	2,900	8,816
1892	1,389	15,419	2,789	7,418
1893	1,032	11,457	2,983	7,612
1894	836	10,556	1,884	5,270
1895	1,629	17,112	2,551	7,561
1896	2,467	23,315	509	1,274
1897	1,300	13,822	502	579
1898	687	8,678	1,022	2,678
1899	2,111	22,919	1,739	5,488
1900	2,454	24,160	2,568	8,301
1901	2,454	27,062	3,150	12,380
1902	3,908	37,389	3,929	14,322

[a] Short tons since 1890.

Besides the above manufactured and unmanufactured barytes imported into the United States during 1902, there was also brought in other barium compounds to the value of $152,361. These were divided as follows:

Other imports of barium compounds in 1902.

Material.	Quantity.	Value.
	Pounds.	
Witherite, barium carbonate	....	$12,777
Barium binoxide	920,422	66,746
Barium chloride	5,005,058	46,905
Blanc fixe, or artificial barium sulphate	2,016,016	25,933
Total	7,941,496	152,361

This makes the total value of the importation of barium and barium compounds amount to $204,072. With the exception of the witherite, all these compounds should be manufactured from American barytes; and it is very probable that, upon the completion of the plant at Niagara Falls by the United Barium Company and of the plant at Bristol, Tenn., by Messrs. John T. Williams & Co., there will be a considerable portion of these barium compounds manufactured in this country.

STRONTIUM.

No strontium minerals were produced in the United States during 1902, and, so far as could be learned, no development work was done at any of the localities that are known to contain these minerals. There are a number of places where celestite, the strontium sulphate, occurs in some quantity, as near Burnet, Burnet County, Tex.; Drummond, Drummond Island, Chippewa County, Mich.; Cedar Cliff, Mineral County, W. Va., and in the vicinity of Schoharie, Schoharie County, N. Y. The occurrence of the carbonate of strontium, strontianite, near Clinton, Oneida County, N. Y., is worthy of further investigation.

One of the main uses of the strontium minerals has been in the preparation of strontium hydroxide, but as barium hydroxide is beginning to be manufactured in considerable quantity, to be used for the same purposes as the other, there will be a proportionally less demand for the strontium hydroxide. The use of other strontium salts in pyrotechnics for red fire may be replaced to some extent by lithium salts if these can be produced at a low enough price, as it is expected will be done by the American Lithia and Chemical Company of New York, which is largely interested in the lithium deposits of California.

MINERAL PAINTS.

By Joseph Struthers.

MINERALS USED AS PIGMENTS.

The mineral substances included under this heading are those which are mined and prepared primarily for pigments. They consist of iron ores (red and brown hematites) which are ground and used in the manufacture of metallic paint and which are not included in the production of iron ores for the manufacture of metallic iron, clay, and other earths containing iron used in making yellow and brown pigments (such as ocher, umber, sienna, etc.), barytes (or "heavy spar") used as a substitute for or as an adulterant of white lead, slate (or shale), soapstone, asbestos, and graphite.

PRODUCTION.[a]

The pigments treated in this report as natural mineral paints consist essentially of metallic paint (including mortar colors), ocher, umber, sienna, venetian red, zinc white, slate, and graphitic and carbonaceous shales ground especially for paint.

The aggregate production of these pigments in 1902 amounted to 125,694 short tons, valued at $4,960,831, as compared with 107,960 short tons, valued at $4,509,962, in 1901. The percentage of increase was most apparent in the production of soapstone, which increased from 50 tons, valued at $350, in 1901, to 1,100 tons, valued at $2,200, in 1902, an increase corresponding, respectively, to 2,100 per cent in quantity and to 529 per cent in value.

The greatest increase in quantity was in the production of zinc white, which amounted to 52,730 short tons, valued at $4,023,299, in 1902, as compared with 46,500 short tons, valued at $3,720,000, in 1901, the increase in quantity being 14 per cent and in value about 8 per cent.

The production of metallic paint during 1902 was 18,220 short tons, valued at $312,590, as compared with 15,915 short tons, valued at $204,937, in 1901.

The production of mortar colors showed a decrease during 1902, the respective figures being 8,355 short tons, valued at $98,729, for 1902, and 9,346 short tons, valued at $112,943, for 1901.

The production of ocher, which showed a decrease in 1901 as compared with 1900, was practically the same for 1902, being 16,565 short tons, valued at $145,708, as compared with 16,711 short tons, valued at $177,799, in 1901.

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[a] The production of the crude material of mineral paints in 1902 is reported as 35,479 short tons, valued at $360,885, including 4,500 tons, valued at $18,000, reported as mined but not marketed.

The output of venetian red increased from 9,201 short tons, valued at $153,467, in 1901, to 11,758 short tons, valued at $196,905, in 1902.

In considering the variations between product and value per ton allowance must be made for the comparatively wide range in the qualities of the materials, and for the fact that a larger production of a higher or lower priced article will effect a comparatively larger or smaller increase in the value, as the case may be, so that the rise or fall shown in the average price may be apparent only. Zinc white and venetian red are practically uniform in quality, but this does not hold true with the other pigments. It is evident that the decline in value of metallic paint to $10.67 per short ton in 1899, notwithstanding an increased tonnage, was due to the displacement in the market of some higher-priced paint by a cheaper article. In 1900, however, the price rose to $11.27, in 1901 to $12.87, and in 1902 to $17.16 per short ton.

The production of mineral paints during the last eight years is shown in the following table:

Production of mineral paints, 1895–1902.

Kind.	1895.		1896.		1897.		1898.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Ocher	12,045	$139,328	14,074	$136,458	14,006	$162,764	11,963	$123,832
Umber	320	4,350	165	2,646	[a] 1,080	11,710	[b] 1,177	8,285
Sienna	275	6,950	395	5,416	620	10,610	689	11,140
Metallic paint	17,315	212,761	14,805	180,134	16,699	187,694	20,972	263,979
Mortar color	11,544	106,381	9,660	89,600	8,237	75,570	7,107	74,894
Venetian red	4,595	102,900	4,138	93,866	13,603	294,744	10,271	160,711
Zinc white	20,710	1,449,700	20,000	1,400,000	25,000	1,750,000	33,000	2,310,000
Soapstone	270	3,200	....	....	2	20	100	800
Slate [c]	4,331	45,682	4,795	44,835	4,666	46,681	4,571	46,215
Other colors	....	....	....	....	2,000	6,000	2,000	6,000
Total	71,405	2,071,252	68,032	1,952,955	85,913	2,545,793	91,850	3,005,856

Kind.	1899.		1900.		1901.		1902. [d]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Ocher	14,124	$140,168	17,015	$186,707	16,711	$177,799	16,565	$145,708
Umber	473	4,151	1,452	26,927	759	11,326	480	11,230
Sienna	588	8,205	957	14,771	305	9,304	189	4,316
Metallic paint	23,423	249,945	23,218	261,831	15,915	204,937	[e] 19,020	313,390
Mortar color	5,736	65,156	6,689	79,911	9,346	112,943	8,355	98,729
Venetian red	11,991	210,361	14,696	236,574	9,201	153,467	11,758	196,905
Zinc white	40,146	3,211,680	48,840	3,667,210	46,500	3,720,000	52,645	4,016,499
Soapstone	100	700	100	700	50	350	1,100	2,200
Slate [c]	4,676	43,703	6,395	53,942	4,865	41,211	[f] 4,071	39,401
Other colors	2,000	6,000	1,700	20,000	4,308	78,625	[g] 11,511	132,453
Total	103,257	3,940,069	121,062	4,548,573	107,960	4,509,962	125,694	4,960,831

[a] Includes 600 tons of Spanish brown.
[b] Includes 640 tons of Spanish brown.
[c] Includes mineral black.
[d] In addition there were produced during 1902, 4,000 short tons of zinc-lead pigment, valued at $225,000, and 4,733 short tons of sublimed lead, valued at $449,611.
[e] Includes 800 tons of unground material valued at $800.
[f] Slate and shale ground for pigment.
[g] Chiefly other iron oxide pigments.

OCHER, UMBER, AND SIENNA.

PRODUCTION.

The production of ocher in the United States during 1902 was slightly less than in the preceding year, being 16,565 short tons, valued at $145,708, as compared with 16,711 short tons, valued at $177,799, in 1901. Nine States contributed to the output in the following order of importance: Pennsylvania, Georgia, Arkansas, Illinois, Iowa, Virginia, Missouri, California, Vermont. Wisconsin, which was numbered among the producers in 1901, reported no production during 1902. In only four of these States—California, Georgia, Pennsylvania, and Vermont—were there more than two producers, and the outputs of the other producing States are grouped together in order to preserve confidentially the information concerning the production of individual companies.

Pennsylvania produced 59 per cent of the total output of ocher in 1902, as compared with 46 per cent in 1901. Pennsylvania contributed 9,818 short tons of ocher, valued at $80,259, during 1902, as compared with 7,632 short tons, valued at $76,106, in 1901, which shows a considerable increase in quantity, although the increase in value is relatively less.

The decline in the Georgia output continued. The production of ocher in Georgia during 1902 was more than 27 per cent smaller in quantity and about 22 per cent less in value than that of the preceding year, the outputs for the two years being 3,688 short tons, valued at $38,423, in 1902, as compared with 5,077 short tons, valued at $49,176, in 1901. The production of Georgia in 1900 was 6,828 short tons, valued at $73,172.

The production of ocher in Vermont during 1902 was 441 short tons, valued at $4,544, as compared with 370 short tons, valued at $3,493, in 1901.

California produced 580 short tons of ocher in 1902, valued at $3,650.

Umber was produced in three States in 1902—Illinois, Pennsylvania, and Georgia; and sienna was reported from three States—Illinois, Pennsylvania, and New York.

The following tables show the production of ocher during the last four years, by States, and the total production of ocher, umber, and sienna since 1896. The variations in value are in many cases due chiefly to an increased or decreased production of different grades of these pigments and not to any notable fluctuations in prices.

Production of ocher in 1899, 1900, 1901, and 1902, by States.

State.	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Georgia	3,212	$39,505	6,828	$73,172	5,077	$49,176	3,688	$38,423
Pennsylvania	7,285	57,245	7,601	84,661	7,632	76,106	9,818	80,259
Vermont	653	6,200	401	3,856	370	3,493	441	4,544
California	....	....	....	....	....	....	580	3,650
Other States	2,974	37,218	2,185	25,018	3,632	49,024	2,038	18,832
Total	14,124	140,168	17,015	186,707	16,711	177,799	16,565	145,708

Production of ocher, umber, and sienna, 1896–1902.

Year.	Ocher.		Umber.		Sienna.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1896	14,074	$136,458	165	$2,646	395	$5,416	14,634	$144,520
1897	14,006	162,764	[a] 1,080	11,710	620	10,610	15,706	185,084
1898	11,963	123,832	[b] 1,177	8,285	689	11,140	13,829	143,257
1899	14,124	140,168	473	4,151	588	8,205	15,185	152,524
1900	17,015	186,707	1,452	26,927	957	14,771	19,424	228,405
1901	16,711	177,799	759	11,326	305	9,304	17,775	198,429
1902	16,565	145,708	480	11,230	189	4,316	17,234	161,254

[a] Includes 600 tons Spanish brown from Maryland.
[b] Includes 640 tons Spanish brown from Maryland.

The combined annual production of ocher, umber, and sienna for the years 1884 to 1895, inclusive, is shown in the following table:

Production of ocher, umber, and sienna, 1884–1895.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1884	7,000	$84,000	1890	17,555	$237,523
1885	3,950	43,575	1891	18,294	233,823
1886	6,300	91,850	1892	14,365	193,074
1887	8,000	75,000	1893	11,147	141,828
1888	10,000	120,000	1894	10,193	104,015
1889	15,158	177,472	1895	12,640	150,628

IMPORTS.

The following tables show the amount and value of ochers, etc., imported into the United States from 1867 to 1902, inclusive:

Ocher, etc., imported, 1867–1883.

Fiscal year ending June 30—	All ground in oil.		Indian red and Spanish brown.		Mineral French and Paris green.		Other, dry, not otherwise specified.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	11,373	$385	....	$35,374	....	$2,083	1,430,118	$9,923
1868	6,949	333	....	11,165	....	500	3,670,093	32,102
1869	65,344	2,496	2,582,335	31,624	8,369	2,495	5,379,478	39,546
1870	149,240	6,042	3,377,944	41,607	9,618	3,444	3,935,978	32,593
1871	121,080	4,465	2,286,930	40,663	33,488	11,038	2,800,148	24,767
1872	277,617	9,225	2,810,282	38,763	41,422	10,341	5,645,343	56,680
1873	94,245	3,850	135,360	2,506	34,382	8,078	3,940,785	51,318
1874	98,176	4,623	263,389	3,772	102,876	18,153	3,212,988	35,365
1875	280,517	12,352	646,009	9,714	64,910	13,506	3,282,415	37,929
1876	63,916	3,365	2,524,989	19,555	21,222	5,385	3,962,646	47,405
1877	41,718	2,269	2,179,631	24,218	27,687	6,724	3,427,208	32,924
1878	25,674	1,591	2,314,028	23,677	67,655	14,376	3,910,947	33,260
1879	17,649	1,141	2,873,550	26,929	17,598	3,114	3,792,850	42,563
1880	91,293	4,233	3,655,920	32,726	16,154	3,269	4,602,546	52,120
1881	99,431	4,676	3,201,880	30,195	75,465	14,648	3,414,704	46,069
1882	159,281	7,915	3,789,586	34,136	18,293	2,821	5,530,204	68,106
1883[a]	137,978	6,143	1,549,968	13,788	6,972	885	7,022,615	90,593

[a] Since 1883 classified as "dry" and "ground in oil."

Imports of ocher of all kinds, 1884–1902.

Year ending—	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*		*Pounds.*	
1884	6,164,359	$63,973	108,966	$4,717	6,273,325	$68,690
1885	4,983,701	51,499	79,666	3,616	5,063,367	55,115
Dec. 31—						
1886	4,939,183	53,593	112,784	6,574	5,051,967	60,167
1887	5,957,200	58,162	54,104	7,337	6,011,304	65,499
1888	6,574,608	64,123	43,142	9,690	6,617,750	73,813
1889	5,540,267	52,502	51,063	9,072	5,591,330	61,574
1890	....	....	....	....	6,471,863	71,953
1891	6,246,890	63,040	52,206	5,272	6,299,096	68,312
1892	8,044,836	97,946	49,714	5,120	8,094,550	103,066
1893	6,225,789	55,074	52,468	3,354	6,278,257	58,428
1894	4,937,738	45,276	22,387	2,100	4,960,125	47,376
1895	7,107,987	56,020	41,153	2,239	7,149,140	58,259
1896	8,954,252	68,196	27,023	1,561	8,981,275	69,757
1897	[a]7,720,075	59,272	20,123	1,000	7,740,198	60,272
1898	5,898,725	46,571	31,460	1,546	5,930,185	48,117
1899	9,765,616	72,825	14,881	756	9,780,497	73,581
1900	8,449,252	57,342	19,167	1,019	8,468,419	58,361
1901	8,546,691	83,196	16,738	918	8,563,429	84,114
1902	9,987,516	107,285	19,668	1,013	10,007,184	108,298

[a] Since 1896 classified as "dry—crude and powdered, washed or pulverized."

Imports of umber, 1867–1902.

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—	*Pounds.*		Dec. 31—	*Pounds.*	
1867	2,147,342	$15,946	1886	1,262,930	$9,187
1868	345,173	2,750	1887	2,385,281	16,536
1869	570,771	6,159	1888	1,423,800	14,684
1870	708,825	6,313	1889	1,555,070	20,887
1871	470,392	7,064	1890	1,556,823	19,329
1872	1,409,822	18,203	1891	633,291	6,498
1873	845,601	8,414	1892	1,028,038	6,256
1874	729,864	6,200	1893	1,488,849	16,636
1875	513,811	5,596	1894	632,995	6,275
1876	681,199	7,527	1895	[a] 1,560,786	13,075
1877	1,101,422	10,213	1896	[b] 689,075	8,360
1878	1,038,880	8,302	1897	[c] 1,447,889	14,479
1879	986,105	6,959	1898	[d] 1,123,079	9,051
1880	1,877,645	17,271	1899	[e] 1,739,036	13,326
1881	1,475,835	11,126	1900	[f] 1,703,256	11,862
1882	1,923,648	20,494	1901	[g] 1,465,431	12,510
1883	785,794	8,419	1902	[h] 1,899,425	16,133
1884	2,946,675	20,654			
1885	1,198,000	8,504			

[a] Includes 6,137 pounds "ground in oil" and 1,554,649 pounds "dry."

[b] Includes 5,292 pounds "ground in oil" and 683,783 pounds "dry."

[c] Includes 14,471 pounds "ground in oil" and 1,433,418 pounds "dry—crude or powdered."

[d] Includes 4,608 pounds "ground in oil" and 1,118,471 pounds "dry—crude and powdered, washed or pulverized."

[e] Includes 4,849 pounds "ground in oil" and 1,734,187 pounds "dry—crude and powdered, washed or pulverized."

[f] Includes 11,653 pounds "ground in oil" and 1,691,603 pounds "dry—crude and powdered, washed or pulverized."

[g] Includes 3,184 pounds "ground in oil" and 1,462,247 pounds "dry—crude and powdered, washed or pulverized."

[h] Includes 11,999 pounds "ground in oil" and 1,887,426 pounds "dry—crude and powdered, washed or pulverized."

Imports of sienna, 1893–1902.

Year ending Dec. 31—	Dry.		Ground in oil.		Year ending Dec. 31	Dry.		Ground in oil.	
	Quantity.	Value.	Quantity.	Value.		Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*			*Pounds.*		*Pounds.*	
1893	1,626,536	$138,889	5,857	$610	1898	544,713	$11,451	4,008	$280
1894	337,909	9,424	18,877	895	1899	798,691	14,470	6,484	492
1895	456,861	11,021	6,576	501	1900	796,534	14,912	6,335	495
1896	668,461	10,857	10,848	877	1901	1,106,553	18,294	13,861	1,004
1897	580,468	12,340	7,058	481	1902	1,534,878	27,299	5,921	494

PRODUCTION OF OCHER IN PRINCIPAL PRODUCING COUNTRIES.

The following table gives the output of ocher in the principal producing countries of the world as far as statistics are available. France leads in quantity, with Great Britain second, and the United States third. The production in France has each year amounted to more than that of the United States and Great Britain combined, although the value of the French product, except for 1897 and 1900, was but little more than that of the United States, and in these years it was considerably less. The German Empire stands fourth, with a production of about 33 per cent of that of France during 1900, although the value was less than 16 per cent.

Production of ocher in principal producing countries, 1893–1902.

Year.	United States.		United Kingdom.		France.		German Empire.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1893	11,147	$141,828	11,798	$67,318				
1894	10,193	104,015	9,538	68,094				
1895	12,640	150,628	8,540	82,397	36,456	$142,756	9,911	$25,297
1896	14,634	144,520	11,078	99,737	30,304	125,164	9,918	26,227
1897	15,706	185,084	16,153	63,165	35,594	150,714	9,660	25,242
1898	13,829	143,257	22,206	63,065	37,236	152,002	9,642	31,737
1899	14,124	140,168	18,272	66,082	36,090	155,821	10,234	31,750
1900	17,015	186,707	17,024	61,627	36,454	164,000	12,681	25,078
1901	16,711	177,799	16,287		39,357	275,930	77,047	102,385
1902	16,565	145,708						

Year.	Canada.		Belgium.		Spain.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1893	1,070	$17,710	1,408	$1,351	1,135	$685		
1894	611	8,690	400	965	132	232	1,714	$3,822
1895	1,339	14,600	800	1,930	224	760	1,500	3,293
1896	2,362	16,045	1,120	2,702	234	820	3,240	6,955
1897	3,905	23,560	560	1,400	220	772	1,721	3,776
1898	2,340	18,531	320	1,138	220	800	3,206	4,656
1899	3,919	19,900	330	1,158	110	400	1,098	2,443
1900	1,966	15,398	330	1,158	64	232		
1901	2,233	16,735	[a]2,100	8,400	181	528		
1902	4,955	30,495						

[a] Cubic meters.

METALLIC PAINT.

Metallic paint is manufactured by grinding certain kinds of hematite iron ore. In some cases the ores are roasted before grinding, in order to improve the color and durability. Considering the widespread occurrence and the enormous deposits of iron ore existing in the United States, the quantity of material suitable for making a good metallic paint is very small and the localities are comparatively rare. Among the localities from which good paint ore is to be obtained are Oneida, Rensselaer, Cattaraugus, and Washington counties, N. Y.; Lehigh, Carbon, and Mercer counties, Pa.; Hamilton and James counties, Tenn.; and Dodge County, Wis. It is also produced in smaller quantities in Maryland, Arkansas, California, Illinois, Iowa, Vermont, Missouri, Ohio, and Wyoming. Part of the ore ground for paint is used as a coloring matter in mortar making. It is not always possible to separate exactly the quantity used for mortar colors; the manufacturers, having sold it as dry ground paint, do not always know the purpose for which it is consumed after leaving their hands. The separation given in this report is the best that could be made under these circumstances, but it is not claimed to be absolutely correct.

The production of metallic paints in 1902, exclusive of mortar colors, was 19,020 short tons, valued at $313,390, as compared with 15,915 short tons, valued at $204,737, in 1901, an increase in quantity of 2,305 tons, or more than 14 per cent, and in value of $107,853, or 52.7 per cent. On the other hand, the production of mortar colors showed a decrease, being 8,355 short tons, valued at $98,729, as compared with 9,346 short tons, valued at $112,943, in 1901, the decrease corresponding to 11 per cent in quantity and 12 per cent in value.

The statistics of production of metallic paint and mortar colors during 1901 and 1902 are given in the subjoined table:

Production of metallic paint and mortar colors in 1901 and 1902.

State.	1901.				1902.			
	Metallic paint.		Mortar colors.		Metallic paint.		Mortar colors.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
New York	2,065	$25,150	3,300	$45,000	1,400	$15,000	4,534	$49,400
Pennsylvania	8,422	120,298	2,150	22,400	9,981	233,832	925	10,600
Tennessee	3,100	27,350	1,500	15,000	5,150	40,880	969	12,990
Other States	2,328	31,939	2,396	30,543	1,689	22,878	1,927	25,739
Total	15,915	204,737	9,346	112,943	18,220	312,590	8,355	98,729

The annual production of metallic paint and mortar colors for the last fourteen years has been as follows:

Production of metallic paint and mortar colors, 1889–1902.

Year.	Metallic paint.[a]		Mortar colors.		Year.	Metallic paint.[a]		Mortar colors.	
	Quantity.	Value.	Quantity.	Value.		Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*			*Short tons.*		*Short tons*	
1889	21,026	$286,294			1896	14,805	$180,134	9,660	$89,600
1890	24,177	340,369			1897	16,699	187,694	8,237	75,570
1891	25,142	334,455			1898	20,972	263,979	7,107	74,894
1892	25,711	362,966			1899	23,423	249,945	5,736	65,156
1893	19,960	297,289			1900	23,218	261,831	6,689	79,911
1894	15,225	189,922	10,150	$94,961	1901	15,915	204,737	9,346	112,943
1895	17,315	212,761	11,544	106,381	1902	18,220	312,540	8,355	98,729

[a] Includes mortar colors from 1889 to 1893, inclusive.

VENETIAN RED.

Venetian red is a bright-red pigment, which is obtained by submitting iron sulphate (commonly called "copperas" or "green vitriol") to a roasting process, whereby the sulphur is oxidized by heat and driven off as sulphur dioxide, leaving the iron oxide of a brighter red than the natural product. The quantity of iron oxide so consumed is small in comparison with the total iron oxide pigment produced, and for this reason the output of venetian red is included in the output of mineral paints.

The production of venetian red during 1902 was 11,758 short tons, as compared with 9,201 short tons in 1901. Accompanying this increase in quantity was an increase in value from $153,467 to $196,905 The annual production since 1890 has been as follows:

Production of venetian red, 1890–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1890	4,000	$84,100	1897	13,603	$294,744
1891	4,191	90,000	1898	10,271	160,711
1892	4,900	106,800	1899	11,991	210,361
1893	3,214	64,400	1900	14,696	236,574
1894	2,983	73,300	1901	9,201	153,467
1895	4,595	102,900	1902	11,758	196,905
1896	4,138	93,866			

SLATE GROUND FOR PIGMENT.

The quantity of slate and shale ground for paint in 1902, including "mineral black," was 4,071 short tons, valued at $39,401, as compared with 4,865 short tons, valued at $41,211, in 1901. This table does not include either the so-called "Baraga graphite" of Michigan, which is a carbonaceous shale or schist, or the graphitic anthracite of Rhode Island, both of which are used to some extent in the manufacture of "graphite paints," the statistics of production and value of which will be found elsewhere in this volume under the caption "Graphite."

The annual production of pigments made from slate and shale since 1880 has been as follows:

Quantity and value of slate and shale ground for pigment, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	1,120	$10,000	1892	3,787	$23,523
1881	1,120	10,000	1893	3,253	25,567
1882	2,240	24,000	1894	3,300	35,370
1883	2,240	24,000	1895	4,331	45,682
1884	2,240	20,000	1896	4,795	44,835
1885	2,212	24,687	1897	4,666	46,681
1886	3,360	30,000	1898	4,571	46,215
1887	2,240	20,000	1899	4,676	43,703
1888	2,800	25,100	1900 [a]	6,395	53,942
1889	2,240	20,000	1901	4,865	41,211
1890	2,240	20,000	1902	4,071	39,401
1891	2,240	20,000			

[a] Includes mineral and carbon black.

WHITE LEAD, RED LEAD, LITHARGE, AND ORANGE MINERAL.

PRODUCTION.

The aggregate production of lead pigments during 1902 was considerably greater than in 1901, the increase being distributed among all varieties except red lead and orange mineral, of which much smaller quantities were produced.

The production of white lead in oil, which amounted to 151,874,933 pounds in 1900 and 154,606,670 pounds in 1901, increased to 179,473,588 pounds in 1902. There was also an increase in the production of dry white lead from 46,966,945 pounds in 1901 to 49,841,821 pounds in 1902. The quantity of white lead imported in 1902 amounted to 506,423 pounds, as compared with 384,673 pounds in 1901. The imports of white lead in 1869 was 8,948,642 pounds, the largest quantity recorded for a single year. The comparison of the figures given on the following pages indicates plainly the gradual displacement of the imported lead pigments by those of domestic production.

The production of red lead during 1902 shows a large decrease from the returns of the preceding year, being 23,338,252 pounds, valued at $1,263,112, in 1902, as compared with 26,206,096 pounds, valued at $1,448,550, in 1901. The decreased production was reflected in the increased imports, which amounted to 1,075,839 pounds in 1902, as compared with 485,467 pounds in 1901.

The production of litharge during 1902 was 25,510,690 pounds, valued at $1,298,343, as compared with 18,919,036 pounds, valued at $979,586, in 1901. The quantity of litharge imported in 1902 was 88,115 pounds, as compared with 49,306 pounds in 1901.

The production of orange mineral in 1902 was 1,973,521 pounds, valued at $139,349, as compared with 2,174,727 pounds, valued at $224,667, in 1901. The imports of orange mineral amounted in 1902 to 997,494 pounds, as compared with 977,644 pounds in 1901. Of all the lead oxide pigments orange mineral is the only one of which the quantity imported is sufficiently large to have any marked effect on the domestic consumption.

The production of white lead, red lead, litharge, and orange mineral during 1900, 1901, and 1902 is given in the subjoined table:

Production of white lead, red lead, litharge, and orange mineral during 1900, 1901, and 1902.

	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
White lead:	*Pounds.*		*Pounds.*		*Pounds.*	
In oil	151,874,933	$8,430,996	154,606,670	$8,978,441	179,473,588	$9,755,197
Dry	44,544,971	2,226,960	46,966,945	2,274,212	49,841,821	2,222,977
Red lead	21,486,825	1,198,008	26,206,096	1,448,550	23,338,252	1,263,112
Litharge	18,984,145	990,391	18,919,036	979,586	25,510,690	1,298,343
Orange mineral	1,973,016	149,288	2,174,727	224,667	1,973,521	139,349

The annual production of white lead since 1884 has been as follows:

Production of white lead in the United States, 1884–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1884	65,000	$6,500,000	1894	76,343	$6,623,071
1885	60,000	6,300,000	1895	90,513	8,723,632
1886	60,000	7,200,000	1896	88,608	8,371,588
1887	70,000	7,560,000	1897	95,658	9,676,815
1888	84,000	10,080,000	1898	96,047	9,400,622
1889	80,000	9,600,000	1899	110,197	11,317,957
1890	77,636	9,382,967	1900	98,210	10,657,956
1891	78,018	10,454,029	1901	100,787	11,252,653
1892	71,485	8,733,620	1902	114,658	11,978,171
1893	72,172	7,695,130			

IMPORTS.

The following table gives the imports of white lead, red lead, litharge, and orange mineral from 1867 to 1902, inclusive:

White lead, red lead, litharge, and orange mineral imported, 1867–1902.

Year ending—	White lead.		Red lead.		Litharge.		Orange mineral.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*	
1867	6,636,508	$430,805	926,843	$53,087	230,382	$8,941	....	....
1868	7,533,225	455,698	1,201,144	76,773	250,615	12,225	....	....
1869	8,948,642	515,783	808,686	46,481	187,333	7,767	....	....
1870	6,228,285	365,706	1,042,813	54,626	97,398	4,442	....	....
1871	8,337,842	483,392	1,295,616	78,410	70,889	3,870	....	....
1872	7,153,978	431,477	1,513,794	85,644	66,514	3,396	....	....
1873	6,331,373	408,986	1,583,039	99,891	40,799	2,379	....	....
1874	4,771,509	323,926	756,644	56,305	25,687	1,450	....	....
1875	4,354,131	295,642	1,048,713	73,131	15,767	950	....	....
1876	2,546,776	175,776	749,918	54,884	47,054	2,562	....	....
1877	2,644,184	174,844	387,260	28,747	40,331	2,347	....	....
1878	1,759,608	113,638	170,608	9,364	28,190	1,499	....	....
1879	1,274,196	76,061	143,237	7,237	38,495	1,667	....	....
1880	1,906,931	107,104	217,033	10,397	27,389	1,222	....	....
1881	1,068,030	60,132	212,423	10,009	63,058	2,568	....	....
1882	1,161,889	64,493	288,946	12,207	54,592	2,191	....	....
1883	1,044,478	58,588	249,145	10,503	34,850	1,312	....	....
1884	902,281	67,918	265,693	10,589	54,183	1,797	....	....
1885	705,535	40,437	216,449	7,641	35,283	1,091	....	....
Dec. 31—								
1886	785,554	57,340	597,247	23,038	51,409	1,831	....	....
1887	804,320	58,602	371,299	16,056	35,908	1,302	....	....
1888	627,900	49,903	529,665	23,684	62,211	2,248	....	....
1889	661,694	56,875	522,026	24,400	41,230	1,412	....	....
1890	742,196	57,659	450,402	20,718	48,283	2,146	....	....
1891	718,228	40,773	651,577	23,807	94,586	3,108	....	....
1892	744,838	40,032	812,703	28,443	56,737	1,811	1,409,601	$64,133
1893	686,490	34,145	854,982	27,349	42,582	1,310	1,385,828	61,360

White lead, red lead, litharge, and orange mineral imported, 1867-1902—Continued.

Year ending—	White lead.		Red lead.		Litharge.		Orange mineral.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Dec. 31—	*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*	
1894	796,480	$10,939	947,873	$29,064	38,595	$1,064	1,386,464	$58,614
1895	1,897,892	79,887	1,764,274	53,139	97,667	2,812	1,689,367	66,492
1896	1,183,538	52,409	1,543,262	47,450	51,050	1,615	1,359,651	51,077
1897	1,101,829	48,988	1,386,070	46,992	60,984	1,931	1,486,042	67,549
1898	506,739	24,334	682,449	25,780	56,417	2,021	795,116	37,745
1899	583,409	30,212	776,197	30,479	55,127	3,614	1,141,387	58,142
1900	456,872	28,366	549,551	25,532	77,314	2,852	1,068,793	61,885
1901	384,673	21,226	485,467	19,370	49,306	1,873	977,644	52,409
1902	506,423	25,320	1,075,839	37,383	88,115	2,908	997,494	49,060

PRICES.

The following table shows the average yearly market prices of corroding pig lead, the net price of white lead in oil (both at New York), and the difference between the two since 1874:

Average yearly net prices, at New York, of pig lead and white lead in oil, 1874-1902.

Year.	Pig lead, in New York.	White lead in oil, in New York.	Difference.	Year.	Pig lead, in New York.	White lead in oil, in New York.	Difference.
	Per 100 pounds.	*Per 100 pounds.*	*Per 100 pounds.*		*Per 100 pounds.*	*Per 100 pounds.*	*Per 100 pounds.*
1874	$6.00	$11.25	$5.25	1889	$3.80	$6.00	$2.20
1875	5.95	10.50	4.55	1890	4.33	6.25	1.92
1876	6.05	10.00	3.95	1891	4.33	6.37	2.05
1877	5.43	9.00	3.57	1892	4.05	6.39	2.34
1878	3.58	7.25	3.67	1893	3.73	6.03	2.30
1879	4.18	7.00	2.82	1894	3.28	5.26	1.98
1880	5.05	7.60	2.55	1895	3.28	5.05	1.77
1881	4.80	7.25	2.45	1896	3.03	4.90	1.87
1882	4.90	7.00	2.10	1897	3.64	5.00	1.36
1883	4.32	6.88	2.56	1898	3.79	5.08	1.29
1884	3.73	5.90	2.17	1899	4.53	5.35	0.82
1885	3.95	6.00	2.05	1900	4.55	5.57	1.02
1886	4.63	6.25	1.62	1901	4.51	5.87	1.36
1887	4.47	5.75	1.28	1902	$4.21\frac{2}{3}$	5.62	$1.40\frac{1}{3}$
1888	4.41	5.75	1.34				

It will be observed from the foregoing table that the difference in price between white lead in oil and pig lead in New York in 1902 was $\$1.40\frac{1}{3}$, as compared with a difference of $1.36 in 1901. Against this must be set the difference in the price of linseed oil, which varied from 47 to 68 cents per gallon in 1902, and from 50 to 82 cents per gallon in 1901. The price of linseed oil at the beginning of 1901 was 56 cents per gallon; it sold as low as 50 cents in September, and reached the highest point of the year, 82 cents, in July. Beginning with 58 cents in January of 1902, the price advanced until it reached 68 cents in

June, and then declined until 47 cents was reached in October, closing the year at 47 cents. The market price for pig lead in New York opened at 4.12½ cents and closed at 4.22½ cents. The former price was maintained until January 25, when it rose to 4.22½, and continued at this quotation for the remainder of the year.

The fluctuations in price of linseed oil at New York during the last nine years are shown in the following table:

Price of linseed oil at New York, 1894-1902.

[In cents per gallon.]

Year.	Highest.	Lowest.	Year.	Highest.	Lowest.
1894	56	50	1899	50	37
1895	59	42	1900	67	50
1896	41	31	1901	82	50
1897	43	30	1902	68	47
1898	46	34			

ZINC WHITE.

The marketed output of zinc white during 1902 amounted to 52,645 short tons, valued at $4,016,499, as compared with 46,500 short tons, valued at $3,720,000, in 1901. The actual production at the works during 1902 was less than the quantity shipped by 2,942 short tons.

The following table gives the production of zinc oxide from 1880 to 1902, inclusive:

Production of zinc white, 1880-1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			Short tons.	
1880	10,107	$763,738	1892	27,500	$2,200,000
1881	10,000	700,000	1893	24,059	1,804,420
1882	10,000	700,000	1894	19,987	1,399,090
1883	12,000	840,000	1895	20,710	1,449,700
1884	13,000	910,000	1896	20,000	1,400,000
1885	15,000	1,050,000	1897	25,000	1,750,000
1886	18,000	1,440,000	1898	33,000	2,310,000
1887	18,000	1,440,000	1899	40,146	3,211,680
1888	20,000	1,600,000	1900	48,840	3,667,210
1889	16,970	1,357,600	1901	46,500	3,720,000
1890	....	1,600,000	1902	52,730	4,023,299
1891	23,700	1,600,000			

IMPORTS.

The imports of zinc oxide during 1902 were: Dry, 3,271,385 pounds, in oil, 163,081 pounds, total 3,434,466 pounds, as compared with dry, 3,199,778 pounds, in oil, 128,198 pounds, total 3,327,976 pounds in 1901, which shows an increase for 1902 of practically 3 per cent above the imports of the preceding year.

The imports of zinc white, both dry and in oil, in 1902 were 106,490 pounds greater than in 1901. The imports of zinc white of both kinds in 1902 were of less value than the imports in 1899.

The following table shows the quantity of zinc white, dry and in oil, imported into the United States since 1885:

Imports of zinc oxide (dry and in oil), 1885–1902.

Year ending—	Dry.	In oil.	Year ending—	Dry.	In oil.	Total value.
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	
June 30, 1885	2,233,128	98,566	Dec. 31—			
Dec. 31—			1894	3,371,292	59,291	$122,690
1886	3,536,289	79,788	1895	4,546,049	129,343	153,641
1887	4,961,080	123,216	1896	4,572,781	311,023	161,188
1888	1,401,342	51,985	1897	5,564,763	502,357	206,636
1889	2,686,861	66,240	1898	3,342,235	27,050	130,039
1890	2,631,458	102,298	1899	3,012,709	41,699	172,359
1891	2,839,351	128,140	1900	2,618,808	38,706	142,395
1892	2,442,014	111,190	1901	3,199,778	128,198	166,908
1893	3,900,749	254,807	1902	3,271,385	163,081	167,084

In addition to the imports given above, there were imported during 1902, 1,247,936 pounds of white sulphide of zinc, valued at $32,879.

ZINC LEAD.

In addition to the products given in the preceding tables the United States Reduction and Refining Company, at Canyon, Colo., produced in 1902, 4,000 short tons of "zinc lead," valued at $225,000, as compared with 2,500 short tons, valued at $150,000, in 1901. Zinc lead is a pigment consisting of a mixture of an oxidized compound of zinc and lead, which is obtained by an oxidizing smelting treatment of lead and zinc ores in a furnace of special design.

SUBLIMED LEAD.

The production of sublimed lead by the Picher Lead Company, of Joplin, Mo., during 1902 amounted to 9,465,500 pounds, valued at $449,611. This special pigment, which is sometimes classed as a white lead, is obtained as a product in the oxidizing smelting of galena ores. It consists essentially of lead sulphate and lead oxide.

ASBESTOS.

By Joseph Hyde Pratt.

OCCURRENCE.

The sources of supply of commercial asbestos are deposits of two distinct minerals; one is a variety of serpentine known as chrysotile, and the other is a variety of amphibole.

The amphibole asbestos is usually found in granitic or schistose rocks, sometimes in pockets, and again in well-defined veins. The chrysotile variety does not occur in a vein formation, but is in seams of varying width, which pinch out and widen, sometimes being thickly clustered together, and again occurring sparingly, and it is always found in serpentine rocks. The demand for the chrysotile asbestos is far in advance of that for the amphibole variety, on account of its being adapted to many more purposes. The amphibole variety can, however, be mined and prepared for market at less expense than the chrysotile variety, and as it makes a cheaper product there is some demand for it for those purposes where its nonconductivity of heat is the principal quality desired, as in the manufacture of fireproof paints, for wall plasters, for packing in the manufacture of fireproof safes and of boiler coverings. Where, however, strength of fiber as well as nonconductivity of heat is desired, as in the manufacture of cloth, ropes, felt, boards, tubes, and washers, it is the chrysotile variety that is used.

PRODUCTION.

The production of asbestos in the United States during 1902 was chiefly from the mines at Sall Mountain, White County, Ga., with smaller amounts from near Hinsdale, Berkshire County, Mass., the total quantity being 1,005 short tons, valued at $16,200. This is an increase of 258 tons in quantity and of $2,702 in value over the production of 1901, which was 747 short tons, valued at $13,498. Of this production all but a few tons was amphibole asbestos. In the development work of the Connecticut Asbestos Company there was a large quantity of crude asbestos taken out, but none of it was treated or placed on the market. The same is true of the Vermont deposits, although during 1901 it was fully expected that this asbestos would be placed on the maiket in 1902.[a] The commercial production of asbestos in the United States has never been over 1,200 tons per annum, and when these figures are compared with the amount of asbestos imported, which is almost entirely of the chrysotile variety, it will be appreciated how large is the demand for this variety. In the table following are given the quantity and value of the annual production of asbestos in the United States since 1880, inclusive:

Annual production of asbestos, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity	Value
	Short tons.			*Short tons.*	
1880	150	$4,312	1892	104	$6,416
1881	200	7,000	1893	50	2,500
1882	1,200	36,000	1894	325	4,463
1883	1,000	30,000	1895	795	13,525
1884	1,000	30,000	1896	504	6,100
1885	300	9,000	1897	580	6,450
1886	200	6,000	1898	605	10,300
1887	150	4,500	1899	681	11,740
1888	100	3,000	1900	1,054	16,310
1889	30	1,800	1901	747	13,498
1890	71	4,560	1902	1,005	16,200
1891	66	3,960			

[a] This crude production is reported as being 1,500 short tons, with an estimated value of $30,000.

IMPORTS.

In 1902 the total value of the imports of asbestos was $762,432, an increase of $70,604 over that of 1901, which amounted to $691,828. This in turn was an increase of $335,877 over that of 1900, which was $355,951, and illustrates the phenomenal increase in the demand in the United States for the chrysotile asbestos.

In the following table is given the value of the asbestos imported into the United States since 1869, inclusive:

Value of asbestos imported, 1869–1902.

Year ending—	Unmanufactured.	Manufactured.	Total.	Year ending—	Unmanufactured.	Manufactured.	Total.
June 30—				Dec. 31—			
1869	....	$310	$310	1885	$73,026	$617	$73,643
1870	....	7	7	1886	134,193	932	135,125
1871	....	12	12	1887	140,264	581	140,845
1872	....	....	....	1888	168,584	8,126	176,710
1873	$18	....	18	1889	254,239	9,154	263,393
1874	152	....	152	1890	252,557	5,342	257,899
1875	4,706	1,077	5,783	1891	353,589	4,872	358,461
1876	5,485	396	5,881	1892	262,433	7,209	269,642
1877	1,671	1,550	3,221	1893	175,602	9,403	185,005
1878	3,536	372	3,908	1894	240,029	15,989	256,018
1879	3,204	4,624	7,828	1895	225,147	19,731	244,878
1880	9,736	....	9,736	1896	229,084	5,773	234,857
1881	27,717	69	27,786	1897	263,640	4,624	268,264
1882	15,235	504	15,739	1898	287,636	12,897	300,533
1883	24,369	243	24,612	1899	303,119	8,949	312,068
1884	48,755	1,185	49,940	1900	331,796	24,155	355,951
				1901	667,087	24,741	691,828
				1902	729,421	33,011	762,432

PRODUCTION OF CANADIAN ASBESTOS.

As nearly all of the asbestos used in the United States is obtained from Canada, the following table, which gives the production of this mineral in that country, will be of interest:

Annual production of asbestos in Canada, 1879–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1879	300	$19,500	1891	9,279	$999,978
1880	380	24,700	1892	6,042	388,462
1881	540	35,100	1893	6,473	313,806
1882	810	52,650	1894	7,630	420,825
1883	955	68,750	1895	8,756	368,175
1884	1,141	75,079	1896	12,250	429,856
1885	2,440	142,441	1897	[a] 30,442	445,368
1886	3,458	206,251	1898	[a] 23,785	486,227
1887	4,619	226,976	1899	[a] 25,536	485,849
1888	4,404	255,007	1900	[a] 30,641	763,431
1889	6,113	426,554	1901	[a] 38,079	1,186,434
1890	9,860	1,260,240	1902	[b] 40,416	1,148,319

[a] Including abestic. [b] Including 10,197 tons of abestic.

The demand for Canadian asbestos is still increasing, as indicated in the above table. The apparent decided variation in value of the asbestos produced is due to the varying amount of asbestic put on the market. Thus the increase of less than 4 per cent in value accompanying an increase of nearly 150 per cent in production in 1897 was due to this fact; and, conversely, the increase of 9.17 per cent in value in 1898, with a decrease of nearly 22 per cent in production, was due to a smaller production of the asbestic.

CHROMITE OR CHROMIC IRON ORE.

By Joseph Hyde Pratt.

INTRODUCTION.

Detailed descriptions of the occurrences, localities, and uses of the mineral chromite have been given in the reports for 1900 and 1901. There has been no increased activity in the development of chromite deposits in the United States, owing to their distance from the point of consumption. This obstacle is being overcome by bringing a market nearer to them and by better railroad transportation. The use of chromite for the lining of furnaces should cause a considerable increase in the demand for this mineral.

There has been some change in the last few years in the method of treatment of chromite ores that are not of sufficient purity to be shipped as mined, or that can not by hand cobbing be brought to contain a high enough percentage of chromic acid. Ores of this type are crushed, stamped, or rolled, and then passed over some form of concentrators. Stamp mills are being used in Canada, and the process is briefly mentioned below.

PRODUCTION.

California was the only State to produce any chromite during 1902, the quantity being 315 long tons, valued at $4,567. This is a decrease of 53 tons in quantity and of $1,223 in value as compared with the production in 1901, which was 368 long tons, valued at $5,790. In the following table is given the production of chromite in the United States since 1885:

Production of chromite, 1885-1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1885	2,700	$40,000	1894	3,680	$53,231
1886	2,000	30,000	1895	1,740	16,795
1887	3,000	40,000	1896	786	6,667
1888	1,500	20,000	1897	.....	.....
1889	2,000	30,000	1898	.....	.....
1890	3,599	53,985	1899	.....	.....
1891	1,372	20,580	1900	140	1,400
1892	1,500	25,000	1901	368	5,790
1893	1,450	21,750	1902	315	4,567

With the completion of the railroad from Erwin, Tenn., to Marion, N. C., the chromite deposits of Yancey County, N. C., will undoubtedly be thoroughly exploited, and if the present indications are fulfilled, they will become producers of this mineral.

The Pacific coast offers a promising field for the erection of a chemical plant to treat chrome ores in the manufacture of various chromium salts, as these ores can be obtained in California.

IMPORTS.

There is a large amount of chromite ore imported each year into the United States, most of which is from Turkey, with smaller amounts from New Caledonia and Canada. Besides the chrome ore, there is considerable chromate and bichromate of potash and chromic acid imported. Up to 1884 there was little or no chromite ore imported, as there was a large production from Maryland. Since then the importation of this ore has been constantly increasing. In the table below are shown the quantity and value of chrome ore, chromate and bichromate of potash, and chromic acid imported and entered for consumption in the United States since 1867:

Chromate and bichromate of potash, chromic acid, and chrome ore imported and entered for consumption in the United States, 1867-1902.

Year ending—	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
June 30—	*Pounds.*		*Pounds.*		*Long tons.*		
1867	875,205	$88,787					$88,787
1868	777,855	68,634					68,634
1869	877,432	78,288		$3			78,291
1870	1,235,946	127,333		8			127,341
1871	2,170,473	223,529		5			223,534
1872	1,174,274	220,111	514	49			220,160
1873	1,121,357	178,472	922	276			178,748
1874	1,387,051	218,517	44	13			218,530
1875	1,417,812	183,424	45	22			183,446
1876	1,665,011	175,795	120	45			175,840
1877	2,471,669	264,392	13	10			264,402
1878	1,929,670	211,136	32	35			211,171
1879	2,624,403	221,151					221,151
1880	3,505,740	350,279	5	3			350,282
1881	4,404,237	402,088	124	89			402,177
1882	2,449,875	261,006	52	42			261,048
1883	1,990,140	208,681	290	338			209,019
1884	2,593,115	210,677		120	2,677	$73,586	284,383
1885	1,448,539	92,556		39	12	239	92,834
December 31—							
1886	1,985,809	139,117		101	3,356	43,721	182,939
1887	1,722,465	120,305		5,571	1,404	20,812	146,688
1888	1,755,489	143,312		281	4,440	46,735	190,328
1889	1,580,385	137,263		2,974	5,474	50,782	191,019
1890	1,304,185	113,613		634	4,353	57,111	171,358
1891	755,254	55,897	634	203	4,459	108,764	164,864
1892	496,972	94,055	772	204	4,930	55,579	149,838
1893	976,706	78,981	3,708	641	6,354	58,629	138,251
1894	1,483,762	125,796	5,680	837	3,470	38,364	164,997
1895	2,045,910	181,242	2,083	414	5,230	82,845	264,501
1896	952,794	80,538	2,429	387	8,669	187,400	268,325
1897	1,329,473	108,497	71,220	5,457	11,570	187,439	301,393
1898	1,160,710	86,134	5,329	1,758	16,304	272,234	360,126
1899	1,130,965	73,510	33,134	6,360	15,793	284,825	364,695
1900	111,761	7,758	35,452	7,232	17,542	305,001	319,991
1901	430,996	29,224	53,462	10,861	20,112	363,108	403,193
1902			90,817	11,115	39,570	582,597	593,712

As is seen from the above, the importation of chrome ore for 1902 of 39,570 tons is nearly twice the quantity imported in 1901, and illustrates the growing demand for this mineral, not only for use in the manufacture of chrome salts, but for use as the mineral.

CANADIAN CHROMITE.

The principal chromite deposits of Canada are in the vicinity of Black Lake and Colraine, Quebec Province. The mineral occurs in the peridotite rocks or serpentine, an altered facies of this.

FLINT AND FELDSPAR.

By Heinrich Ries.

INTRODUCTION.

The statistics of production of these two minerals for 1902 are probably the most complete ever published, as they were collected in conjunction with the mining census.

The States from which the product was obtained in 1902 remained much the same as in 1901, although two new States—Delaware and Virginia—were added to the list of flint producers, and one State—Wisconsin—gave no production. While the producing States have remained much the same from year to year, the list of operators has changed somewhat, for the reason that the deposits are often worked on contract for the refiner, and hence change hands. Some of the larger firms own few mines, leasing most of the properties which they work.

FLINT.

PRODUCTION.

The production of flint or quartz in 1902 amounted to 20,295 short tons of crude flint, valued at $35,046, and 16,070 short tons of ground flint, valued at $109,163, a total of 36,365 short tons, valued at $144,209. The total number of firms reporting was 29; of this number 14 firms sold material in the crude form, 9 ground all or a portion of the flint mined by them, and 6 firms were idle. The flint ground in this manner formed 44.19 per cent of the total quantity mined. A comparison of the figures of 1902 with those of 1901 shows an increase in production of 3,518 short tons and an increase in value of $4,444 for the crude material; in the ground product the decrease in weight was 1,573 short tons, and in value $9,442.

The production for 1902 is given below, the value of the crude material being that given at the mines, and of the refined that given at the mills, which in many cases are situated near the mines:

Production of flint in the United States in 1902, by States.

State.	Crude.		Refined.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Connecticut	862	$1,775	2,620	$22,912
Maine	1,244	2,593		
Massachusetts			(a)	(a)
Maryland	(b)	(b)	13,450	86,251
Montana	(b)	(b)		
New York	13,151	21,357	(a)	(a)
Pennsylvania	5,038	9,321	(c)	(c)
Virginia	(d)	(d)		
Total	20,295	35,046	16,070	109,163

[a] Included under Connecticut.
[b] Included under New York.
[c] Included under Maryland.
[d] Included under Pennsylvania.

These figures do not represent the entire amount of flint consumed annually in the United States, for much is imported from Europe in the form of rolled flints. The flint nodules thrown out of the chalk by the whiting manufacturers are also ground and sold for pottery use.

The value of the flints and flint stone, unground, imported in 1902 was $85,092.

The production of flint from 1892 to 1902 is as follows:

Production of flint in the United States, 1892–1902.

Year.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1892	[a] 22,400	$80,000			22,400	$80,000
1893	[a] 33,231	63,792			33,231	63,792
1894	[a] 42,560	319,200			42,560	319,200
1895	[a] 13,747	21,038			13,747	21,038
1896	[a] 12,458	24,226			12,458	24,226
1897	[a] 13,466	26,227			13,466	26,227
1898	[a] 21,425	42,670			21,425	42,670
1899	[a] 29,852	180,345			29,852	180,345
1900	18,611	34,553	13,884	$51,798	32,495	86,351
1901	16,777	30,602	17,643	118,605	34,420	149,297
1902	20,295	35,046	16,070	109,163	36,365	144,209

[a] Includes both crude and ground.

FELDSPAR.

PRODUCTION.

The production of feldspar in 1902 amounted to 21,870 short tons of crude spar, valued at $55,501, and 23,417 short tons of ground spar, valued at $194,923, giving a total of 45,287 short tons with a value of $250,424.

This is a large increase over 1901, when the total production was 34,741 short tons, valued at $220,422.

These figures do not show the entire amount of spar consumed in this country annually, for some is imported from Canada.

The production for 1902 is given below, the value of the crude material being that given at the mines, and of the refined that given at the mill. The latter does not include that ground by firms owning no mines.

Production of feldspar in the United States in 1902, by States.

State.	Crude.		Refined.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Connecticut	([a])	([a])	8,742	$59,642
Maine	4,665	$12,206	([a])	([a])
Maryland	5,560	9,100	....	....
Massachusetts	....	....	([a])	([a])
New York	5,257	14,272	5,942	39,505
Pennsylvania	6,388	19,923	8,733	95,776
Total	21,870	55,501	23,417	194,923

[a] Included under New York.

The above production was obtained from 28 firms. Of this number 19 produced crude spar, and 10 produced ground product also. Nine firms were idle.

The production of feldspar from 1892 to 1902 is as follows. The figures since 1895 represent information collected directly by the Geological Survey, and are more approximately correct than those of preceding years.

Production of feldspar, 1892–1902.

Year.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1892	[a]16,800	$75,000	....	....	16,800	$75,000
1893	[a]20,578	68,307	....	....	20,578	68,307
1894	[a]19,264	167,000	....	....	19,264	167,000
1895	[a]8,523	30,000	....	....	8,523	30,000
1896	[a]10,203	35,200	....	....	10,203	35,200
1897	[a]12,516	43,100	....	....	12,516	43,100
1898	[a]13,440	32,395	....	....	13,440	32,395
1899	[a]24,202	211,545	....	....	24,202	211,545
1900	1,787	7,259	23,034	$173,712	24,821	180,971
1901	9,960	21,699	24,781	198,753	34,741	220,422
1902	21,870	55,501	23,417	194,923	45,287	250,424

[a] Includes both crude and ground.

GRAPHITE.

By Joseph Struthers

INTRODUCTION.

The mineral graphite is classified in the trade as crystalline and amorphous, the former constituting the finer grades used chiefly for the manufacture of refractory products, lubricants, electrotypes, etc., and the latter being of inferior quality and suited only for foundry facings, paint, stove polish, and similar products. Some of the amorphous variety, however, especially that from Bavaria and Mexico, is utilized also in the manufacture of pencils and in electrotyping work.

The bulk of the supply of the best grades of crystalline graphite continues to be derived from Ceylon, which furnishes at present about 80 per cent of the total consumption of graphite in the United States. Ceylon graphite is imported direct by steamer in packages of 600 pounds net weight each, the ore being sorted and graded into four products, which in the order of value are: "Lump," "chip," "dust," and "sweepings." The lump and the chip varieties are used chiefly in the manufacture of graphite crucibles and for electrical purposes, and the dust and the sweepings are utilized mainly for facings and stove polish. The consumption of crystalline graphite in the arts and manufactures is approximately as follows: For crucibles, 55 per cent; stove polish, 15 per cent; foundry facings, 10 per cent; paint, 5 per cent; for all other purposes, 10 per cent. The last-named division includes powder glazing, electrotyping, steam packing, pencils, and various minor uses.

Artificial graphite is manufactured in the electric furnace in two forms, one being the so-called graphitized electrodes, and the other artificial graphite. To produce the former the ordinary electrode, which is composed of a mixture of petroleum coke, pitch, and a carbide-forming material (silica or iron oxide), is submitted to the great heat of an electric furnace and the whole becomes graphitized, furnishing a product having special qualities. For the production of artificial graphite anthracite coal is heated in the electric arc furnace and the impurities are eliminated, the ash being reduced in some cases to as low as 0.5 per cent.

There are two methods of concentrating graphite from its ore, the wet and the dry. No mill has adopted the dry or air method in its entirety on account of the gravities of the component parts of the ore being so close to one another. Several pneumatic processes have lately proved a partial success, but they have been of limited application on account of the inability to remove the small scales of mica which occur in some of the deposits. The wet or water method of concentration has been developed to a marked degree of efficiency and is the one now used by the operative companies. The general method of procedure is to crush the ore, stamp it wet, separate coarsely by stationary buddles, the concentrates being dried and further treated with buhrstones and screens. In the mill of the North American Graphite Company an improvement has been made by the use of the Brumell separator, which treats the dried ore by flotation upon rather than immersion beneath the surface of the water.

In spite of the development of the manufacture of artificial graphite by the electric furnace, the demand for the natural product has increased very largely in recent years because of the growth of the iron and steel industry, the largely increased use of copper and its alloys, the increased need for lubricants, and the development of electrical machinery which calls for graphitized products. During 1902 but little more than one-tenth of the total consumption of natural graphite in the United States was of domestic origin.

PRODUCTION.

The production of crystalline graphite in the United States during 1902 amounted to 3,936,824[a] pounds, valued at $126,144, as compared with 3,967,612 pounds, valued at $135,914, in 1901. The greater part of the product was derived from the mines at Ticonderoga, N. Y., although the mines at Chester Springs, Chester County, Pa., and at Stockdale, Clay County, Ala., contributed to the output. Considerable progress has been made in developing mines, notably at Ticonderoga, by the Columbia Graphite Company; at Dillon, Beaverhead County, Mont., by the Crystal Graphite Company; at Laramie, Albany County, Wyo., by the Copper Cliff Mining Company, and near Graphiteville, McDowell County, N. C. Exploratory work was done during the year at the graphite properties 8 miles southwest of Raton, Colfax County, N. Mex., and an output of 65 short tons of high-grade amorphous graphite was shipped to Moosic, Lackawanna County, Pa., for manufacture into paint and foundry material. In the aggregate about 2,000 short tons of crude material have been

[a] In addition to this quantity 30,000 pounds, valued at $1,800, were mined but not marketed in 1902, as reported by the Census.

mined during development, and are awaiting the erection of mills or the results of experimental work carried on for the selection of a proper process of concentration.

The production of amorphous graphite in the United States during 1902 was 4,739 short tons, valued at $55,964, as compared with 809 short tons, valued at $31,800, in 1901.[a] The decline in unit value was due to the increased proportion of products of lower grades. Under this head are included the so-called graphitic anthracite of Rhode Island, which is of a structure between scaly and granular and contains in selected samples as much as 52 per cent carbon, and the so-called Baraga graphite of Michigan, which in reality is a carbonaceous schist.

The principal manufacturers of graphite articles in the United States, classified as to products, are named in the subjoined list:

Crucible manufacturers and grinders:

- Joseph Dixon Crucible Company, Jersey City, N. J.
- J. H. Gautier & Co., Jersey City, N. J.
- Robt. Taylor Crucible Company, Callowhill street, Philadelphia, Pa.
- Bridgeport Crucible Company, Bridgeport, Conn.
- R. B. Seidel & Co., Philadelphia, Pa.
- Ross & Co., Philadelphia, Pa.
- Taunton Crucible Company, Taunton, Mass.
- Crucible Steel Company of America, Pittsburg, Pa.
- Tacony Crucible Company, Tacony, Pa.
- McCollough & Dalzell, Pittsburg, Pa. (Ahrenburg & Co., crucible makers).

Grinders:

- Allen Graphite Company, Talladega, Ala.
- Philadelphia Graphite Company, Philadelphia, Pa.
- United States Graphite Company, East Saginaw, Mich. (mines in Mexico).

Paint manufacturers:

- Detroit Graphite Company, Detroit, Mich.
- Wisconsin Graphite Company, Pittsburg, Pa.

Stove polish manufacturers:

- Rising Sun Stove Polish Company, Canton, Conn.
- Enameline Stove Polish Company, Passaic, N. J.
- Nickel Plate Stove Polish Company, Chicago, Ill.

Foundry facing manufacturers:

- S. Obermeyer Company, Cincinnati, Ohio.
- Hill & Griffith, Cleveland, Ohio.
- J. W. Paxton, Philadelphia, Pa.
- E. D. Ranson, Troy, N. Y.
- American Facing Company, New York, N. Y.
- Brown Brothers, Springfield, Mass.
- T. P. Kelly, New York, N. Y.

Grease and lubricant manufacturers:

- Ilsey, Doubleday & Co., New York, N. Y.
- J. S. McCormack, Pittsburg, Pa.
- The Lubriphite Company, Jersey City, N. J.

Dealers:

- Standard Graphite Company, New York, N. Y.
- Pettinos Bros. & Co., South Bethlehem, Pa.

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[a] In addition to this quantity 20,716 short tons, valued at $43,600, were mined but not marketed in 1902, as reported by the Census.

In the following table, which shows the annual production of graphite from 1880 to 1902, inclusive, the refined crystalline product is given in pounds and the amorphous product is given in tons:

Production of natural graphite, 1880–1902.

Year.		Quantity.	Value.	Year.		Quantity.	Value.
1880	pounds..	622,500	$49,800	1896	pounds.....	535,858	$48,460
1881	do....	400,000	30,000		short tons..	760	
1882	do....	425,000	34,000	1897	pounds.....	1,361,706	65,730
1883	do....	575,000	46,000		short tons..	1,070	
1884	do....	500,000	35,000	1898	pounds.....	2,360,000	75,200
1885	do....	327,883	26,231		short tons..	890	
1886	do....	415,525	33,242	1899	pounds.....	2,900,732	167,106
1887	do....	416,000	34,000		short tons..	2,324	
1888	do....	400,000	33,000	1900	pounds.....	5,507,855	197,579
1889		....	72,662		short tons..	611	
1890		....	77,500	1901	pounds.....	3,967,612	167,714
1891	pounds..	1,559,674	110,000		short tons..	809	
1892	do....	1,398,365	87,902	1902	pounds.....	[a]3,936,824	182,108
1893	do....	843,103	63,232		short tons..	[b]4,739	
1894	do....	918,000	64,010				
1895	pounds.....	644,700	52,582				
	short tons..	2,793					

IMPORTS AND EXPORTS.

The following table gives the amounts of graphite imported into the United States from 1867 to 1902, from which it may be seen that the annual consumption of graphite in recent years far exceeds the domestic production. There were 12 long tons of graphite, valued at $834, exported from the United States during 1902, as compared with 5 tons, valued at $365, in 1901, and none in 1900.

Graphite imported into the United States, 1867–1902.

Year ending—	Unmanufactured.		Manufactured.	Total value.
	Quantity.	Value.	Value.	
June 30—	*Long tons.*			
1867	1,356	$54,131	....	$54,131
1868	3,431	149,083	....	149,083
1869	3,742	351,004	....	351,004
1870	4,040	269,291	$833	270,124
1871	2,581	136,200	3,754	139,954
1872	4,819	329,030	....	329,030
1873	7,877	548,613	....	548,613
1874	5,600	382,591	....	382,591
1875	2,329	122,050	....	122,050
1876	2,530	150,709	17,605	168,314
1877	3,768	204,630	18,091	222,721
1878	3,012	154,757	16,909	171,666
1879	3,283	164,013	24,637	188,650
1880	5,495	278,022	22,941	300,963
1881	7,546	381,966	31,674	413,640

[a] In addition 30,000 pounds, valued at $1,800, were mined but not marketed in 1902.
[b] In addition 20,716 short tons, valued at $13,600, were mined but not marketed in 1902.

Graphite imported into the United States, 1867–1902—Continued.

Year ending—	Unmanufactured.		Manufactured.	Total value.
	Quantity.	Value.	Value.	
June 30—	*Long tons.*			
1882	7,521	$363,835	$25,536	$389,371
1883	7,745	361,949	21,721	383,670
1884	7,204	286,393	1,863	288,256
1885	5,523	207,228	....	207,228
1886	4,168	164,111	....	164,111
1887	8,442	331,621	....	331,621
December 31—				
1888	9,200	353,990	....	353,990
1889	8,869	378,057	....	378,057
1890	12,798	594,746	....	594,746
1891	10,118	555,080	....	555,080
1892	11,677	667,775	....	667,775
1893	14,437	865,379	....	865,379
1894	5,814	225,720	....	225,720
1895	8,814	260,090	....	260,090
1896	15,230	437,159	....	437,159
1897	8,533	270,952	....	270,952
1898	13,482	743,820	....	743,820
1899	20,793	1,990,649	....	1,990,649
1900	14,417	1,390,141	....	1,390,141
1901	14,325	895,010	....	895,010
1902	18,213	1,169,388	....	1,169,388

ARTIFICIAL GRAPHITE.

The manufacture of artificial graphite has assumed a very prominent position in the graphite industry in recent years, the production during 1902 amounting to 2,358,828 pounds, as compared with 2,500,000 pounds in 1901 and 860,750 pounds in 1900.

The manufacture of artificial graphite, both of the crystalline and of the amorphous variety, has been steadily developed by the sole producer, the International Acheson Graphite Company, at Niagara Falls, N. Y., whose progress is shown in the subjoined table of annual production from the commercial inception of the industry in 1897 to 1902, inclusive:

Production and value of artificial graphite, 1897–1902.

Year.	Quantity.	Value.	Unit value per pound.
	Pounds.		*Cents.*
1897	162,382	$10,149	6.20
1898	185,647	11,603	6.20
1899	405,870	32,475	8.00
1900	860,750	68,860	8.00
1901	2,500,000	119,000	4.75
1902	2,358,828	110,700	4.69

The decrease in unit value of the total production from 8 cents per pound in 1899 and 1900 to 4.75 cents per pound in 1901 and 4.69 cents per pound in 1902 was largely due to the increased proportion of the amorphous variety produced.

The output of 1902 consisted of 883,591 pounds of graphitized electrodes and 1,475,237 pounds of artificial graphite in the granular or powdered form. The electrodes were used in electrolytic processes for the production of caustic soda and of chlorine and metals in chloride solution; also in electrometallurgical processes, such as the production of calcium chloride, the electric smelting of copper and iron ores, and the manufacture of various iron alloys. The artificial graphite in the form of grains and powders was used chiefly in the manufacture of paint, dry batteries, and commutator brushes, although a considerable quantity was used in the manufacture of lubricants, in electroplating work, and in certain chemical processes requiring a carbon of exceptional purity.

OCCURRENCE AND PRODUCTION IN CANADA.

Graphite occurs in Canada both as amorphous and as crystalline, the former grade being found chiefly in Nova Scotia and New Brunswick, where it occurs as graphitic shale or clay, and the latter variety occurring notably in Ottawa and Argenteuil counties, Quebec, and in similar deposits in Lanark, Leeds, and Frontenac counties, Ontario. The most important of the amorphous deposits are in the vicinity of St. Johns, New Brunswick, although other deposits of lesser note are located in Kings and Westmoreland counties, New Brunswick, and at the Lochaber mine, Nova Scotia. Amorphous deposits have also been found in Haliburton and Hastings counties, Ontario, and in Renfrew County, Brougham Township, is a very extensive deposit of this character, which carries. also considerable crystalline graphite. The Ontario Graphite Company operated this last-named deposit during 1902. The value of the output in Ontario during 1902 amounted to $17,868.

The crystalline variety occurs in two distinct forms, namely, lump and disseminated. The lump graphite generally occurs in limestone in the form of nodular masses or small veins, although in a few cases the ore is in small veins in diorite or other igneous rock. Up to the present time the lump deposits have not warranted systematic mining.

The disseminated graphite is of the crystalline or flaky variety and occurs in gneiss, assaying up to 35 per cent carbon. According to Mr. H. B. H. Brumell these bands of gneiss are considerably developed in the townships of Buckingham and Lochaber, Lochaber County, Quebec, many beds having a thickness of 20 feet or over, and the product assaying about 20 per cent graphite. A few of these beds have been opened and considerable quantities of ore extracted and treated at the various mills in the district, more especially in later years at the mills of the American Graphite Company, the Buckingham Company, and the Walker Mining Company.

The following companies were interested in graphite mining in 1902: In New Brunswick, the Canada Paint Company, near St. John Station; in Ontario, the Ontario Graphite Company, Brougham, and the Globe Refining Company, Port Emsley; in Quebec, the North American Graphite Company, Buckingham; the Walker Mining Company, Buckingham; the Calumet Mining and Milling Graphite Company, Calumet, and the Grenville Graphite Company, Grenville (formerly Keystone Graphite Company).

Of the above-named companies the North American Graphite Company contributed regularly throughout the year. The Ontario Graphite Company did not begin to produce until August, nor the Globe Refining Company until December. The Canada Paint Company acquired 500 acres of mineral land at Petitcodiac in January, 1903.

The production of graphite in Canada during 1902 amounted to 1,995 short tons, valued at $28,300, as compared with 2,005 short tons, valued at $38,780, in 1901. The subjoined table gives the annual production of graphite in Canada from 1886 to 1902, inclusive.

Annual production of graphite in Canada, 1886–1902.

Calendar year.	Quantity.	Value.	Calendar year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1886	500	$4,000	1895	220	$6,150
1887	300	2,400	1896	139	9,455
1888	150	1,200	1897	436	16,240
1889	242	3,160	1898	(*a*)	13,698
1890	175	5,200	1899	1,130	24,179
1891	260	1,560	1900	1,922	30,940
1892	167	3,763	1901	2,005	38,780
1893	None.	None.	1902	1,095	28,300
1894	3	223			

[a] Quantity not reported.

WORLD'S PRODUCTION.

In the following table is shown the world's production of graphite, by countries, from 1896 to 1901, inclusive:

World's production of graphite, 1896–1901.

[Quantity in metric tons.]

Country.	1896.		1897.		1898.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	933	$48,460	1,589	$65,730	1,878	$75,200
Austria	35,972	410,081	38,504	439,610	33,062	421,058
Canada	126	9,455	396	16,240	....	13,698
Ceylon	10,463	414,405	19,275	1,159,885	78,509	9,243,263
Germany	5,248	72,108	3,861	66,126	4,593	97,916
India	....	....	61	316	22	110
Italy	3,148	10,193	5,650	11,300	6,435	17,423
Japan	215	6,925	204	16,075	346	10,265
Mexico	620	5,287	907	8,663	1,857	18,237
Sweden	14	491	99	3,240	50	1,620
Total	56,739	977,405	70,546	1,787,185	126,752	9,898,790

Country.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	3,774	$167,106	3,054	$197,579	2,533	$167,714
Austria	31,819	395,280	33,663	418,126	29,992	1,918,509
Canada	1,025	24,179	1,744	30,940	2,005	38,780
Ceylon	29,037	2,904,970	19,168	[d] 875,190	22,707	[d] 3,203,215
Germany	5,196	120,250	9,248	136,500	4,435	58,000
India	1,548	7,572	1,858	9,104	2,530	(a)
Italy	9,990	55,944	9,720	55,720	10,313	59,211
Japan	53	5,120	94	9,118	(a)	(a)
Mexico	2,305	22,847	2,561	25,650	762	7,615
Sweden	[b] 535	1,674	84	3,186	56	1,900
Total	85,282	3,704,942	[c] 81,194	[c] 1,761,113	[c] 75,427	5,473,166

[a] Statistics not available.
[b] Includes crude.
[c] Latest available figures used in making up total.
[d] These values are taken from the official year books of the United Kingdom.

MAGNESITE.

By Joseph Struthers.

INTRODUCTION.

The mineral magnesite, or magnesium carbonate ($MgCO_3$), in the pure state is composed of carbon dioxide (CO_2) 52.4 per cent, and magnesium oxide or magnesia (MgO) 47.6 per cent. It frequently contains, however, a small quantity of magnesium silicate, and at times iron carbonate is present. The color is white, often with a yellowish or grayish tinge. In appearance the massive form is similar to unglazed porcelain; and, though brittle, it is exceedingly hard to drill. It is found in talcose schist, serpentine and other magnesian rocks, also in gypsum, and as veins in serpentine; and often mixed with the latter, it forms a variety of verde-antique marble.

PRODUCTION, IMPORTS, CONSUMPTION, AND PRICES.

The production of magnesite in the United States continues to be limited to California, and during 1902 the quantity reported was 3,466 short tons, valued at $21,362,[a] as compared with 13,172 short tons, valued at $43,057, in 1901. The production during 1902 consisted of 1,230 short tons of crude product, valued at $5,582, and 1,050 short tons of calcined product, valued at $15,780, the latter being equivalent to 2,236 short tons of crude product, which are included in the total of 3,466 short tons of crude magnesite.

The following table gives the quantity and value of crude magnesite produced in the United States from 1891 to 1902, inclusive:

Quantity and value of crude magnesite produced in the United States, 1891–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1891	439	$4,390	1897	1,143	$13,671
1892	1,004	10,040	1898	1,263	19,075
1893	704	7,040	1899	1,280	18,480
1894	1,440	10,240	1900	2,252	19,333
1895	2,220	17,000	1901	13,172	43,057
1896	1,500	11,000	1902	a3,466	21,362

a Including 380 short tons, valued at $1,723, mined previously.

The production of crude magnesite is practically under the control of one firm, which ships the entire output to manufacturers of carbon-dioxide gas for the production of the gas by calcination; the calcined product, which is essentially magnesium oxide, or magnesia, is returned to the shipper and is subsequently utilized by paper-mill concerns.

The demand for calcined magnesite for this purpose in the West is limited, and only a small portion of the available supply is utilized—a trade condition which is reflected by the different unit values of the calcined product in various years considered in connection with the quantities produced. Thus in 1900 the supply amounted to 1,013 short tons, and the average value per ton was $15.70; in 1901 the output of 4,726 short tons far exceeded the demand and the average value decreased to $5.58 per ton; in 1902, when the supply reached the normal consumption of 1,050 short tons, the average value per ton rose to $15.

The imports of crude and calcined magnesite during 1902—chiefly from Greece and Austria—amounted to 49,786 short tons ($373,928), as compared with 33,461 short tons in 1901. There was also a large importation of magnesite bricks, but no statistics of their quantity and value are available. It is thus seen that the United States furnishes a small proportion only of the total consumption.

The total quantity of magnesite consumed in the United States is approximated by adding together the domestic production and the importation, although in the latter case there is no distinction made between the crude and calcined magnesite. On this basis the total consumption of magnesite during 1902 was 53,252 short tons, as compared with 46,633 short tons in 1901, and with 31,073 in 1900.

USES.

In the crude state magnesite is used in the manufacture of carbon-dioxide gas by treatment with sulphuric acid or by the application of heat alone. In the former case magnesium sulphate is obtained as a by-product, which, being dissolved in water, filtered, and crystallized, yields Epsom salts ($MgSO_4$, $7H_2O$). During 1902 it is estimated that at least 50,000 barrels of this salt were produced in the United States. Early in 1903 a combination was effected of the various concerns engaged in the manufacture of Epsom salts. The chief use of the carbon-dioxide gas derived from this source, in both the gaseous and the liquefied forms, is to charge, or carbonate, mineral waters. On account of its antiseptic properties the gas is used also in place of the ordinary pump or engine to raise beer and similar beverages. Its use in mechanical refrigeration in warm countries and on shipboard is being developed.

In its calcined state (which corresponds to magnesia, MgO) the consumption of magnesite has increased very largely since 1899, owing to its uses in the form of bricks or concrete as a refractory lining for open-hearth furnaces and converters in the steel industry.

MICA.

By Joseph A. Holmes.

OCCURRENCE.

Mica is widely distributed in the United States, but its commercial sizes are found only in about one-third of the States and Territories: Alabama, Arizona, California, Colorado, Connecticut, Georgia, Idaho, Maine, Missouri, Nevada, New Hampshire, New Mexico, New York, North Carolina, Rhode Island, South Dakota, Virginia, and Wyoming. The actual mining of mica in the United States during the last few years has been limited mainly to North Carolina, New Hampshire, South Dakota, New Mexico, Idaho, Virginia, and Colorado, though some development work has also been carried on in California, Nevada, Maine, Alabama, and Georgia. In several of these States good deposits of mica are known to exist that are not now available on account of their distance from railroad transportation. This is especially true of the deposits in Colorado, Nevada, New Mexico, and Wyoming.

The mode of occurrence of mica in coarse pegmatite dikes has been described in the Twentieth Annual Report.[a] The mineral constituents of these pegmatitic dikes are principally quartz, one or more of the feldspars, and mica, the latter being in the United States mainly muscovite, with occasionally quantities of biotite. The Canadian mica is mainly phlogopite. There are many accessory minerals found in these dikes, some of which are of economic importance and have made valuable by-products. The feldspar, especially when of the potash variety, and the quartz become available as commercial commodities when the deposits are near the markets for these products. Thus the deposits in the Eastern States are more favorably situated for utilizing these two minerals than those in the West. In a few instances it is the feldspar that is the principal mineral mined, with the mica as a by-product.

In California mica of commercial sizes has been reported from several localities, but at only one of these was any mining reported during

[a] Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6 cont., 1899, pp. 695-707.

1902, namely, at the Mount Alamo Mica Company's mine in the Piru mining district, Ventura County, which is 58 miles from Bakersfield and about the same distance from Lancaster, the nearest railroad stations. Here some development work was carried on during the year. The pegmatitic dikes outcrop prominently, varying in width from a few feet to several hundred feet. As is the case in all such dikes, the percentage of mica, always small, is variable, not only with respect to quantity, but also in the percentage of plate mica in the individual crystals or blocks. Thus far most of the mica obtained has been scrap mica which has been pulverized. Occasional crystals of clear, clean mica were obtained that cut sheets from 2 by 3 inches to 4 by 10 inches. The scrap mica is pulverized at the mine, and the commercial product is shipped.

The mica deposits of Nevada are at the present time too isolated to warrant mining on any extensive scale. The only deposits that have been opened up to any extent are those in the Czarina and the Snowdrift groups of claims. The former are situated in the Virgen Mountains, the last southern promontory of the Wasatch Range, which lie between the Rio Virgen and the Colorado River. The nearest town is Rioville, which is at the confluence of the two rivers and from 16 to 25 miles southwest from the different claims comprising the general Czarina group. The deposits are at an elevation of about 5,000 feet and are in pegmatitic dikes, cutting a granitic schist. As reported by Mr. Daniel Bonelli, the associated minerals found with the mica are mainly garnet, tourmaline, columbite, and beryl. These deposits have been opened to a depth of about 45 feet, and a considerable quantity of sheet mica was shipped from here a number of years ago, a part of which cut sheets 2 by 3 to 3 by 5 inches. The largest mica found cut sheets 8 by 13 inches. The nearest railroad station is Chloride, Ariz., distant about 90 miles. The Snowdrift group of claims are located on the north side of the highest peak of the Virgen Range, about 15 miles south of Bunkerville, Lincoln County, Nev., close to the Arizona line. The proposed Arizona and Utah railroad will come within 15 miles of this group and within 12 miles of the Czarina group. Samples of this mica examined were of good quality.

In the Black Hills region of South Dakota, near Custer, a number of workable deposits of mica have been opened during the last few years, and many of these have been worked at intervals. Only the mines of the Black Hills Porcelain, Clay, and Marble Company, however, were worked, and these for only a short time during 1902.

In New Mexico mica of sufficient size and in sufficient quantity to be workable has been found in the eastern central portion of Rio Arriba County, and these deposits have been worked at a number of different places at intervals during several years past. Also along the crest of the mountains 20 to 30 miles northeast of Santa Fe, and in

San Miguel County 20 to 30 miles west and northwest of Las Vegas, a number of such deposits have been found, and several of them have been worked to a limited extent. But little mica was actually mined, however, in New Mexico during 1902.

In the New England States workable deposits of mica have been found and have been mined in a number of different New Hampshire localities, and at several localities in Maine and Vermont. But little actual mining was carried on in either of these States during 1902, though in New Hampshire there was a considerable amount of development work done, principally by the Tugg-Hill Mining and Development Company on its property at North Groton. At this place the company expects to utilize not only the mica, but also the quartz and feldspar.

In the southern Appalachian region mica deposits are numerous, and in North Carolina mining operations were carried on during 1902 at a number of different localities, mainly in Ashe, Mitchell, Yancey, Jackson, Macon, Stokes, Cleveland, and Rutherford counties. In Virginia mica mining was carried on at several localities in Amelia County.

PRODUCTION.

During 1902 the production of mica was confined to the following States: California, New Mexico, South Dakota, Vermont, New Hampshire, Maine, Virginia, North Carolina, and Georgia, over two-thirds of the quantity coming from North Carolina. Of these States only New Hampshire, New Mexico, North Carolina, and South Dakota were producers in 1901.

The total quantity of mica produced in the United States during the year 1902, as reported to the Survey, was as follows: Plate mica, 373,266 pounds, valued at $83,843; scrap mica, 1,928 short tons, valued at $13,081; and mica, rough as mined or unmanufactured, 372 short tons, valued at $21,925; total value of mica produced during 1902, $118,849. The increase in the production of plate mica during the last three years is due to the increasing quantity of small-sized mica disks and rectangular sheets that have been cut for electrical purposes. This was formerly all thrown away as scrap mica. There was also a large falling off in the production of scrap mica, which in 1902 amounted to 1,150 short tons, valued at $14,606, as compared with 2,171 short tons, valued at $19,719, in 1901.

In the following table is shown the annual production of mica in the United States from 1880 to 1902, inclusive:

Annual production of mica, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1880	81,669	$127,825	1896 Sheet	49,156	65,441
1881	100,000	250,000	1896 Scrap	[a] 222	1,750
1882	100,000	250,000	1897 Sheet	82,676	80,774
1883	114,000	285,000	1897 Scrap	[a] 740	14,452
1884	147,410	368,525	1898 Sheet	129,520	103,534
1885	92,000	161,000	1898 Scrap	[a] 3,999	27,564
1886	40,000	70,000	1899 Sheet	108,570	70,587
1887	70,000	142,250	1899 Scrap	[a] 1,505	50,878
1888	48,000	70,000	1900 Sheet	456,283	92,758
1889	49,500	50,000	1900 Scrap	[a] 5,497	55,202
1890	60,000	75,000	1901 Sheet	360,060	98,859
1891	75,000	100,000	1901 Scrap	[a] 2,171	19,719
1892	75,000	100,000	1902 Sheet	373,266	83,843
1893 Sheet	51,111	88,929	1902 Scrap	[a] 1,028	13,081
1893 Scrap	[a] 156		1902 Rough as mined, or unmanufactured	[a] 372	21,925
1894 Sheet	35,943	52,388			
1894 Scrap	[a] 191				
1895 Sheet	44,325	$55,831			
1895 Scrap	[a] 148				

[a] Short tons.

The relatively small production of mica can be accounted for by the low prices maintained for plate mica, by the uncertainty of the occurrence of the mica in the veins, and by the large number of small producers who are entirely dependent upon one small mine, and who, when the mica in this begins to give out or is poor, have not the means to carry on much dead work and have no other deposit to help to fill out this deficiency. The consolidation of a number of the mica mines in different sections might be profitable. The importation of mica from Canada and India at a low valuation tends also to curtail the production of mica in the United States. This is especially true of the mica imported from India, which can be mined and landed in this country at a lower price than in some cases it can be mined in the United States.

In the following tables is given the quantity of plate and scrap mica produced in 1900 and 1901, by States:

Production of mica in 1900, by States.

State.	Sheet mica.	Scrap mica.
	Pounds.	*Short tons.*
New Hampshire	191,118	645
New Mexico	9,620	258
North Carolina	107,255	4,450
South Dakota	[a] 123,090	80
Virginia	16,000	....
Other States [b]	9,200	64
Total	456,283	5,497

[a] Sold in rough or unmanufactured condition.
[b] Idaho, Maine, Nevada, and Rhode Island.

Production of mica in 1901, by States.

State.	Sheet mica.	Scrap mica.
	Pounds.	*Short tons.*
New Hampshire	65,800	250
New Mexico	3,100	146
North Carolina	266,160	1,775
South Dakota	25,000	....
Total	360,060	2,171

The following table gives the quantity and value of plate and scrap mica produced in 1902, by States:

Production of mica in 1902, by States.

State.	Sheet mica.		Scrap mica.		Rough as mined.	
	Pounds.	Value.	Short tons.	Value.	Short tons.	Value.
California	....	....	50	$2,250	....	....
Georgia	....	....	....	....	23	$1,000
Maine	3,000	$450	74	740	....	....
New Hampshire	33,950	4,074	323	4,522	134	2,675
New Mexico	500	300	1	40	....	....
North Carolina	303,816	65,419	545	4,729	10	1,000
South Dakota	6,000	1,200	....	....	205	17,250
Virginia	26,000	12,400	35	800	....	....
Total	373,266	83,843	1,028	13,081	372	21,925

From these tables it will be seen that the production of plate mica in North Carolina in 1902 was greater than in 1900 and 1901, but that there was a large falling off in the production of scrap mica. This can be accounted for by the fact that most of the scrap mica now produced is that obtained as waste in mining and cutting the plate mica, whereas formerly a very large amount of the scrap mica was obtained from old dumps, the accumulation from the waste or trimmings of previous years.

New Hampshire's production was again very materially reduced, as was also that of South Dakota and New Mexico, as compared with that of 1900 and 1901. California, Vermont, Virginia, and Georgia were additional producers to those of 1901, but in all cases the production was small. The production of North Carolina was 303,816 pounds of plate mica, valued at $65,419, showing North Carolina to be the principal mica-producing State of the country.

IMPORTS.

There is annually imported into the United States three to four times the value of the plate mica of domestic production; the imports are principally from India and Canada.

In the following table is given the value of mica imported into the United States from 1869 to 1896, inclusive:

Value of unmanufactured mica imported and entered for consumption in the United States, 1869–1896.

Year ending—	Value.	Year ending—	Value.	Year ending—	Value.
June 30—		June 30—		Dec. 1—	
1869	$1,165	1879	$9,274	1888	[a] $57,541
1870	226	1880	12,562	1889	[a] 97,351
1871	1,460	1881	5,839	1890	[a] 207,375
1872	1,002	1882	5,175	1891	95,242
1873	498	1883	9,884	1892	218,938
1874	1,204	1884	28,284	1893	147,927
1875	....	1885	28,685	1894	126,184
1876	569	Dec. 31—		1895	174,886
1877	13,085	1886	[a] 56,354	1896	169,085
1878	7,930	1887	[a] 49,085		

[a] Including mica waste.

Under the new classification made necessary by the Dingley tariff act, in effect from and after July 24, 1897, mica is designated as "unmanufactured" and "cut or trimmed." A specific import duty of 6 cents per pound is imposed upon the former and 12 cents per pound upon the latter, with an additional 20 per cent ad valorem duty on each.

The imports, after the new classification took effect, for the years 1898, 1899, 1900, 1901, and 1902, were mainly as "unmanufactured" mica, as follows:

Mica imported and entered for consumption in 1898, 1899, 1900, 1901, and 1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1898.	*Pounds.*		1901.	*Pounds.*	
Unmanufactured	877,930	$115,930	Unmanufactured	1,598,722	$299,065
Cut or trimmed	78,567	34,152	Cut or trimmed	78,843	35,989
Total	956,497	150,082	Total	1,677,565	335,054
1899.			1902.		
Unmanufactured	1,709,839	233,446	Unmanufactured	2,149,557	419,362
Cut or trimmed	67,293	42,538	Cut or trimmed	102,299	46,970
Total	1,777,132	275,984	Total	2,251,856	466,332
1900.					
Unmanufactured	1,892,000	290,872			
Cut or trimmed	64,391	28,688			
Total	1,956,391	319,560			

As is seen from these tables, the import of mica for 1902, amounting to 2,251,856 pounds, valued at $466,332, is an increase of 574,291 pounds, valued at $131,278, over the importation of 1901, and this increase is greater than the total value of the production of mica in the United States during 1902. This illustrates the increasing demand for mica in this country, a demand, however, that is being supplied largely by foreign mica.

MINERAL WATERS.

PRODUCTION.

For the year 1902 a larger number of springs report sales than in any previous year; and, with only one exception, every section of the country reports also an increased production as compared with 1901.

The list for 1902 includes 721 springs, an increase of 62 over the list of 1901, which contained 659 springs. There have been added to the list 96 springs, and 34 have been dropped, chiefly because water from them is no longer on the market. A few springs have been taken from the list because they have not been heard from for several years, and no data relating to them can be obtained.

The springs actually reporting sales for 1902 are 649, an increase of 67 over 1901. Of the remaining 72 springs, 39 report that no sales were made in 1902. Of the 33 springs not heard from, about one-half were represented in the figures of the report for 1901, and among them are a number of springs doing considerable business. They are all included in the estimate, which is based on previous reports from these springs. The average price per gallon for 1902 is nearly 13.7 cents, as compared with 13.6 cents for 1901 and with 12.5 cents for 1900.

The total production for 1902, including the figures estimated for the delinquent springs, is 64,859,451 gallons, which is 9,088,263 gallons more than were reported for 1901. The value of the product of 1902 is $8,793,761, an increase of $1,206,799 over that of 1901. Considering only the 648 springs actually reporting sales in 1902, the figures are 63,174,552 gallons, as compared with 54,733,661 gallons in 1901, an increase of 8,440,891 gallons. The value of this product of 1902 is $8,634,179, compared with $7,443,904 in 1901, an increase of $1,190,275.

As in 1901, the North Atlantic States lead the other sections, showing the greatest gain both in production and in value. The list makes a net gain of 8 springs, 22 having been added and 14 dropped, leaving the total at 257, as compared with 249 for 1901. Reports of sales were received from 230 springs, which is 14 more than were heard from in 1901. The number of gallons sold in 1902 is reported as

22,047,263, valued at $3,540,433, an increase of 4,470,294 gallons and of $1,027,348 over the figures for 1901. The springs new to the list, 22 in number, are the following:

Connecticut.—Granite Rock Spring.

Maine.—Carrabasset Spring, Rocky Hill Spring.

Massachusetts.—Arctic Polar Spring, Beach Hill Spring, Berkshire Crystal Spring, Hygeia Artesian Well, Lexington Spring, Purity Spring.

New Jersey.—Alpha Spring, Trinity Springs, Turtle Hill Spring, Washington Rock Spring.

New York.—Big Indian Spring, Dryden Springs, Hide's Franklin Spring, Illston Artesian Well.

Pennsylvania.—Artesia Spring, Imperial Spring, Korrylutz Well, Malvern Spring, White House Spring.

In the South Atlantic States there is also a gain both in production and value, and also in the total number of springs whose waters are used commercially. The net gain in the list is 10, as 18 springs have been added and 8 dropped, leaving the total at 116 for 1902, as compared with 106 for 1901. Sales for 1902 are reported by 104 springs, which is 16 more than the number reporting in 1901. The production for 1902 is 4,040,202 gallons, valued at $670,354, an increase over 1901 of 867,493 gallons in quantity and of $122,867 in value. The 18 springs new to the list are as follows:

District of Columbia.—Crystal Spring, Laurelwood Spring.

Florida.—White Sulphur Springs.

Maryland.—Elim Spring, Roland Park Artesian Well.

North Carolina.—Alkalithia Spring, Jackson Springs.

South Carolina.—Buffalo Lick Springs, Cokesburg Mineral Spring, West Springs.

Virginia.—Augusta White Lithia Spring, Basic Lithia Spring, Bellfont Spring, Coppahaunk Lithia Arsenic Spring, Craig Healing Spring, Lone Jack Spring, Sublett's Lithia Spring.

West Virginia.—Magnesia Spring No. 2.

The North Central section shows a decided increase in the number of gallons sold, but a decrease in the total value of the product. There is an increase in the total number of springs, the net gain over the list of 1901 being 18. There were added to the list 23 springs and 5 were taken from it, leaving the total for 1902 at 180 as compared with 162 in 1901. Of these 166 reported sales. The number of gallons reported as sold in 1902 is 25,258,218, the largest in any section. This is 2,408,220 gallons more than were sold in 1901. The value of the product of 1902 is $2,838,498, which is $354,867 less than that of 1901. The 23 springs new to the list of 1902 are the following:

Illinois.—Blue Grass Springs, Elmhurst Mammoth Spring, Mokena Mineral Spring.

Indiana.—Mudlavia Artesian Sulphur Spring, Porter Mineral Springs.

Kansas.—Boon Mineral Spring, California Spring, Geyser Mineral Spring, Hoover's Mineral Spring, Merrill Mineral Spring, Phillips's Mineral Spring, Sulpho-Magnesian Spring, Sun Springs.

Michigan.—Prosit Flowing Well.

Missouri.—Brown's Lineville Springs, Haymaker's Lineville Springs, Monegaw Springs, Mysterious Medical Spring, Ponce de Leon Well.

Ohio.—Alba Spring, Deerfield Mineral Springs, Green Springs, Artesian Mineral Well.

Wisconsin.—Sanitas Fountain.

The South Central States gain both in production and in value, and have the largest increase in the number of springs. The net increase is 20, the section adding 23 new springs to the list and dropping 3 from it. The total for 1902 is 73, instead of 53 in 1901. Sales in 1902 were reported by 66, which is 16 more than in 1901. The sales of 1902 amounted to 8,190,825 gallons, an increase of 401,016 gallons from 1901. The value of this product is $625,492, an increase of $210,769 over the previous year. The 23 springs new to the list are the following:

Alabama.—Cherokee Spring, MacGregor Spring.

Arkansas.—Allen's Alterative Magnesia Spring, Ravenden Springs.

Indian Territory.—Sulphur Spring.

Kentucky.—Upper Blue Lick Mineral Springs.

Louisiana.—Ozone Spring.

Tennessee.—Eastbrook Springs, Hinson Springs, Horn Mineral Springs, Larkins Spring, Lockeland Springs, Montvale Springs, Willow Brook Springs, Whittle Springs.

Texas.—China Spring Well, Cicero Smith Well, Gibson Well, Hawthorne Well, Lithia Well, Sangcura Well, Star Well, Texas Carlsbad Well.

For the Western States there is noted, as in the previous section, a gain in production and value and in the number of springs on the list. There is in 1902 a net gain of 6 springs for the section, 10 springs having been added and 4 dropped from the list of 1901. The total for the list of 1902 is 95, as compared with 89 for the previous year. Of these 83 report sales in 1902, which is 3 more than reported in 1901. The number of gallons reported sold in 1902 is 3,638,044, an increase of 293,868 over 1901. The value of the product is $959,402, an increase of $184,158. The 10 springs new to the list are the following:

California.—Grant Mineral Spring.

Colorado.—Colorado Mineral Spring, Columbia Mineral Spring, Glaze's Spring, Golden Lithia Spring, Montrose Mineral Spring.

Montana.—White Sulphur Springs.

Oregon.—Boswell Springs, Colestin Spring, Kingsbury Spring.

Production of mineral waters in 1902, by States and Territories.

State or Territory.	Springs reporting.	Quantity.	Value.
		Gallons.	
Alabama	8	68,050	$28,109
Arkansas	7	149,100	52,575
California	43	2,419,430	678,224
Colorado	17	667,424	133,798
Connecticut	11	307,000	194,085
District of Columbia	4	212,100	12,105
Florida	5	21,900	8,277
Georgia	10	419,100	60,797
Illinois	22	1,767,955	89,565
Indiana	16	273,380	236,501
Iowa	6	152,050	14,655
Kansas	15	3,139,970	207,100
Kentucky	5	169,750	21,537
Louisiana	3	499,261	43,502
Maine	23	764,750	82,588
Maryland	9	488,288	45,100
Massachusetts	75	8,475,365	562,973
Michigan	28	8,653,690	275,763
Minnesota	5	2,217,000	415,140
Mississippi	7	459,485	77,868
Missouri	18	963,545	204,270
Montana	3	87,020	19,635
New Hampshire	8	629,500	185,995
New Jersey	16	360,900	41,875
New Mexico	6	75,600	11,100
New York	56	6,609,176	1,299,037
North Carolina	10	104,400	18,795
Ohio	20	1,948,840	172,746
Oregon	8	35,470	7,345
Pennsylvania	31	4,567,260	1,124,532
Rhode Island	4	244,212	26,588
South Carolina	9	259,706	76,525
South Dakota	2	158,340	23,185
Tennessee	13	247,429	36,315
Texas	21	6,568,550	362,446
Vermont	6	89,100	22,760
Virginia	48	2,442,398	423,412
Washington	3	78,000	9,300
West Virginia	9	92,310	25,343
Wisconsin	33	5,982,948	1,199,473
Other States[a]	6	304,700	103,240
Total	649	63,174,552	8,634,179
Estimated production of springs not reporting sales	72	1,684,899	159,582
Grand total	721	64,859,451	8,793,761

[a] The States in which only one spring for each has made a report are included here. These States are Idaho, Indian Territory, Nebraska, Oklahoma, Utah, and Wyoming.

Production of natural mineral waters, 1883–1902.

Geographic division.	Springs reporting.	Quantity sold.	Value.
1883.		*Gallons.*	
North Atlantic	38	2,470,670	$282,270
South Atlantic	27	312,090	64,973
North Central	37	1,435,809	323,600
South Central	21	1,441,042	139,973
Western	6	169,812	52,787
	129	5,829,423	863,603
Estimated	60	1,700,000	256,000
Total	189	7,529,423	1,119,603
1884.			
North Atlantic	38	3,345,760	328,125
South Atlantic	27	464,718	103,191
North Central	37	2,070,533	420,515
South Central	21	1,526,817	147,112
Western	6	307,500	85,200
	129	7,715,328	1,084,143
Estimated	60	2,500,000	375,000
Total	189	10,215,328	1,459,143
1885.			
North Atlantic	51	2,527,310	192,605
South Atlantic	32	908,692	237,153
North Central	45	2,925,288	446,211
South Central	31	540,436	74,100
Western	10	509,675	86,776
	169	7,411,401	1,036,845
Estimated	55	1,737,000	276,000
Total	224	9,148,401	1,312,845
1886.			
North Atlantic	49	2,715,050	177,969
South Atlantic	38	720,397	123,517
North Central	40	2,048,914	401,861
South Central	31	822,016	58,222
Western	14	781,540	137,796
	172	7,087,917	899,365
Estimated	53	1,862,400	384,705
Total	225	8,950,317	1,284,070
1887.			
North Atlantic	40	2,571,004	213,210
South Atlantic	34	614,041	147,149
North Central	38	1,480,820	208,217
South Central	29	741,080	87,946
Western	12	1,236,324	288,737
	153	6,643,269	945,259
Estimated	62	1,616,340	316,204
Total	215	8,259,609	1,261,463

Production of natural mineral waters, 1883-1902—Continued.

Geographic division.	Springs reporting.	Quantity sold.	Value.
1888.		*Gallons.*	
North Atlantic	42	2,856,799	$247,108
South Atlantic	32	1,689,387	493,489
North Central	38	2,002,373	325,839
South Central	19	426,410	71,215
Western	15	1,853,679	421,651
	146	8,828,648	1,559,302
Estimated	52	750,000	120,000
Total	198	9,578,648	1,679,302
1889.			
North Atlantic	60	4,106,464	471,575
South Atlantic	47	646,239	198,032
North Central	86	6,137,776	604,238
South Central	33	500,000	43,356
Western	32	1,389,992	431,257
Total	258	12,780,471	1,748,458
1890.			
North Atlantic	55	5,043,074	1,175,512
South Atlantic	39	647,625	245,760
North Central	71	5,050,413	737,672
South Central	30	604,571	81,426
Western	25	869,504	253,578
	220	12,215,187	2,493,948
Estimated	53	1,692,231	106,802
Total	273	13,907,418	2,600,750
1891.			
North Atlantic	62	5,724,752	1,591,746
South Atlantic	41	796,439	313,443
North Central	68	8,010,556	482,082
South Central	29	629,015	106,022
Western	27	1,123,640	414,564
	227	16,284,402	2,907,857
Estimated	61	2,108,330	88,402
Total	288	18,392,732	2,996,259
1892.			
North Atlantic	65	6,853,722	1,933,416
South Atlantic	47	1,062,945	353,193
North Central	74	11,566,440	1,834,732
South Central	32	693,544	109,334
Western	24	1,261,453	594,469
	242	21,438,104	4,825,144
Estimated	41	438,500	80,826
Total	283	21,876,604	4,905,970
1893.			
North Atlantic	79	8,351,192	1,844,845
South Atlantic	49	1,092,829	304,736
North Central	78	8,833,712	1,073,427

Production of natural mineral waters, 1883–1902—Continued.

Geographic division.	Springs reporting.	Quantity sold.	Value.
1893.		*Gallons.*	
South Central	35	1,139,959	$122,331
Western	29	675,041	307,623
	270	20,092,733	3,652,962
Estimated	60	3,451,762	593,772
Total	330	23,544,495	4,246,734
1894.			
North Atlantic	83	8,217,528	1,488,361
South Atlantic	55	660,120	129,143
North Central	82	6,914,900	1,115,322
South Central	37	2,319,813	273,836
Western	29	859,905	274,235
	286	18,972,266	3,280,897
Estimated	71	2,597,342	460,949
Total	357	21,569,608	3,741,846
1895.			
North Atlantic	88	8,668,907	1,572,881
South Atlantic	51	953,713	287,623
North Central	92	6,428,582	1,577,118
South Central	35	2,346,806	161,073
Western	31	886,185	292,832
	297	19,284,193	3,891,527
Estimated	73	2,179,350	362,710
Total	370	21,463,543	4,254,237
1896.			
North Atlantic	90	9,234,890	2,069,336
South Atlantic	60	1,306,088	400,408
North Central	97	8,123,080	808,307
South Central	34	4,364,957	255,943
Western	31	1,577,185	400,998
	312	24,606,200	3,934,992
Estimated	65	1,189,112	201,200
Total	377	25,795,312	4,136,192
1897.			
North Atlantic	125	9,708,266	2,607,357
South Atlantic	68	1,244,563	347,717
North Central	104	6,281,931	718,182
South Central	36	2,432,647	129,185
Western	48	2,694,875	703,179
	381	22,362,282	4,505,620
Estimated	60	893,629	93,486
Total	441	23,255,911	4,599,106
1898.			
North Atlantic	131	11,161,300	3,288,915
South Atlantic	71	5,073,941	3,165,171
North Central	107	7,499,563	896,153

Production of natural mineral waters, 1883–1902—Continued.

Geographic division.	Springs reporting.	Quantity sold.	Value.
1898.		*Gallons.*	
South Central	35	1,253,517	$93,437
Western	62	2,693,318	482,817
	406	27,681,639	7,926,493
Estimated	78	1,171,825	125,340
Total	484	28,853,464	8,051,833
1899.			
North Atlantic	171	13,674,764	2,003,388
South Atlantic	79	1,826,543	469,579
North Central	124	13,496,723	1,734,727
South Central	41	5,599,152	311,388
Western	64	2,424,357	965,612
	479	37,021,539	5,484,694
Estimated	62	2,540,597	1,463,336
Total	541	39,562,136	6,948,030
1900.			
North Atlantic	173	13,344,708	2,001,606
South Atlantic	75	2,373,607	439,905
North Central	137	19,679,499	2,239,261
South Central	41	6,548,662	389,513
Western	65	3,330,519	721,520
	491	45,276,995	5,791,805
Estimated	70	2,281,789	453,367
Total	561	47,558,784	6,245,172
1901.			
North Atlantic	216	17,576,969	2,513,085
South Atlantic	88	3,172,709	547,487
North Central	147	22,849,998	3,193,365
South Central	50	7,789,809	414,723
Western	80	3,344,176	775,244
	581	54,733,661	7,443,904
Estimated	78	1,037,527	143,058
Total	659	55,771,188	7,586,962
1902.			
North Atlantic	230	22,047,263	3,540,433
South Atlantic	104	4,040,202	670,354
North Central	166	25,258,218	2,838,498
South Central	66	8,190,825	625,492
Western	83	3,638,044	959,402
	649	63,174,552	8,634,179
Estimated	72	1,684,899	159,582
Total	721	64,859,451	8,793,761

Summary of reports of mineral springs for 1902.

State or Territory.	Springs reporting.	Springs not reporting.	Total used commercially.
NORTH ATLANTIC STATES.			
Maine	23	3	26
New Hampshire	8	1	9
Vermont	6	0	6
Massachusetts	75	6	81
Rhode Island	4	0	4
Connecticut	11	3	14
New York	56	8	64
New Jersey	16	0	16
Pennsylvania	31	6	37
SOUTH ATLANTIC STATES.			
Maryland	9	2	11
District of Columbia	4	0	4
Virginia	48	8	56
West Virginia	9	0	9
North Carolina	10	2	12
South Carolina	9	0	9
Georgia	10	0	10
Florida	5	0	5
SOUTH CENTRAL STATES.			
Kentucky	5	1	6
Tennessee	13	0	13
Alabama	8	0	8
Mississippi	7	0	7
Louisiana	3	0	3
Texas	21	6	27
Arkansas	7	0	7
Oklahoma	1	0	1
Indian Territory	1	0	1
NORTH CENTRAL STATES.			
Ohio	20	2	22
Indiana	16	1	17
Illinois	22	1	23
Michigan	28	2	30
Wisconsin	33	5	38
Minnesota	5	1	6
Iowa	6	0	6
Missouri	18	1	19
South Dakota	2	0	2
Nebraska	1	0	1
Kansas	15	1	16
WESTERN STATES AND TERRITORIES.			
Wyoming	1	0	1
Montana	3	0	3
Colorado	17	3	20
New Mexico	6	1	7
Arizona	0	1	1
Utah	1	2	3
Nevada	0	1	1
Idaho	1	0	1
Oregon	8	0	8
Washington	3	1	4
California	43	3	46
Total	649	72	721

IMPORTS.

The following tables show the imports of mineral waters from 1867 to 1901, inclusive:

Mineral waters imported and entered for consumption in the United States, 1867–1902.

Fiscal year ending June 30—	In bottles of 1 quart or less.		In bottles in excess of 1 quart.		Not in bottles.		All not artificial.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Bottles.		*Quarts.*		*Gallons.*		*Gallons.*		
1867	370,610	$24,913	3,792	$360	....	$137	....	....	$25,410
1868	241,702	18,438	22,819	2,052	554	104	....	....	20,594
1869	344,691	25,635	9,739	802	1,042	245	....	....	26,682
1870	433,212	30,680	18,025	1,743	2,063	508	....	....	32,931
1871	470,947	34,604	2,320	174	1,336	141	....	....	34,919
1872	892,913	67,951	....	....	639	116	....	....	68,067
1873	35,508	2,326	....	....	355	75	394,423	$98,151	100,552
1874	7,238	691	....	....	95	16	199,035	79,789	80,496
1875	4,174	471	....	....	5	2	395,956	101,640	102,113
1876	25,758	1,899	....	....	....	....	447,646	134,889	136,788
1877	12,965	1,328	....	....	....	22	520,751	167,458	168,808
1878	8,229	815	....	....	....	....	883,674	350,912	351,727
1879	28,440	2,352	....	....	3	4	798,107	282,153	284,509
1880	207,554	19,731	....	....	....	....	927,759	285,798	305,529
1881	150,326	11,850	....	....	55	26	1,225,462	383,616	395,492
1882	152,277	17,010	....	....	....	....	1,542,905	410,105	427,115
1883	88,497	7,054	....	....	....	....	1,714,085	441,439	448,493

Year ending—	Artificial mineral waters.		Natural mineral waters.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Gallons.*		*Gallons.*	
1884	29,366	$4,591	1,505,298	$362,651
1885	7,972	2,157	1,660,072	397,875
Dec. 31—				
1886	62,464	16,815	1,618,960	354,242
1887	13,885	4,851	1,915,511	385,906
1888	12,752	4,411	1,716,461	341,695
1889	36,494	8,771	1,558,968	368,661
1890	22,328	7,133	2,322,008	433,281
1891	26,700	8,700	2,019,833	392,894
1892	16,052	9,089	2,266,123	497,660
1893	6,086	2,992	2,321,081	506,866
1894	7,753	3,047	1,891,964	417,500
1895	101,115	19,151	2,104,811	506,384
1896	51,108	11,739	2,273,393	551,097
1897	....	....	a 2,942,200	a 501,684
1898	....	....	a 1,955,723	a 526,071
1899	....	....	a 2,382,410	a 663,803
1900	....	....	a 2,485,042	a 687,874
1901	....	....	a 2,567,323	a 744,392
1902	....	....	a 2,460,119	a 712,714

a Including artificial.

MONAZITE.

By Joseph Hyde Pratt.

INTRODUCTION.

The grant by the Brazilian Government [a] to a German of the exclusive right to develop the monazite sand deposits along the coast of Brazil for a period of ten years will have a further tendency to increase the demand for and the interest in the monazite deposits of North and South Carolina. The consul-general at Frankfort has informed the Department of State that a company has been organized in Berlin to acquire control of this privilege. During 1902 a number of inquiries were received from German importers for information regarding the occurrence of Carolina monazite, its quantity, percentage of thoria, and value. Satisfactory replies were made in all cases except with regard to the price of the monazite sand. This is held at a higher figure delivered in Germany than the Brazilian, but with the latter deposits controlled by one company the price of the sand will naturally be increased, and probably so much so that the Carolina sand will be in considerable demand for exporting to Germany. During the latter part of 1902 and the early part of 1903 there has been a very noticeable impetus in the monazite mining industry in North Carolina and South Carolina, and the result should be a large increase in the production of this mineral during 1903 as compared with that of 1902. One company, the German Monazite Company, is operating in North Carolina and shipping its product exclusively to Germany.

OCCURRENCE.

In the report for 1901 the occurrences, localities, and methods of mining of monazite were described in detail. The commercial deposits are not found in the original rocks, but in the gravel deposits of the present and former streams, which have resulted from the disintegration and erosion of the crystalline rocks which contain the monazite. The deposits of North Carolina, South Carolina, and Brazil still supply the world's demand for this mineral and no other commercial deposits have as yet been discovered. Perhaps a ton a year has been obtained as a by-product in feldspar mining of the pegmatitic dikes of southern

[a] Advance sheets U. S. Con. Repts., May 9, 1902.

Norway, but this will represent practically all the monazite that is obtained commercially outside of the Brazil and the Carolina deposits.

The occurrence of monazite in iron ore and in graphite has recently been described by Mr. Orville A. Derby,[a] and while they are not considered at the present time of commercial importance they are of considerable scientific interest. The iron ore consists of magnetite and ilmenite, through which the monazite is quite abundantly scattered. It was obtained from the fazenda Catita, on the lower Rio Doce, state of Espirito Santo, Brazil. Monazite associated with graphite was obtained from near Jequitinhonha, in Minas Geraes, and from near São Fidelis, in Rio de Janeiro, Brazil, and from both localities it constitutes the principal portion of the noncarbonaceous residuum.

USES.

Monazite, which is essentially an anhydrous phosphate of the rare earth metals, cerium, lanthanum, and didymium ((Ce, La, Di) PO_4), nearly always contains a small but varying percentage of thoria (ThO_2), to which is due its economic value. This oxide is separated and used with much smaller quantities of lanthanum and didymium oxides in the manufacture of the cylindrical hood or mantle of the Welsbach and other incandescent gaslights. Cerium oxide can also be used to advantage with the thoria in the manufacture of incandescent mantles. In the United States Consular Report No. 66[b] is described an invention of Mr. R. Langhaus for making an incandescent mantle by treating a mantle made of the oxides of thorium and cerium with the silico-zirconates of soda. By this treatment, the inventor claims, an incandescent mantle is obtained that has a more permanent candlepower and a less tendency to shrinkage than the other mantles. The life of this mantle is reckoned at from 1,800 to 2,000 hours. Zircon, the mineral from which zirconia is obtained, occurs in considerable quantity in North Carolina, and these deposits could undoubtedly furnish all of this mineral required.

In determining the percentage of thoria in monazite considerable difficulty has been experienced in finding a method that would give accurate as well as quick results. Mr. Emil Benz has reviewed the various methods described for determining thoria in a monazite sand, and as a result of his research recommends the following process:[c]

Five-hundredths of a gram of the finely divided sample is mixed in a platinum crucible with 0.5 gram of sodium fluoride, and then slowly fused with 10 grams of potassium prosulphate, the crucible being covered with a lid. When evolution of gas ceases, a faint red heat is applied for about fifteen minutes, and when cold the

[a] Am. Jour. Sci., 4th series, vol. 13, 1902, p. 211.

[b] U. S. Con. Rpt., No. 66, pp. 262-265.

[c] Abst. in Jour. Chem. Soc. from Zeit. Angew. Chem., 1902, 15, pp. 297-309, and Amer. Mfr., Aug. 21, 1902.

mass is extracted with warm dilute hydrochloric acid. After filtering, the undissolved mass is boiled with a little strong acid, diluted with water, and again filtered. The mixed filtrate, measuring about 300 c. c., is partially neutralized with ammonia and then precipitated while boiling by adding 3.5 grams of solid ammonium oxalate. After remaining over night, the precipitate is collected and the thorium estimated as follows: The oxalates are converted into nitrates by evaporation with fuming nitric acid, the residuum is dissolved in 50 c. c. of water containing at most 1 c. c. of dilute nitric acid (1:10) and precipitated at 60 to 80° by adding 10 c. c. of hydrogen peroxide. The thorium peroxide is then converted by ignition into the oxide and weighed. A mere trace of cerium may be present, which may be estimated colorimetrically.

A paper on the "Theory of the incandescent mantle" has recently been published by Messrs. A. H. White and A. F. Traver,[a] which is an addendum to papers already published by Mr. White in cooperation with others.[b]

This paper gives additional data on the temperature of the flame and the mantle, on the relation existing between the temperature and the illumination, and a discussion of the question as to whether the illumination is a pure temperature effect or whether other agencies come into play. It would seem from these researches that the illumination is due more to the composition of the mantle than to the temperature, and that the mantle acts as a transformer in changing the heat of the flame into light. The results are summarized as follows:

The temperature of the commercial mantle burned under usual conditions will vary from 1,500° to 1,600° C. For any single mantle the illumination will vary with the temperature. For different mantles, the illumination will depend to a greater degree upon the composition of the mantle than it will upon the temperature. The mantle with the highest temperature does not necessarily give the most light. A mechanical mixture of thorium and cerium oxides when exposed to a flame gradually increases in temperature and illumination till these approximate what would initially be shown by oxides prepared from the mixed nitrates, but the temperature remains below that which pure oxide of thorium would attain in the same flame. It is concluded that the exceptional efficiency of the mantle is due to a solid solution of the oxide of cerium in the oxide of thorium, and that this substance is capable of transforming the heat of the flame into light more economically than a black body or any other substance yet known.

PRODUCTION.

The production of monazite is confined exclusively to North Carolina and South Carolina, by far the larger amount being obtained from the former State, and in 1902 this amounted to 802,000 pounds, valued at $64,160. This is an increase of $4,898 in value and of 53,264 pounds in quantity as compared with the production of 1901, which was

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[a] Jour. Soc. Chem. Industry, Aug. 15, 1902, pp. 1012–1017.

[b] Relation of "Heating to lighting power of gases, with special reference to the incandescent mantle," by A. H. White and H. Russell. Am. Gas Light Jour., 1901, 74, p. 468, and Jour. Gas Lighting, 1901, 77, p. 878.

Theory of the "Incandescent mantle (first paper)," A. H. White, A. F. Traver, and H. Russell. Amer. Gas Light Jour., 1902, 76, p. 143, and Jour. Gas Lighting, 1902, 79, p. 892.

748,736 pounds, valued at $59,262. The price per pound received by the independent miners for the monazite produced in 1902 varied from 2½ to 8 cents, according to the percentage of thoria. The nearer the sand is brought to a pure monazite the higher its relative value, and this is accomplished by closer concentration and the use of the electro-magnet in separating the iron minerals.

The production and value of monazite mined in the United States from 1893 to 1902 are given in the following table:

Production of monazite in the United States, 1893–1902.

Year.	Quantity.	Value.
	Pounds.	
1893	130,000	$7,600
1894	546,855	36,193
1895	1,573,000	137,150
1896	30,000	1,500
1897	44,000	1,980
1898	250,776	13,542
1899	350,000	20,000
1900	908,000	48,805
1901	748,736	59,262
1902	802,000	64,160

A number of new companies have begun operations in the monazite field during the last year, and the outlook for 1903 is for a much larger production than that of 1902.

IMPORTS AND EXPORTS.

There was imported into the United States during 1902, 190 pounds of monazite sand and thorite, valued at $12, which shows that practically all the thoria used in the Welsbach and other gaslight mantles is obtained from this country. There is no record of any monazite having been exported in 1902, but in 1903 there will very probably be a considerable quantity of this mineral exported to Germany.

GLASS SAND.

By A. T. Coons.

PRODUCTION.

In collecting the statistics of the glass sand produced in the United States it has been impossible to avoid the collection of statistics of the sand produced for other purposes than for the manufacture of glass, and the following table shows the quantity and value of all the sand reported as produced in those States where sand is found of sufficient purity to be used in the manufacture of glass.

Production of glass sand and of other sand in the United States in 1902, by States.

State.	Glass sand.		Engine sand.		Furnace sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Illinois	215,012	$115,023	....	....	54,324	$27,994
Indiana	21,416	25,055	....	....	....	....
Maryland	12,888	10,875	....	....	2,000	1,200
Massachusetts	8,923	17,846	....	....	....	....
Missouri	134,587	82,552	....	....	20,175	9,538
New Jersey	64,469	45,078	....	....	116,951	55,078
New York	12,600	13,275	1,500	$2,625	2,000	2,400
Ohio	42,311	50,426	12,625	15,130	85,871	88,318
Pennsylvania	356,209	348,327	84,457	68,387	22,470	25,475
West Virginia	74,720	99,340	4,500	3,390	....	....
Total	943,135	807,797	103,082	89,532	303,791	210,003

State.	Building sand.		Other uses.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Illinois	....	....	9,290	$5,300	278,626	$148,317
Indiana	....	....	....	....	21,416	25,055
Maryland	2,500	$1,875	1,700	875	19,088	14,825
Massachusetts	25,000	16,390	28,550	34,785	62,473	69,021
Missouri	9,600	5,800	5,950	2,975	170,312	100,865
New Jersey	....	....	22,099	18,223	203,519	118,379
New York	41,500	31,125	1,200	2,250	58,800	51,675
Ohio	1,875	2,330	38,300	27,000	180,982	183,204
Pennsylvania	173,287	57,534	108,742	91,010	745,165	590,733
West Virginia	26,200	17,450	2,100	1,360	107,520	121,540
Total	279,962	132,504	217,931	183,778	1,847,901	1,423,614

As will be seen from the table, the production is limited to ten States, and although the production reported for other purposes than for glass is fairly representative of these States, it does not by any means give the total amount of sand produced in them.

The glass sand as given in the above table is the sand used in making glass and not that used in grinding and cutting glass, this being included in the sand reported for "Other uses."

The value given is the value of the sand free on board at the quarry or mine, and does not include freight or transportation, which, if included, would raise the value considerably, as most of the sand mined is subjected to considerable transportation. The value of the sand at the mine depends on the cheapness of labor and the ease with which the sand can be obtained, as well as on the purity of the sand; and, as will be seen from the table, the values range from 50 cents to $2 per ton.

In 1885 the quantity of glass sand mined and used in the United States, as given by Mr. John D. Weeks, in Mineral Resources of the United States for 1885, was 248,128 short tons, valued at $507,178; in 1902 the quantity was 943,135 short tons, valued at $807,797. The difference in value per ton is accounted for in that the value in 1885 was given at the glass works, where the value ranged from 60 cents per ton in the case of works mining their own sand to $10.25 per ton at works remote from source of supply.

The commercial production of glass sand is reported from the States of Illinois, Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, Ohio, Pennsylvania, and West Virginia. Small quantities have been quarried also in Henry County, Tenn.; in Richland County, S. C.; and near Lumber City, Montgomery County, Ga. In Florida the natural deposits of sand, although very fine, contain, as decomposed coral, too much calcium oxide to be suitable for many classes of glass. There are deposits in other States that are undeveloped, and also undeveloped deposits in States that are already producers.

OCCURRENCE BY STATES.

The location of the sand beds in the producing States is given in the following pages.

ILLINOIS.

The glass sand in this State is found near Wedron and South Ottawa, La Salle County, and is known as Fox River sand. It is also found at Millington, Randall County. Illinois sand is used in plate-glass works in the vicinity of Chicago and in Indiana, and is also shipped to flint-glass works in the West. Sand from these deposits is also used in furnaces for steel molding, and as sand for sawing and grinding stone at the various quarries. The deposits in this State occur mostly as sand, and but little labor is required to make them fit for use. However, for making the best glass the sand is treated with water and steam, and is thoroughly washed and dried before being shipped. An analysis of this sand will be found in the table showing analyses of glass sand.

The glass sand produced in Illinois in 1902 amounted to 215,012 short tons, valued at $115,023.

INDIANA.

The Indiana glass sand has not been as much used as that of the other States, but sand is now being produced near Coxville, Parke County, at Walcott, White County, and from rock quarried near Attica, Fountain County. An analysis of each of these sands is given in the table.

MARYLAND.

The glass sand in Maryland comes from Anne Arundel County, along the Severn River. This sand, and some from Cecil County, is also used for furnace and building sand.

MASSACHUSETTS.

The glass sand of Cheshire, Berkshire County, is especially valued for its use in the manufacture of the best flint glass, and is found at a considerable distance under ground, and contains moisture. The grains adhere sufficiently to give the appearance of a solid white rock, which is prepared for use by crushing. The sand is then carried by running water through a series of sieves, and after being spread out and thoroughly dried is ready for market. This sand is also quarried for filtration and other purposes.

MISSOURI.

The deposits of glass sand in Missouri are at Klondike, St. Charles County; Pacific, Franklin County; and Crystal City, Jefferson County. The deposits in Missouri are among the important deposits of the West, and are shipped to the East also. The sand occurs as sandstone, but is easily taken out with picks. After quarrying, it is broken up into fine sand. The glass sand produced in Missouri in 1902 amounted to 134,587 tons, valued at $82,552.

NEW JERSEY.

The glass sand production of New Jersey is from Penbryn, Camden County; Cedarville, Maurice River, South Vineland, and Millville, Cumberland County; and Downer, Radix, and Williamstown, Gloucester County. It is a highly refractory sand and is largely used for steel molding in furnaces. The glass sand produced in New Jersey in

1902 amounted to 64,469 tons, valued at $45,078; the furnace sand to 116,951 tons, valued at $55,078; and 22,099 tons of sand, valued at $18,223, were produced and used for other purposes, which included sand for filtration purposes, a comparatively new enterprise with this sand. The mineral occurs as sand and needs no crushing. The glass works of southern New Jersey and southeastern Pennsylvania are supplied from these banks

NEW YORK.

The sand deposits of New York State from which glass is made are in the neighborhood of Bernhards Bay, Oswego County; Rome Fish Creek, and Booneville, Oneida County; and Ellenville, Ulster County. Sand also occurs in deposits in Madison County. The sand occurs in a form sufficiently disintegrated to need no further crushing to fit it for use in glass manufacture. The production of glass sand in New York in 1902 amounted to 12,600 short tons, valued at $13,275.

OHIO.

The sand used for glass purposes in Ohio is quarried in the form of sandstone and then crushed and screened to the proper size. Most of the stone crushed in this manner, however, is used for other purposes than glass manufacture. The localities where the stone is crushed for sand are Akron, Summit County; Barrs Mills, Dundee, and Strasburg, Tuscarawas County; Leavittsburg, Trumbull County; Chalfants, Perry County; Zanesville, Muskingum County; Coalton, Jackson County; Massilon and Warrick, Stark County; Twinsburg, Summit County; and in 1903 a company will operate in Lucas County. The total sand production in Ohio for 1902 was 180,982 tons, valued at $183,204, the glass sand production being 42,311 tons, valued at $50,426.

PENNSYLVANIA.

The greater part of the sand mined in Pennsylvania for glass manufacture is mined by the Pennsylvania Glass Sand Company, of Lewistown. This company has bought a large number of the sand deposits in this State and has plants located at Granville, McVeytown, and Vineyard, Mifflin County; and at Mapleton and Mill Creek, Huntingdon County. Besides the Pennsylvania Glass Sand Company, the following companies are engaged in mining sand: The American Window Glass Company, Derry, Westmoreland County; the Dunbar Sand Manufacturing Company, Dunbar, Fayette County; the Fitzpatrick Glass Manufacturing Company, Falls Creek, Jefferson County; the Glass Sand Company (Limited), Franklin, Venango County; the Pittsburg White Sand Company, Mapleton, Huntingdon County; the Crystal Sand Company, Vineyard, and the Juniata Silica Company, Newton

Hamilton, Mifflin County. Other counties producing silica sand are Lancaster, Butler, Berks, Chester, Mercer, and Bedford.

The glass sand production of Pennsylvania in 1902 amounted to 356,209 short tons, valued at $348,327, a larger quantity and value than shown by any other State.

The sand in this State occurs both as a sandstone, needing to be quarried, crushed, and prepared for use, and as a sand which, although occurring as rock, quickly disintegrates when quarried and exposed to air and moisture.

WEST VIRGINIA.

In West Virginia the glass sand is mined mostly at Berkeley Springs and Hancock, Morgan County, but is mined also at Sturgisson, Monongalia County. Sand for other uses is obtained in Marion, Hampshire, Randolph, and Monongalia counties.

REQUIREMENTS OF GLASS SAND.

Of the essential constituents in the manufacture of glass, silica, the oxide of silicon, is the most important and is the only material which enters into all varieties of glass. This silica, which is generally used in the form of sand, is found in greater or less purity in nature in deposits as a sand, as a rock easily disintegrated, or as a hard sandstone which has to be crushed before being used.

The chief of the other constituents of glass are the oxides of soda, lime, potash, and lead. The oxides of zinc, tin, barium, and antimony are also occasionally employed; and the oxides of manganese, gold, cobalt, tin, arsenic, copper, iron, and aluminum are found in glass either as coloring matter, as impurities, or as material for the correction of impurities. The silica enters into the sand mixture, or "batch," as the oxide, while the other ingredients are mixed with the silica as the salts of the metals. Under the action of heat these salts decompose, the silica fuses, and, acting as an acid, forms silicates with the other metals, making the glass a mixture of various silicates.

The quality of glass, however, depends chiefly on the quality of the sand used. For the finest glass, as flint, plate, and cut glass, freedom from color, absolute transparency, and exceeding brilliancy are required, and only the purest sand can be employed, as even slight impurities, especially small quantities of iron, tend to destroy these effects. Iron is the chief impurity, and often can be removed only by the use of magnets. Alumina and clay give a cloudy appearance. When cheap glass is desired and color is not a matter of consequence, sand containing impurities may be used, as these impurities act as fluxes and require, therefore, less flux in the "batch," or mixture, of ingredients.

Preliminary tests applied to sand to determine its value as a glass material, while giving a general idea, are inadequate without an analysis of the sand and also without a test in the furnace. In general, the sand should be perfectly white, rather fine, uniform, even-grained, and with sharp rather than round grains. Coarse sand and exceedingly fine sand, or sand which has rounded grains, is not so certain in its results, as it does not seem to fuse so easily or completely as sharp, fine sand, and makes an uneven glass. If, however, the melting is properly and carefully carried on, the size and shape of the grain does not render the sand unfit for use. The important point is to have it as clean and as free from iron as possible.

Sand which effervesces or loses color when heated with acid is not good sand, as these properties indicate the presence of lime by the effervescence, and of clay or other impurities by change of color. The presence of iron may be detected by dissolving the sand in hydrofluoric acid and adding potassium ferro-cyanide, which indicates the presence of iron, even in the most minute quantities, by a blue color.

The sand for making the best glass, however, should be free from iron, copper, clay, magnesia, and organic compounds. In some cases these impurities may be removed to a large extent by washing, or by burning when there is much organic matter present, and the metallic color may be removed by the use of chemicals in the "batch" when fused.

ANALYSES OF GLASS SAND.

The following analyses as submitted by the American Window Glass Company show the different qualities of sand used in their glass works:

Analyses of glass sand used by American Window Glass Company.

Constituent.	No. 1.	No. 2.	No. 3.	No. 4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Silica (SiO_2)	99.990	99.714	99.659	99.579
Alumina (Al_2O_3)	.008	.280	.310	.350
Oxide of iron (Fe_2O_3)	Slight trace.	.006	.011	.021
Limestone and magnesia (CaO and MgO)	.002	.020	.020	.050
Total	100.000	100.020	100.000	100.000

No. 1 is suitable for the very highest grades of glassware and flint glass. Nos. 2 and 3 are suitable for tableware, plate glass, chimneys, prescription ware, etc.; and No. 4 is used for window glass. Sand containing more iron than is shown in the table is used in making green glass bottles and cheap glassware. The use of oxide of manganese in the mixture will enable sand containing a greater percentage of iron than is shown in the table to be used for window glass, as this oxide neutralizes the color of the iron, but in itself gives a color to the glass if used in excess

The following analyses are submitted by the Pittsburg Plate Glass Company as samples of sand used regularly by them:

Analyses of glass sand used by Pittsburg Plate Glass Company.

Constituent.	No. 1.	No. 2.	No. 3.	No. 4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Silica (SiO_2)	99.21	98.90	98.95	98.94
Alumina (Al_2O_3)	.30	.20	.50	.30
Volatile matter	.21	.25	.24	.23
Oxide of iron (Fe_2O_3)	.003	.002	.0024	.0036
Lime (CaO)	.20	.54	.30	.40
Magnesia (MgO)	Trace.	.20	.10	Trace.
Total	99.923	100.092	100.0924	99.8736

For sands with analyses comparable with the above, no discoloration is attempted in manufacturing plate glass.

In the following tables are given analyses of the principal glass sands of the United States, as well as analyses of European sands:

Analyses of glass sands

Operator.	Location of mine or quarry.	Constituent.	
		Silica (SiO_2).	Magnesia (MgO).
		Per cent.	*Per cent.*
Millington White Sand Co	Millington, Randall County, Ill	99.42	
Ottawa Silica Co	Ottawa, Lasalle County, Ill	99.45	Trace.
U. S. Silica Co	South Ottawa, Lasalle County, Ill	99.89	0.01
Wedron White Sand Co	Wedron, Lasalle County, Ill	99.89	.01
American Window Glass Co	Wolcott, White County, Ind	98.67	Trace.
Western Silica Co	Attica, Fountain County, Ind	98.84	.03
Hoosier Glass Sand Co.[c]	Coxville, Parke County, Ind	98.61	Trace.
Berkshire Glass Sand Co	Cheshire, Berkshire County, Mass	99.78	
Do	do	99.46	
Do	do	99.31	
Tavern Rock Sand Co	Klondike, St. Charles County, Mo	99.97	
Downer Silica Mining Co	Downer, Gloucester County, N. J	98.824	.015
Do	do	97.705	.442
Diamond Rock Sand Co	Hanover, Burlington County, N. J	97.62	
National Sand Co	Chalfants, Perry County, Ohio	98.506	.014
P. Arnold	Strasburg, Tuscarawas County, Ohio.	98.80	Trace.
Detweiler Sand Co	Columbia, Lancaster County, Pa	99.5044	
Do	do	98.45	.05
American Window Glass Co	Derry, Westmoreland County, Pa	98.760	.071
Fitzpatrick Glass Manufacturing Co	Falls Creek, Jefferson County, Pa	99.410	Trace.
Berkeley Sand Co	Berkeley Springs, Morgan County, W. Va.	99.37	
Potomac White Sand Co	Greenspring, Hampshire County, W. Va.	99.19	
Mountain State Silica Sand Co	McCaulley Station, Randolph County, W. Va.	98.60	
Decker Creek Stone and Sand Co	Sturgisson, Monongalia County, W. Va.	99.55	

[a] Fe_2O_3. [b] FeO.

mined in the United States.

Constituent.					Authority.
Oxide of iron (Fe_2O_3).	Alumina (Al_2O_3).	Lime (CaO).	Other.	Total.	
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
0.02	....	....	K_2O	100.00	Prof. A. W. Smith, Case School Applied Science, Cleveland, Ohio.
		0.56			
0.30		.13	....	99.88	Prof. R. E. Lyons, Indiana University, Bloomington, Ind.
Trace.	0.051	.00	....	99.951	R. W. Hunt & Co., Chicago, Ill.
....	.051	.00	....	99.951	Cary & Moore, Chicago, Ill.
a .02 b .29	.89	.13	....	100.00	Dr. Otto Wuth, Pittsburg, Pa.
.10	.38	....	Titanium (TiO_2) trace; loss, 0.32.	99.67	W. S. Blatchley, State geologist of Indiana.
.22	.74	.12	Loss 0.32	100.01	Rose Polytechnic Institute, Terre Haute, Ind.
....	0.22		....	100.00	S. Dana Hayes, State assayer, Boston, Mass.
....	.48	.06	....	100.00	Prof. Leonard P. Kinnicutt, Worcester Polytechnic Institute, Worcester, Mass.
....	.58	.11	....	100.00	Do.
	.03		....	100.00	Regis Chauvenet & Bro., St. Louis, Mo.
.165	.935	.056	Chlorine, 0.0054 ..	100.0004	New Jersey State Geologist Cook.
.150	.755	.955	....	100.007	Whitney Glass Works, Glassboro, N. J.
2.40		....	....	100.02	Booth, Garrett & Blair, Philadelphia, Pa.
.09		....	Moisture, 0.60.....	99.210	Professor Horton, Columbus, Ohio.
.034	1.17	Trace.	....	100.004	Dr. Otto Wuth, Pittsburg, Pa.
.2998	.1337	....	Moisture and loss, 0.0620.	99.9999	Henry C. Deming, Harrisburg, Pa.
.05	1.35	.10	....	100.000	Pennsylvania Steel Co., Steelton, Pa.
.054	.932	.183	....	100.000	Dr. Otto Wuth, Pittsburg, Pa.
.029	.551	.101	....	100.091	Do.
.04	.33	....	Moisture, 0.17; cobalt, none.	99.91	Pittsburg Testing Laboratory, Pittsburg, Pa.
.56	....	....	....	99.75	F. T. Ashman & Co., Pittsburg, Pa.
....	....	....	....	98.60	Wheeling Chemical Laboratory, Wheeling, W. Va.
.33	....	....	Moisture, 0.11.....	99.99	B. H. Hite, chemist, West Virginia Experiment Station.

[c] Analysis before sand was cleaned.

Analyses of European glass sands.

	France.		England.		Germany.	
	Fontainebleau. (*a*)	Fontainebleau. (*b*)	Leighton Buzzard. (*a*)	Alum Bay. (*b*)	Herzogenrath. (*c*)	Hohenbocka. (*d*)
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Silica	99.00	98.80	99.00	97.00	99.240	99.760
Alumina	.50		.30		.200	.040
Lime					.053	.011
Magnesia					.033	.012
Manganese						.015
Sesquioxide of iron	Trace.		.50		.005	.055
Carbonate of lime	.50		.20			
Magnesia and sesquioxide of iron		.70				
Water		.50		1.00	.469	
Alumina, magnesia, and sesquioxide of iron				2.00		
Phosphorus						.039
Loss						.240
Total	100.00	100.00	100.00	100.00	100.00	100.172

[a] Authority: H. Chance.
[b] Authority: Spon.
[c] Authority: Julius Fahdt.
[d] Authority: Bischof.

INDEX.

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PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

[Mineral Resources, 1902.]

The serial publications of the United States Geological Survey consist of (1) Annual Reports, (2) Monographs, (3) Professional Papers, (4) Bulletins, (5) Mineral Resources, (6) Water-Supply and Irrigation Papers, (7) Topographic Atlas of the United States—folios and separate sheets thereof, (8) Geologic Atlas of the United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application. The list of reports on mineral resources follows:

MINERAL RESOURCES.

Mineral Resources of the United States, 1882, Albert Williams, jr., chief of division. 1883. 8°. xvii, 813 pp. Price, 50 cents. Out of stock.

Mineral Resources of the United States, 1883 and 1884, Albert Williams, jr., chief of division. 1885. 8°. xiv, 1016 pp. Price, 60 cents. Out of stock.

Mineral Resources of the United States, 1885. Division of Mining Statistics and Technology. 1886. 8°. vii, 576 pp. Price, 40 cents.

Mineral Resources of the United States, 1886, David T. Day, chief of division. 1887. 8°. viii, 813 pp. Price, 50 cents.

Mineral Resources of the United States, 1887, David T. Day, chief of division. 1888. 8°. vii, 832 pp. Price, 50 cents. Out of stock.

Mineral Resources of the United States, 1888, David T. Day, chief of division. 1890. 8°. vii, 652 pp. Price, 50 cents.

Mineral Resources of the United States, 1889 and 1890, David T. Day, chief of division. 1892. 8° viii, 671 pp. Price, 50 cents.

Mineral Resources of the United States, 1891, David T. Day, chief of division. 1893. 8°. vii, 630 pp. Price, 50 cents.

Mineral Resources of the United States, 1892, David T. Day, chief of division. 1893. 8°. vii, 850 pp. Price, 50 cents.

Mineral Resources of the United States, 1893, David T. Day, chief of division. 1894. 8°. viii, 810 pp. Price, 50 cents.

On March 2, 1895, the following provision was included in an act of Congress:

"*Provided*, That hereafter the report of the mineral resources of the United States shall be issued as a part of the report of the Director of the Geological Survey."

In compliance with this legislation the following reports were published:

Mineral Resources of the United States, 1894, David T. Day, chief of division. 1895. 8°. xv, 646 pp., 23 pls.; xix, 735 pp., 6 pls. Being Parts III and IV of the Sixteenth Annual Report. Out of stock.

Mineral Resources of the United States, 1895, David T. Day, chief of division. 1896. 8°. xxiii, 542 pp., 8 pls. and maps; iii, 543–1058 pp., 9–13 pls. Being Part III (in 2 vols.) of the Seventeenth Annual Report. Out of stock.

Mineral Resources of the United States, 1896, David T. Day, chief of division. 1897. 8°. xii, 642 pp., 1 pl.; 643–1400 pp. Being Part V (in 2 vols.) of the Eighteenth Annual Report. Out of stock.

Mineral Resources of the United States, 1897, David T. Day, chief of division. 1898. 8°. viii, 651 pp., 11 pls.; viii, 706 pp. Being Part VI (in 2 vols.) of the Nineteenth Annual Report. Out of stock.

Mineral Resources of the United States, 1898, David T. Day, chief of division. 1899. 8°. viii, 616 pp.; ix, 804 pp., 1 pl. Being Part VI (in 2 vols.) of the Twentieth Annual Report. Out of stock.

Mineral Resources of the United States, 1899, David T. Day, chief of division. 1901. 8°. viii, 656 pp.; viii, 634 pp. Being Part VI (in 2 vols.) of the Twenty-first Annual Report.

By act of Congress approved March 3, 1901, the report on mineral resources was again made a distinct publication. In compliance with this legislation the following reports have been published:

Mineral Resources of the United States, 1900, David T. Day, chief of division. 1901. 8°. 927 pp.

Mineral Resources of the United States, 1901, David T. Day, chief of division. 1902. 8°. 996 pp.

Mineral Resources of the United States, 1902, David T. Day, chief of division. 1904. 8°. 1038 pp.

All remittances must be by MONEY ORDER, made payable to the Director of the United States Geological Survey, or in CURRENCY—the exact amount. Checks, drafts, and postage stamps can not be accepted. Correspondence should be addressed to—

THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

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Day, David Talbot.

see, as chief of Division of mining and mineral resources, 1886–

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